(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
30 July 2009 (30.07.2009)

PCT

(10) International Publication Number
WO 2009/094442 A2

(51) International Patent Classification:
C07D 239/47 (2006.01) *C07D 413/12* (2006.01)
C07D 401/12 (2006.01) *C07D 417/12* (2006.01)
C07D 403/12 (2006.01) *A01N 43/54* (2006.01)
C07D 405/12 (2006.01) *A01N 43/78* (2006.01)
C07D 409/12 (2006.01) *A01P 3/00* (2006.01)

(21) International Application Number:
PCT/US2009/031683

(22) International Filing Date: 22 January 2009 (22.01.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/011,799 22 January 2008 (22.01.2008) US
61/115,297 17 November 2008 (17.11.2008) US

(71) Applicant *(for all designated States except US)*: **DOW AGROSCIENCES LLC** [US/US]; 9330 Zionsville Road, Indianapolis, IN 46268-1054 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BENKO, Zoltan** [US/US]; 8402 North Park Avenue, Indianapolis, IN 46240 (US). **BOEBEL, Timothy** [US/US]; 5747 N. Oxford Street, Indianapolis, IN 46220 (US). **BREAUX, Nneka** [US/US]; 1526 East Sturm Avenue, Indianapolis, IN 46201 (US). **BRYAN, Kristy** [US/US]; 1502 Cool Creek Drive, Carmel, IN 46033 (US). **DAVIS, George** [US/US]; 15114 Count Fleet Ct., Carmel, IN 46032 (US). **EPP, Jeffrey** [US/US]; 17947 Kinder Oak Drive, Noblesville, IN 46062 (US). **LORSBACH, Beth** [US/US]; 6034 Haverford Avenue, Indianapolis, IN 46220 (US). **MARTIN, Timothy** [US/US]; 6095 Ramsey Drive, Noblesville, IN 46062 (US). **MEYER, Kevin** [US/US]; 100 Lexington Court, Zionsville, IN 46077 (US). **NADER, Bassam** [US/US]; 12025 Colbarn Drive, Fishers, IN 46038 (US). **OWEN, W.** [GB/US]; 12421 Pebblepointe Pass, Carmel, IN 46033 (US). **POBANZ, Mark** [US/US]; 4293 Sedge Ct., Zionsville, IN 46077 (US). **RUIZ, James** [US/US]; 13448 Glen Oaks Court, Westfield, IN 46074 (US). **SMITH, Frisby** [US/US]; 4622 Cowell Boulevard, Davis, CA 95618 (US). **SULLENBERGER, Michael** [US/US]; 15610 River Birch Road, Westfield, IN 46074 (US). **WEBSTER, Jeffery** [US/US]; 7581 W. Oakwood Court, New Palestine, IN 46163 (US). **YAO, Chenglin** [US/US]; 14178 Esprit Drive, Westfield, IN 46074 (US). **YOUNG, David** [US/US]; 5263 Navajo Way, Carmel, IN 46033 (US).

(74) Agent: **ARNETT, Charles**; 9330 Zionsville Rd, Indianapolis, Indiana 46268 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:
— *without international search report and to be republished upon receipt of that report*

(54) Title: 5-FLUORO PYRIMIDINE DERIVATIVES

(57) Abstract: This present disclosure is related to the field of 5-fluoro pyrmidines and their derivatives and to the use of these compounds as fungicides.

WO 2009/094442 A2

5-FLUORO PYRIMIDINE DERIVATIVES

Cross Reference to Related Applications

This application claims the benefit of U.S. Provisional Patent Application Serial No. 61/011,799 filed January 22, 2008, and U.S. Provisional Patent Application Serial No. 61/115,297 filed November 17, 2008.

Field of the Invention

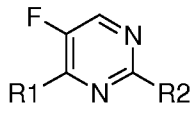
This present disclosure is related to the field of 5-fluoro pyrimidines and their derivatives and to the use of these compounds as fungicides.

Background and Summary of the Invention

Fungicides are compounds, of natural or synthetic origin, which act to protect and cure plants against damage caused by agricultural relevant fungi. Generally, no single fungicide is useful in all situations. Consequently, research is ongoing to produce fungicides that may have better performance, are easier to use, and cost less.

The present disclosure relates to 5-fluoro pyrimidine compounds and their use as fungicides. The compounds of the present disclosure may offer protection against ascomycetes, basidiomycetes, deuteromycetes and oomycetes.

One embodiment of the present disclosure may include compounds of Formula I:



I

wherein R^1 is $-N(R^3)R^4$;

R^2 is $-OR^{21}$;

R^3 is:

H;

C_1-C_6 alkyl optionally substituted with 1- to 3 R^5;

C_2-C_6 alkenyl optionally substituted with 1-3 R^5;

a 5- or 6- membered heteroaromatic ring selected from the group consisting of furanyl, pyridinyl, pyridinyl-N-oxide, pyrimidinyl, pyridazinyl, pyrazinyl, thiazolyl, triazinyl, thiadiazolyl, oxazolyl, isoxazolyl, triazolyl, each heteroaromatic ring being optionally substituted with 1-3 R^{30};

imidazole fused with an aromatic or heteroaromatic ring selected from the group consisting of benzene, oxazole, isoxazole, furan, thiazole, pyrimidine, pyridine, pyrrole, pyrazine, thiophene, each aromatic or heteroaromatic ring being optionally substituted with 1 to 3 R^{30};

benzo[1,3]dioxolyl;

3H-isobenzofuran-1-onyl;

cyano;

C_3-C_6 alkynyl optionally substituted with 1-3 R^5;

$-C(=O)R^6$;

$-C(=O)OCH_2C(=O)R^8$;

$-C(=S)R^6$;

$-C(=S)NHR^8$;

$-C(=O)N(R^8)\ R^{10}$;

$-OR^7$;

$-P(O)(OR^{15})_2$;

$-S(O)_2R^8$;

$-SR^8$;

$-Si(R^8)_3$;

$-N(R^9)R^{10}$;

$-N=C(R^{15})R^{16}$;

$-(CHR^{22})_mR^{37}$;

$-(CHR^{24})OR^{29}$; or

$-C(=NR^{16})SR^{16}$;

wherein m is an integer from 1-3;

R^4 is:

H;

C_1-C_6 alkyl, optionally substituted with 1-3 R^5;

-C(=O)R^6; or

-C(=O)N(R^8) R^{10};

alternatively R^3 and R^4 may be taken together to form:

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

=C(R^{12})N(R^{13})R^{14};

=C(R^{13})(R^{14});

=C(R^{15})OR^{15};

=S(R^{34})$_2$; or

=NR^{35};

R^5 is independently halogen, C_1-C_6 alkyl, C_1-C_4 haloalkyl, C_1-C_4 alkoxy, C_1-C_4 haloalkoxy, C_1-C_4 alkylthio, C_1-C_4 haloalkylthio, amino, C_1-C_3 alkylamino, C_2-C_6 alkoxycarbonyl, C_2-C_6 alkylcarbonyl, C_2-C_6 alkylaminocarbonyl, -OH, N-methyl piperazine or C_3-C_6 trialkylsilyl;

R^6 is independently H, C_1-C_6 alkyl, C_1-C_5 haloalkyl, C_1-C_5 alkoxy, C_1-C_5 haloalkoxy C_2-C_6 alkoxycarbonyl, C_1-C_4 alkoxyalkoxy, C_2-C_6 alkylaminocarbonyl; 1-benzo[1,2,3]thiadiazol-7-yl, thiazolyl, benzyl, phenyl, phenoxy, or benzyloxy wherein the thiazolyl, benzyl, phenyl, phenoxy, or benzyloxy may be optionally substituted with 1-3 R^{20}, a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^7 is H, C_1-C_6 alkyl, C_2-C_6 alkenyl, C_1-C_5 haloalkyl, benzyl which may be optionally substituted with 1-5 R^{20}, CHR^{18}C(O)OR^{19}, or a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^8 is independently C_1-C_6 alkyl, C_1-C_6 haloalkyl, amino, C_1-C_6 alkylamino, C_2-C_6 dialkylamino, phenyl optionally substituted with 1-3 R^{30}, or a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^9 is H, C_1-C_6 alkyl C_1-C_6 haloalkyl, -C(=O)R^{17}, or phenyl optionally substituted with 1-3 R^{20},

R^{10} is H or C_1-C_6 alkyl, C_1-C_6 haloalkyl, or phenyl optionally substituted with 1-3 R^{20};

R^{11} is independently halogen, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_1- C_6 alkylthio, C_1-C_6 haloalkylthio, amino, C_1-C_6 alkylamino, C_2-C_6 dialkylamino, C_2-C_6 alkoxycarbonyl, or C_2-C_6 alkylcarbonyl;

R^{12} is H or C_1-C_4 alkyl;

R^{13} and R^{14} are independently H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, C_2-C_6, alkylcarbonyl, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20};

alternatively R^{13} and R^{14} may be taken together to form:

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, or 3,4-dihydro-1H-isoquinolin-2-yl;

alternatively R^{12} and R^{13} may be taken together to form:

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^{15} is H or C_1-C_6 alkyl;

R^{16} is H, C_1-C_6 alkyl, or phenyl optionally substituted with 1-3 R^{20};

alternatively R^{15} and R^{16} may be taken together as $-(CH_2)_4-$ or $-(CH_2)_5-$;

R^{17} is H, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 alkoxy, phenyl, phenoxy, or benzyloxy wherein each ring may be optionally substituted with 1-3 R^{20};

R^{18} is H, C_1-C_6 alkyl, or C_1-C_6 haloalkyl;

R^{19} is H, C_1-C_6 alkyl, C_1-C_6 haloalkyl, or benzyl;

R^{20} is independently halogen, cyano, nitro, amino, C_1-C_6 alkoxyalkoxy, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 hydroxyalkyl, C_2-C_6 alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, C_2-C_6 alkenyl, C_2-C_6 haloalkenyl, C_3-C_6 alkynyl, C_3-C_6 haloalkynyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_2-C_6 alkenyloxy, C_2-C_6 haloalkenyloxy, C_3-C_6 alkynyloxy, C_3-C_6 haloalkynyloxy, C_1-C_6 alkylthio, C_1-C_6 haloalkylthio, C_1-C_6 alkylsulfonyl, C_1-C_6 haloalkylsulfonyl, C_2-C_6 alkenylthio, C_2-C_6 haloalkenylthio, C_2-C_6 haloalkenylsulfonyl, C_3-C_6 alkynylthio, C_3-C_6 alkynylsulfonyl, C_3-C_6 haloalkynylsulfonyl, C_1-C_6 alkylamino, C_2-C_8 dialkylamino, C_3-C_8 dialkylaminocarbonyl, C_2-C_6 alkoxycarbonyl, C_2-C_6 alkylcarbonyl, C_3-C_6 trialkylsilyl, 2-[(E)-methoxyimino]-N-methyl-acetamidyl, phenyl, benzyl, benzyloxy, phenoxy,or a 5- or 6- membered heteroaromatic ring wherein each phenyl, benzyl, benzyloxy, phenoxy, or 5- or 6- membered heteroaromatic ring may be optionally substituted with 1-3 substitutents independently selected from R^{31};

R^{21} is:

H;

C_1-C_{14} alkyl;

C_1-C_6 haloalkyl;

C_2-C_4 alkenyl;

C_2-C_4 haloalkenyl;

C_3-C_4 alkynyl;

C_3-C_4 haloalkynyl;

phenyl, naphthyl, or tetrahydroquinolinyl each optionally substituted with 1-3 R^{20};

$-(CHR^{22})_mR^{23}$;

$-(CHR^{24})_mC(O)OR^{25}$;

$-(CHR^{24})_mC(O)R^{26}$;

$-(CHR^{24})_mC(O)N(R^{27})R^{28}$;

$-(CHR^{24})_mOR^{29}$;

$-(CHR^{24})_mSR^{29}$

$-(CHR^{24})_mN(R^{27})R^{28}$;

$-C(=O)R^{32}$;

$-N=C(R^{32})(R^{36})$;

$-NR^{25}C(=O)OR^{25}$

$-Si(R^8)_3$;

$-SO_2R^{33}$;

C_2-C_6 alkoxy carbonyl;

C_2-C_6 alkylaminocarbonyl;

C_2-C_6 alkylcarbonyl;

sugars selected from the group consisting of beta-D-glucose-tetraacetate, rhamnose, fructose, and pentose; or

a 5- or 6- membered heteroaromatic ring selected from the group consisting of furanyl, pyridinyl, pyridinyl-N-oxide, pyrimidinyl, pyridazinyl, pyrazinyl, pyrazolyl, thiazolyl, triazinyl, thiadiazolyl, oxazolyl, triazolyl or isoxazolyl wherein each 5- or 6- member heteroaromatic ring may be optionally substituted with 1-5 R^{20};

R^{22} is independently:

H;

halogen;

cyano;

nitro;

C_1-C_6 alkyl;

C_1-C_6 haloalkyl;

phenyl or benzyl optionally substituted with 1-3 R^{20};

C_1-C_6 hydroxyalkyl;

C_2-C_6 alkoxylalkyl;

C_3-C_6 haloalkynyl;

C_2-C_6 alkenyl;

C_2-C_6 haloalkenyl;

C_3-C_6 alkynyl;

C_1-C_6 alkoxy;

C_1-C_6 haloalkoxy;

C_1-C_6 alkylthio;

C_1-C_6 alkylamino;

C_2-C_8 dialkylamino;

C_3-C_6 cycloalkylamino;

C_4-C_6 (alkyl)cycloalkylamino;

C_2-C_6 alkylcarbonyl;

C_2-C_6 alkoxycarbonyl;

C_2-C_6 alkylaminocarbonyl;

C_3-C_8 dialkylaminocarbonyl;

C_3-C_6 trialkylsilyl;

ring-fused heteroaromatic rings selected from the group consisting of benzothiophenyl, quinolinyl, isoquinolinyl, thieno[2,3-b]pyridyl, 1-methyl-1H-thieno[2,3-c]pyrazolyl, and benzoimidazolyl, wherein each of the rings may be further substituted with 1-3 R^{20}; or

a 5- or 6- membered heteroaromatic ring selected from the group consisting of furanyl, pyridinyl, pyridinyl-N-oxide, pyrimidinyl, pyridazinyl, pyrazinyl, thiazolyl, triazinyl, thiadiazolyl, oxazolyl, isoxazolyl, triazolyl and thienyl;

R^{23} is:

H;

halogen;

C_1-C_6 alkyl;

C_1-C_6 haloalkyl;

C_2-C_6 dialkylamino;

phenyl optionally substituted with 1-5 R^{20};

ring-fused heteroaromatic rings selected from the group consisting of

benzothiophenyl, quinolinyl, isoquinolinyl, thieno[2,3-b]pyridyl, 1-methyl-1H-thieno[2,3-c]pyrazolyl, benzofuranyl and benzoimidazolyl, 2,3-dihydro-benzofuran-2-yl, 4-methyl-4H-thieno[3,2-b]pyrrol-5-yl, 1-methyl-1H-indol-5-yl, imidazo[1,2-a]pyridin-2-yl, imidazo[2,1-b]thiazol-6-yl, benzothiazol-2-yl, benzo[b]thiophen-7-yl, and 1-methyl-1H-indazol-3-yl, wherein each of the rings may be further substituted with 1-3 R^{20};

naphthyl;

benzo[1,3]dioxolyl;

pyrrolidinonyl;

oxetanyl;

C_1-C_6 alkylthio optionally substituted with 1-5 R^{20};

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}; or

a 5- or 6- membered heteroaromatic ring selected from the group consisting of furanyl, pyridinyl, pyridinyl-N-oxide, pyrimidinyl, pyridazinyl, pyrazinyl, pyrazolyl, thiazolyl, triazinyl, thiadiazolyl, oxazolyl, isoxazolyl, triazolyl, imidazolyl, thiophene-2-yl and thiophen-3-yl wherein each heteroaromatic ring may be optionally substituted with 1-3 R^{20};

R^{24} is H, C_1-C_6 alkyl, C_1-C_6 alkoxy, benzyl, or phenyl wherein each of the benzyl or phenyl may be optionally substituted with 1-3 R^{20};

R^{25} is H, C_1-C_6 alkyl, phenyl or benzyl optionally substituted with 1-3 R^{20};

R^{26} is:

H;

C_1-C_6 alkyl;

C_1-C_6 alkoxy;

phenyl optionally substituted with 1-3 R^{20}; or

a 5- or 6 membered heteroaromatic ring selected from the group consisting of furanyl, pyridinyl, pyridinyl-N-oxide, pyrimidinyl, pyridazinyl, pyrazinyl,

thiazolyl, triazinyl, thiadiazolyl, oxazolyl, triazolyl and isoxazolyl;

R^{27} and R^{28} are independently:

H;

C_1-C_6 alkyl;

benzyl or phenyl wherein each of the benzyl or phenyl may be optionally substituted with 1-3 R^{20};or

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^{29} is:

H;

C_1-C_6 alkyl;

C_1-C_6 haloalkyl;

C_1-C_6 alkoxyalkyl;

C_2-C_6 alkylcarbonyl;

benzyl or phenyl wherein each of the benzyl or phenyl may be optionally substituted with 1-3 R^{20}; or

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^{30} is independently halogen, cyano, nitro, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 hydroxyalkyl, C_2-C_6 alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, C_2-C_6 alkenyl, C_2-C_6 haloalkenyl, C_3-C_6 alkynyl, C_3-C_6 haloalkynyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_2-C_6 alkenyloxy, C_2-C_6 haloalkenyloxy, C_3-C_6 alkynyloxy, C_3-C_6 haloalkynyloxy, C_1-C_6 alkylthio, C_1-C_6 alkylsulfonyl, C_1-C_6 haloalkylsulfonyl, C_2-C_6

alkenylthio, C_2-C_6 haloalkenylthio, C_2-C_6 haloalkenylsulfonyl, C_3-C_6 alkynylthio, C_3-C_6 alkynylsulfonyl, C_3-C_6 haloalkynylsulfonyl, C_1-C_6 alkylamino, C_2-C_8 dialkylamino, C_3-C_8 dialkylaminocarbonyl, C_3-C_6 trialkylsilyl, thiazolyl, phenyl, pyrimidinyl, or pyridyl, wherein the thiazolyl, phenyl, pyridyl, or pyrimidinyl may be optionally substituted with 1-3 R^{20};

R^{31} is independently halogen, cyano, nitro, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 hydroxyalkyl, C_2-C_6 alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, C_2-C_6 alkenyl, C_2-C_6 haloalkenyl, C_3-C_6 alkynyl, C_3-C_6 haloalkynyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_2-C_6 alkenyloxy, C_2-C_6 haloalkenyloxy, C_3-C_6 alkynyloxy, C_3-C_6 haloalkynyloxy, C_1-C_6 alkylthio, C_1-C_6 alkylsulfonyl, C_1-C_6 haloalkylsulfonyl, C_2-C_6 alkenylthio, C_2-C_6 haloalkenylthio, C_2-C_6 haloalkenylsulfonyl, C_3-C_6 alkynylthio, C_3-C_6 alkynylsulfonyl, C_3-C_6 haloalkynylsulfonyl, C_1-C_6 alkylamino, C_2-C_8 dialkylamino, C_3-C_8 dialkylaminocarbonyl, or C_3-C_6 trialkylsilyl;

R^{32} is independently:

C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 hydroxyalkyl, C_2-C_6 alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, C_2-C_6 alkenyl, C_2-C_6 haloalkenyl, C_3-C_6 alkynyl, C_3-C_6 haloalkynyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_2-C_6 alkenyloxy, C_2-C_6 haloalkenyloxy, C_3-C_6 alkynyloxy, C_3-C_6 haloalkynyloxy, C_1-C_6 alkylthio, C_1-C_6 alkylsulfonyl, C_1-C_6 haloalkylsulfonyl, C_2-C_6 alkenylthio, C_2-C_6 haloalkenylthio, C_2-C_6 haloalkenylsulfonyl, C_3-C_6 alkynylthio, C_3-C_6 alkynylsulfonyl, C_3-C_6 haloalkynylsulfonyl, C_1-C_6 alkylamino, C_2-C_8 dialkylamino, C_3-C_8 dialkylaminocarbonyl, C_3-C_6 trialkylsilyl;

phenyl wherein the phenyl ring may be optionally substituted with 1-3 R^{20}; or

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^{33} is independently:

C_1-C_6 alkyl, C_1-C_6 haloalkyl, phenyl or thienyl optionally substituted with 1-3 R^{20}; or

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^{34} is:

C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_2-C_6 alkoxyalkyl, C_1-C_6 alkylamino; or

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^{35} is:

C_1-C_6 alkyl, C_2-C_6 alkylcarbonyl; or

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^{36} is H, cyano, C_1-C_6 alkyl, C_1-C_6 alkoxy, benzyl, or phenyl wherein each of the benzyl or phenyl may be optionally substituted with 1-3 R^{20};

alternatively R^{32} and R^{36} may be taken together to form:

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}; and

R^{37} is independently:

H, halogen, or phenyl optionally substituted with 1-5 R^{20};

C_1-C_6 alkyl, C_1-C_6 haloalkyl, hydroxyl, C_1-C_6 alkoxy, or C_1-C_6 haloalkoxy; or

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}.

Another embodiment of the present disclosure may include a fungicidal composition for the control or prevention of fungal attack comprising the compounds described below and a phytologically acceptable carrier material.

Yet another embodiment of the present disclosure may include a method for the control or prevention of fungal attack on a plant, the method including the steps of applying a fungicidally effective amount of one or more of the compounds described below to at least one of the fungus, the plant, an area adjacent to the plant, and the seed adapted to produce the plant.

The term "alkyl" refers to a unbranched, branched, or cyclic carbon chain, including methyl, ethyl, propyl, butyl, isopropyl, isobutyl, tertiary butyl, pentyl, hexyl, cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl and the like.

The term "alkenyl" refers to a branched, unbranched or cyclic carbon chain containing one or more double bonds including ethenyl, propenyl, butenyl, isopropenyl, isobutenyl, cyclohexenyl, and the like.

The term "alkynyl" refers to refers to a branched or unbranched carbon chain containing one or more triple bonds including propynyl, butynyl and the like.

As used throughout this specification, the term 'R' refers to the group consisting of C_{2-8} alkyl, C_{3-8} alkenyl or C_{3-8} alkynyl, unless stated otherwise.

The term "alkoxy" refers to an -OR substituent.

The term "alkoxycarbonyl" refers to a -C(O)-OR substituent.

The term "alkylcarbonyl" refers to a -C(O)-R substituent.

The term "alkylsulfonyl" refers to an $-SO_2$-R substituent.

The term "haloalkylsulfonyl" refers to a sulfonyl substitution on an alkyl which is partially substituted with halogen atoms.

The term "alkylthio" refers to an -S-R substituent.

The term "alkylaminocarbonyl" refers to a -C(O)-N(H)-R substituent.

The term "dialkylaminocarbonyl" refers to a $-C(O)-NR_2$ substituent.

The term "alkylcycloalkylamino" refers to a cycloalkylamino substituent that is substituted with an alkyl group.

The term "trialkylsilyl" refers to $-SiR_3$.

The term "cyano" refers to a -C≡N substituent.

The term "hydroxyl" refers to a -OH substituent

The term "amino" refers to a $-NH_2$ substituent

The term "alkylamino" refers to a –N(H)-R substituent

The term "dialkylamino" refers to a $-NR_2$ substituent

The term "alkoxyalkoxy" refers to $-O(CH2)_nO(CH2)_n$ where n is an interger from 1-3

The term "alkoxyalkyl" refers to an alkoxy substitution on an alkyl.

The term "haloalkoxyalkyl" refers to an alkoxy substitution on an alkyl which may be partially substituted with halogen atoms

The term "hydroxyalkyl" refers to an alkyl which is substituted with a hydroxyl group.

The term "haloalkoxy" refers to a –OR-X substituent, wherein X is Cl, F, Br, or I, or any combination thereof.

The term "haloalkyl" refers to an alkyl, which is substituted with Cl, F, I, or Br or any combination thereof.

The term "haloalkenyl" refers to an alkenyl, which is substituted with Cl, F, I, or Br or any combination thereof.

The term "haloalkynyl" refers to an alkynyl which is substituted with Cl, F, I, or Br or any combination thereof.

The term "halogen" or "halo" refers to one or more halogen atoms, defined as F, Cl, Br, and I.

The term "hydroxycarbonyl" refers to a –C(O)-OH substituent.

The term "nitro" refers to a $-NO_2$ substituent.

The term "thienyl" refers to a 5-member aromatic ring with one sulfur atom.

Throughout the disclosure, reference to the compounds of Formula I is read as also including optical isomers and salts of Formula I, and hydrates thereof. Specifically, when Formula I contains a branched chain alkyl group, it is understood that such compounds include optical isomers and racemates thereof. Exemplary salts include: hydrochloride, hydrobromide, hydroiodide, and the like.

It is also understood by those skilled in the art that additional substitution is allowable, unless otherwise noted, as long as the rules of chemical bonding and strain energy are satisfied and the product still exhibits fungicidal activity.

Another embodiment of the present disclosure is a use of a compound of Formula I, for protection of a plant against attack by a phytopathogenic organism or the treatment of a plant infested by a phytopathogenic organism, comprising the application of a compound of Formula I, or a composition comprising the compound to soil, a plant, a part of a plant, foliage, and/or seeds.

Additionally, another embodiment of the present disclosure is a composition useful for protecting a plant against attack by a phytopathogenic organism and/or treatment of a plant infested by a phytopathogenic organism comprising a compound of Formula I and a phytologically acceptable carrier material.

Detailed Description of the Present Disclosure

The compounds of the present disclosure may be applied by any of a variety of known techniques, either as the compounds or as formulations comprising the compounds. For example, the compounds may be applied to the roots, seeds or foliage of plants for the control of various fungi, without damaging the commercial value of the plants. The materials may be applied in the form of any of the generally used formulation types, for example, as solutions, dusts, wettable powders, flowable concentrates, or emulsifiable concentrates.

Preferably, the compounds of the present disclosure are applied in the form of a formulation, comprising one or more of the compounds of Formula I with a phytologically acceptable carrier. Concentrated formulations may be dispersed in water, or other liquids, for application, or formulations may be dust-like or granular, which may then be applied without further treatment. The formulations can be prepared according to procedures that are conventional in the agricultural chemical art.

The present disclosure contemplates all vehicles by which one or more of the compounds may be formulated for delivery and use as a fungicide. Typically, formulations are applied as aqueous suspensions or emulsions. Such suspensions or

emulsions may be produced from water-soluble, water suspendable, or emulsifiable formulations which are solids, usually known as wettable powders; or liquids, usually known as emulsifiable concentrates, aqueous suspensions, or suspension concentrates. As will be readily appreciated, any material to which these compounds may be added may be used, provided it yields the desired utility without significant interference with the activity of these compounds as antifungal agents.

Wettable powders, which may be compacted to form water dispersible granules, comprise an intimate mixture of one or more of the compounds of Formula I, an inert carrier and surfactants. The concentration of the compound in the wettable powder may be from about 10 percent to about 90 percent by weight based on the total weight of the wettable powder, more preferably about 25 weight percent to about 75 weight percent. In the preparation of wettable powder formulations, the compounds may be compounded with any finely divided solid, such as prophyllite, talc, chalk, gypsum, Fuller's earth, bentonite, attapulgite, starch, casein, gluten, montmorillonite clays, diatomaceous earths, purified silicates or the like. In such operations, the finely divided carrier and surfactants are typically blended with the compound(s) and milled.

Emulsifiable concentrates of the compounds of Formula I may comprise a convenient concentration, such as from about 10 weight percent to about 50 weight percent of the compound, in a suitable liquid, based on the total weight of the concentrate. The compounds may be dissolved in an inert carrier, which is either a water miscible solvent or a mixture of water-immiscible organic solvents, and emulsifiers. The concentrates may be diluted with water and oil to form spray mixtures in the form of oil-in-water emulsions. Useful organic solvents include aromatics, especially the high-boiling naphthalenic and olefinic portions of petroleum such as heavy aromatic naphtha. Other organic solvents may also be used, for example, terpenic solvents, including rosin derivatives, aliphatic ketones, such as cyclohexanone, and complex alcohols, such as 2-ethoxyethanol.

Emulsifiers which may be advantageously employed herein may be readily determined by those skilled in the art and include various nonionic, anionic, cationic and amphoteric emulsifiers, or a blend of two or more emulsifiers. Examples of nonionic emulsifiers useful in preparing the emulsifiable concentrates include the polyalkylene

glycol ethers and condensation products of alkyl and aryl phenols, aliphatic alcohols, aliphatic amines or fatty acids with ethylene oxide, propylene oxides such as the ethoxylated alkyl phenols and carboxylic esters solubilized with the polyol or polyoxyalkylene. Cationic emulsifiers include quaternary ammonium compounds and fatty amine salts. Anionic emulsifiers include the oil-soluble salts (e.g., calcium) of alkylaryl sulphonic acids, oil soluble salts or sulfated polyglycol ethers and appropriate salts of phosphated polyglycol ether.

Representative organic liquids which may be employed in preparing the emulsifiable concentrates of the compounds of the present invention are the aromatic liquids such as xylene, propyl benzene fractions; or mixed naphthalene fractions, mineral oils, substituted aromatic organic liquids such as dioctyl phthalate; kerosene; dialkyl amides of various fatty acids, particularly the dimethyl amides of fatty glycols and glycol derivatives such as the n-butyl ether, ethyl ether or methyl ether of diethylene glycol, and the methyl ether of triethylene glycol and the like. Mixtures of two or more organic liquids may also be employed in the preparation of the emulsifiable concentrate. Organic liquids include xylene, and propyl benzene fractions, with xylene being most preferred in some cases. Surface-active dispersing agents are typically employed in liquid formulations and in an amount of from 0.1 to 20 percent by weight based on the combined weight of the dispersing agent with one or more of the compounds. The formulations can also contain other compatible additives, for example, plant growth regulators and other biologically active compounds used in agriculture.

Aqueous suspensions comprise suspensions of one or more water-insoluble compounds of Formula I, dispersed in an aqueous vehicle at a concentration in the range from about 5 to about 50 weight percent, based on the total weight of the aqueous suspension. Suspensions are prepared by finely grinding one or more of the compounds, and vigorously mixing the ground material into a vehicle comprised of water and surfactants chosen from the same types discussed above. Other components, such as inorganic salts and synthetic or natural gums, may also be added to increase the density and viscosity of the aqueous vehicle.

The compounds of Formula I can also be applied as granular formulations, which are particularly useful for applications to the soil. Granular formulations generally

contain from about 0.5 to about 10 weight percent, based on the total weight of the granular formulation of the compound(s), dispersed in an inert carrier which consists entirely or in large part of coarsely divided inert material such as attapulgite, bentonite, diatomite, clay or a similar inexpensive substance. Such formulations are usually prepared by dissolving the compounds in a suitable solvent and applying it to a granular carrier which has been preformed to the appropriate particle size, in the range of from about 0.5 to about 3 mm. A suitable solvent is a solvent in which the compound is substantially or completely soluble. Such formulations may also be prepared by making a dough or paste of the carrier and the compound and solvent, and crushing and drying to obtain the desired granular particle.

Dusts containing the compounds of Formula I may be prepared by intimately mixing one or more of the compounds in powdered form with a suitable dusty agricultural carrier, such as, for example, kaolin clay, ground volcanic rock, and the like. Dusts can suitably contain from about 1 to about 10 weight percent of the compounds, based on the total weight of the dust.

The formulations may additionally contain adjuvant surfactants to enhance deposition, wetting and penetration of the compounds onto the target crop and organism. These adjuvant surfactants may optionally be employed as a component of the formulation or as a tank mix. The amount of adjuvant surfactant will typically vary from 0.01 to 1.0 percent by volume, based on a spray-volume of water, preferably 0.05 to 0.5 volume percent. Suitable adjuvant surfactants include, but are not limited to ethoxylated nonyl phenols, ethoxylated synthetic or natural alcohols, salts of the esters or sulphosuccinic acids, ethoxylated organosilicones, ethoxylated fatty amines and blends of surfactants with mineral or vegetable oils. The formlulations may also include oil-in-water emulsions such as those disclosed in U.S. Patent Application Serial No. 11/495,228, the disclosure of which is expressly incorporated by reference herein.

The formulations may optionally include combinations that contain other pesticidal compounds. Such additional pesticidal compounds may be fungicides, insecticides, herbicides, nematocides, miticides, arthropodicides, bactericides or combinations thereof that are compatible with the compounds of the present invention in the medium selected for application, and not antagonistic to the activity of the present

compounds. Accordingly, in such embodiments, the other pesticidal compound is employed as a supplemental toxicant for the same or for a different pesticidal use. The compounds of Formula I, and the pesticidal compound in the combination can generally be present in a weight ratio of from 1:100 to100:1.

The compounds of the present disclosure may also be combined with other fungicides to form fungicidal mixtures and synergistic mixtures thereof. The fungicidal compounds of the present disclosure are often applied in conjunction with one or more other fungicides to control a wider variety of undesirable diseases. When used in conjunction with other fungicide(s), the presently claimed compounds may be formulated with the other fungicide(s), tank mixed with the other fungicide(s) or applied sequentially with the other fungicide(s). Such other fungicides may include 2-(thiocyanatomethylthio)-benzothiazole, 2-phenylphenol, 8-hydroxyquinoline sulfate, antimycin, Ampelomyces, quisqualis, azaconazole, azoxystrobin, Bacillus subtilis, benalaxyl, benomyl, benthiavalicarb-isopropyl, benzylaminobenzene-sulfonate (BABS) salt, bicarbonates, biphenyl, bismerthiazol, bitertanol, blasticidin-S, borax, Bordeaux mixture, boscalid, bromuconazole, bupirimate, calcium polysulfide, captafol, captan, carbendazim, carboxin, carpropamid, carvone, chloroneb, chlorothalonil, chlozolinate, Coniothyrium minitans, copper hydroxide, copper octanoate, copper oxychloride, copper sulfate, copper sulfate (tribasic), cuprous oxide, cyazofamid, cyflufenamid, cymoxanil, cyproconazole, cyprodinil, dazomet, debacarb, diammonium ethylenebis-(dithiocarbamate), dichlofluanid, dichlorophen, diclocymet, diclomezine, dichloran, diethofencarb, difenoconazole, difenzoquat ion, diflumetorim, dimethomorph, dimoxystrobin, diniconazole, diniconazole-M,dinobuton, dinocap, diphenylamine, dithianon, dodemorph, dodemorph acetate, dodine, dodine free base, edifenphos, enestrobin, epoxiconazole, ethaboxam, ethoxyquin, etridiazole, famoxadone, fenamidone, fenarimol, fenbuconazole, fenfuram, fenhexamid, fenoxanil, fenpiclonil, fenpropidin, fenpropimorph, fentin, fentin acetate, fentin hydroxide, ferbam, ferimzone, fluazinam, fludioxonil, flumorph, fluopicolide, fluoroimide, fluoxastrobin, fluquinconazole, flusilazole, flusulfamide, flutolanil, flutriafol, folpet, formaldehyde, fosetyl, fosetyl-aluminium, fuberidazole, furalaxyl, furametpyr, guazatine, guazatine acetates, GY-81, hexachlorobenzene, hexaconazole, hymexazol, imazalil, imazalil sulfate, imibenconazole,

iminoctadine, iminoctadine triacetate, iminoctadine tris(albesilate), ipconazole, iprobenfos, iprodione, iprovalicarb, isoprothiolane, kasugamycin, kasugamycin hydrochloride hydrate, kresoxim-methyl, mancopper, mancozeb, mandipropamid, maneb, mepanipyrim, mepronil, mercuric chloride, mercuric oxide, mercurous chloride, metalaxyl, mefenoxam, metalaxyl-M, metam, metam-ammonium, metam-potassium, metam-sodium, metconazole, methasulfocarb, methyl iodide, methyl isothiocyanate, metiram, metominostrobin, metrafenone, mildiomycin, myclobutanil, nabam, nitrothal-isopropyl, nuarimol, octhilinone, ofurace, oleic acid (fatty acids), orysastrobin, oxadixyl, oxine-copper, oxpoconazole fumarate, oxycarboxin, pefurazoate, penconazole, pencycuron, pentachlorophenol, pentachlorophenyl laurate, penthiopyrad, phenylmercury acetate, phosphonic acid, phthalide, picoxystrobin, polyoxin B, polyoxins, polyoxorim, potassium bicarbonate, potassium hydroxyquinoline sulfate, probenazole, prochloraz, procymidone, propamocarb, propamocarb hydrochloride, propiconazole, propineb, proquinazid, prothioconazole, pyraclostrobin, pyrazophos, pyributicarb, pyrifenox, pyrimethanil, pyroquilon, quinoclamine, quinoxyfen, quintozene, Reynoutria sachalinensis extract, silthiofam, simeconazole, sodium 2-phenylphenoxide, sodium bicarbonate, sodium pentachlorophenoxide, spiroxamine, sulfur, SYP-Z071, SYP-048, tar oils, tebuconazole, tecnazene, tetraconazole, thiabendazole, thifluzamide, thiophanate-methyl, thiram, tiadinil, tolclofos-methyl, tolylfluanid, triadimefon, triadimenol, triazoxide, tricyclazole, tridemorph, trifloxystrobin, triflumizole, triforine, triticonazole, validamycin, vinclozolin, zineb, ziram, zoxamide, Candida oleophila, Fusarium oxysporum, Gliocladium spp., Phlebiopsis gigantean, Streptomyces griseoviridis, Trichoderma spp., (RS)-N-(3,5-dichlorophenyl)-2-(methoxymethyl)-succinimide, 1,2-dichloropropane, 1,3-dichloro-1,1,3,3-tetrafluoroacetone hydrate, 1-chloro-2,4-dinitronaphthalene, 1-chloro-2-nitropropane, 2-(2-heptadecyl-2-imidazolin-1-yl)ethanol, 2,3-dihydro-5-phenyl-1,4-dithi-ine 1,1,4,4-tetraoxide, 2-methoxyethylmercury acetate, 2-methoxyethylmercury chloride, 2-methoxyethylmercury silicate, 3-(4-chlorophenyl)-5-methylrhodanine, 4-(2-nitroprop-1-enyl)phenyl thiocyanateme: ampropylfos, anilazine, azithiram, barium polysulfide, Bayer 32394, benodanil, benquinox, bentaluron, benzamacril; benzamacril-isobutyl, benzamorf, binapacryl, bis(methylmercury) sulfate, bis(tributyltin) oxide, buthiobate, cadmium

calcium copper zinc chromate sulfate, carbamorph,
CECA, chlobenthiazone, chloraniformethan, chlorfenazole, chlorquinox, climbazole, copper bis(3-phenylsalicylate), copper zinc chromate, cufraneb, cupric hydrazinium sulfate, cuprobam, cyclafuramid, cypendazole, cyprofuram, decafentin, dichlone, dichlozoline, diclobutrazol, dimethirimol, dinocton, dinosulfon, dinoterbon, dipyrithione, ditalimfos, dodicin, drazoxolon, EBP, ESBP, etaconazole, etem, ethirim, fenaminosulf, fenapanil, fenitropan, fluotrimazole, furcarbanil, furconazole, furconazole-cis, furmecyclox, furophanate, glyodine, griseofulvin, halacrinate, Hercules 3944, hexylthiofos, ICIA0858, isopamphos, isovaledione, mebenil, mecarbinzid , metazoxolon, methfuroxam, methylmercury dicyandiamide, metsulfovax, milneb, mucochloric anhydride, myclozolin, N-3,5-dichlorophenyl-succinimide, N-3-nitrophenylitaconimide, natamycin, N-ethylmercurio-4-toluenesulfonanilide, nickel bis(dimethyldithiocarbamate), OCH, phenylmercury dimethyldithio-carbamate, phenylmercury nitrate, phosdiphen, prothiocarb; prothiocarb hydrochloride, pyracarbolid, pyridinitril, pyroxychlor, pyroxyfur, quinacetol; quinacetol sulfate, quinazamid, quinconazole, rabenzazole, salicylanilide, SSF-109, sultropen, tecoram, thiadifluor, thicyofen, thiochlorfenphim, thiophanate, thioquinox, tioxymid, triamiphos, triarimol, triazbutil, trichlamide, urbacid, XRD-563, and zarilamid, IK-1140, NC-224, and any combinations thereof.

Additionally, the compounds of the present invention may be combined with other pesticides, including insecticides, nematocides, miticides, arthropodicides, bactericides or combinations thereof that are compatible with the compounds of the present invention in the medium selected for application, and not antagonistic to the activity of the present compounds to form pesticidal mixtures and synergistic mixtures thereof. The fungicidal compounds of the present disclosure may be applied in conjunction with one or more other pesticides to control a wider variety of undesirable pests. When used in conjunction with other pesticides, the presently claimed compounds may be formulated with the other pesticide(s), tank mixed with the other pesticide(s) or applied sequentially with the other pesticide(s). Typical insecticides include, but are not limited to: antibiotic insecticides such as allosamidin and thuringiensin; macrocyclic lactone insecticides such as spinosad; avermectin insecticides such as abamectin, doramectin, emamectin, eprinomectin, ivermectin and selamectin; milbemycin

insecticides such as lepimectin, milbemectin, milbemycin oxime and moxidectin; arsenical insecticides such as calcium arsenate, copper acetoarsenite, copper arsenate, lead arsenate, potassium arsenite and sodium arsenite; botanical insecticides such as anabasine, azadirachtin, d-limonene, nicotine, pyrethrins, cinerins, cinerin I, cinerin II, jasmolin I, jasmolin II, pyrethrin I, pyrethrin II, quassia, rotenone, ryania and sabadilla; carbamate insecticides such as bendiocarb and carbaryl; benzofuranyl methylcarbamate insecticides such as benfuracarb, carbofuran, carbosulfan, decarbofuran and furathiocarb; dimethylcarbamate insecticides dimitan, dimetilan, hyquincarb and pirimicarb; oxime carbamate insecticides such as alanycarb, aldicarb, aldoxycarb, butocarboxim, butoxycarboxim, methomyl, nitrilacarb, oxamyl, tazimcarb, thiocarboxime, thiodicarb and thiofanox; phenyl methylcarbamate insecticides such as allyxycarb, aminocarb, bufencarb, butacarb, carbanolate, cloethocarb, dicresyl, dioxacarb, EMPC, ethiofencarb, fenethacarb, fenobucarb, isoprocarb, methiocarb, metolcarb, mexacarbate, promacyl, promecarb, propoxur, trimethacarb, XMC and xylylcarb; dinitrophenol insecticides such as dinex, dinoprop, dinosam and DNOC; fluorine insecticides such as barium hexafluorosilicate, cryolite, sodium fluoride, sodium hexafluorosilicate and sulfluramid; formamidine insecticides such as amitraz, chlordimeform, formetanate and formparanate; fumigant insecticides such as acrylonitrile, carbon disulfide, carbon tetrachloride, chloroform, chloropicrin, para-dichlorobenzene, 1,2-dichloropropane, ethyl formate, ethylene dibromide, ethylene dichloride, ethylene oxide, hydrogen cyanide, iodomethane, methyl bromide, methylchloroform, methylene chloride, naphthalene, phosphine, sulfuryl fluoride and tetrachloroethane; inorganic insecticides such as borax, calcium polysulfide, copper oleate, mercurous chloride, potassium thiocyanate and sodium thiocyanate; chitin synthesis inhibitors such as bistrifluron, buprofezin, chlorfluazuron, cyromazine, diflubenzuron, flucycloxuron, flufenoxuron, hexaflumuron, lufenuron, novaluron, noviflumuron, penfluron, teflubenzuron and triflumuron; juvenile hormone mimics such as epofenonane, fenoxycarb, hydroprene, kinoprene, methoprene, pyriproxyfen and triprene; juvenile hormones such as juvenile hormone I, juvenile hormone II and juvenile hormone III; moulting hormone agonists such as chromafenozide, halofenozide, methoxyfenozide and tebufenozide; moulting hormones such as α-ecdysone and ecdysterone; moulting inhibitors such as diofenolan; precocenes such as precocene I,

precocene II and precocene III; unclassified insect growth regulators such as dicyclanil; nereistoxin analogue insecticides such as bensultap, cartap, thiocyclam and thiosultap; nicotinoid insecticides such as flonicamid; nitroguanidine insecticides such as clothianidin, dinotefuran, imidacloprid and thiamethoxam; nitromethylene insecticides such as nitenpyram and nithiazine; pyridylmethyl-amine insecticides such as acetamiprid, imidacloprid, nitenpyram and thiacloprid; organochlorine insecticides such as bromo-DDT, camphechlor, DDT, pp′-DDT, ethyl-DDD, HCH, gamma-HCH, lindane, methoxychlor, pentachlorophenol and TDE; cyclodiene insecticides such as aldrin, bromocyclen, chlorbicyclen, chlordane, chlordecone, dieldrin, dilor, endosulfan, endrin, HEOD, heptachlor, HHDN, isobenzan, isodrin, kelevan and mirex; organophosphate insecticides such as bromfenvinfos, chlorfenvinphos, crotoxyphos, dichlorvos, dicrotophos, dimethylvinphos, fospirate, heptenophos, methocrotophos, mevinphos, monocrotophos, naled, naftalofos, phosphamidon, propaphos, TEPP and tetrachlorvinphos; organothiophosphate insecticides such as dioxabenzofos, fosmethilan and phenthoate; aliphatic organothiophosphate insecticides such as acethion, amiton, cadusafos, chlorethoxyfos, chlormephos, demephion, demephion-O, demephion-S, demeton, demeton-O, demeton-S, demeton-methyl, demeton-O-methyl, demeton-S-methyl, demeton-S-methylsulphon, disulfoton, ethion, ethoprophos, IPSP, isothioate, malathion, methacrifos, oxydemeton-methyl, oxydeprofos, oxydisulfoton, phorate, sulfotep, terbufos and thiometon; aliphatic amide organothiophosphate insecticides such as amidithion, cyanthoate, dimethoate, ethoate-methyl, formothion, mecarbam, omethoate, prothoate, sophamide and vamidothion; oxime organothiophosphate insecticides such as chlorphoxim, phoxim and phoxim-methyl; heterocyclic organothiophosphate insecticides such as azamethiphos, coumaphos, coumithoate, dioxathion, endothion, menazon, morphothion, phosalone, pyraclofos, pyridaphenthion and quinothion; benzothiopyran organothiophosphate insecticides such as dithicrofos and thicrofos; benzotriazine organothiophosphate insecticides such as azinphos-ethyl and azinphos-methyl; isoindole organothiophosphate insecticides such as dialifos and phosmet; isoxazole organothiophosphate insecticides such as isoxathion and zolaprofos; pyrazolopyrimidine organothiophosphate insecticides such as chlorprazophos and pyrazophos; pyridine organothiophosphate insecticides such as chlorpyrifos and

chlorpyrifos-methyl; pyrimidine organothiophosphate insecticides such as butathiofos, diazinon, etrimfos, lirimfos, pirimiphos-ethyl, pirimiphos-methyl, primidophos, pyrimitate and tebupirimfos; quinoxaline organothiophosphate insecticides such as quinalphos and quinalphos-methyl; thiadiazole organothiophosphate insecticides such as athidathion, lythidathion, methidathion and prothidathion; triazole organothiophosphate insecticides such as isazofos and triazophos; phenyl organothiophosphate insecticides such as azothoate, bromophos, bromophos-ethyl, carbophenothion, chlorthiophos, cyanophos, cythioate, dicapthon, dichlofenthion, etaphos, famphur, fenchlorphos, fenitrothion fensulfothion, fenthion, fenthion-ethyl, heterophos, jodfenphos, mesulfenfos, parathion, parathion-methyl, phenkapton, phosnichlor, profenofos, prothiofos, sulprofos, temephos, trichlormetaphos-3 and trifenofos; phosphonate insecticides such as butonate and trichlorfon; phosphonothioate insecticides such as mecarphon; phenyl ethylphosphonothioate insecticides such as fonofos and trichloronat; phenyl phenylphosphonothioate insecticides such as cyanofenphos, EPN and leptophos; phosphoramidate insecticides such as crufomate, fenamiphos, fosthietan, mephosfolan, phosfolan and pirimetaphos; phosphoramidothioate insecticides such as acephate, isocarbophos, isofenphos, methamidophos and propetamphos; phosphorodiamide insecticides such as dimefox, mazidox, mipafox and schradan; oxadiazine insecticides such as indoxacarb; phthalimide insecticides such as dialifos, phosmet and tetramethrin; pyrazole insecticides such as acetoprole, ethiprole, fipronil, pyrafluprole, pyriprole, tebufenpyrad, tolfenpyrad and vaniliprole; pyrethroid ester insecticides such as acrinathrin, allethrin, bioallethrin, barthrin, bifenthrin, bioethanomethrin, cyclethrin, cycloprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenothrin, deltamethrin, dimefluthrin, dimethrin, empenthrin, fenfluthrin, fenpirithrin, fenpropathrin, fenvalerate, esfenvalerate, flucythrinate, fluvalinate, tau-fluvalinate, furethrin, imiprothrin, metofluthrin, permethrin, biopermethrin, transpermethrin, phenothrin, prallethrin, profluthrin, pyresmethrin, resmethrin, bioresmethrin, cismethrin, tefluthrin, terallethrin, tetramethrin, tralomethrin and transfluthrin; pyrethroid ether insecticides such as etofenprox, flufenprox, halfenprox, protrifenbute and silafluofen; pyrimidinamine insecticides such as flufenerim

and pyrimidifen; pyrrole insecticides such as chlorfenapyr; tetronic acid insecticides such as spiromesifen; thiourea insecticides such as diafenthiuron; urea insecticides such as flucofuron and sulcofuron; and unclassified insecticides such as closantel, crotamiton, EXD, fenazaflor, fenoxacrim, flubendiamide, hydramethylnon, isoprothiolane, malonoben, metaflumizone, metoxadiazone, nifluridide, pyridaben, pyridalyl, rafoxanide, triarathene and triazamate, and any combinations thereof.

Additionally, the compounds of the present invention may be combined with herbicides that are compatible with the compounds of the present invention in the medium selected for application, and not antagonistic to the activity of the present compounds to form pesticidal mixtures and synergistic mixtures thereof. The fungicidal compounds of the present disclosure may be applied in conjunction with one or more herbicides to control a wide variety of undesirable plants. When used in conjunction with herbicides, the presently claimed compounds may be formulated with the herbicide(s), tank mixed with the herbicide(s) or applied sequentially with the herbicide(s). Typical herbicides include, but are not limited to: *amide herbicides* such as allidochlor, beflubutamid, benzadox, benzipram, bromobutide, cafenstrole, CDEA, chlorthiamid, cyprazole, dimethenamid, dimethenamid-P, diphenamid, epronaz, etnipromid, fentrazamide, flupoxam, fomesafen, halosafen, isocarbamid, isoxaben, napropamide, naptalam, pethoxamid, propyzamide, quinonamid and tebutam; *anilide herbicides* such as chloranocryl, cisanilide, clomeprop, cypromid, diflufenican, etobenzanid, fenasulam, flufenacet, flufenican, mefenacet, mefluidide, metamifop, monalide, naproanilide, pentanochlor, picolinafen and propanil; *arylalanine herbicides* such as benzoylprop, flamprop and flamprop-M; *chloroacetanilide herbicides* such as acetochlor, alachlor, butachlor, butenachlor, delachlor, diethatyl, dimethachlor, metazachlor, metolachlor, S-metolachlor, pretilachlor, propachlor, propisochlor, prynachlor, terbuchlor, thenylchlor and xylachlor; *sulfonanilide herbicides* such as benzofluor, perfluidone, pyrimisulfan and profluazol; *sulfonamide herbicides* such as asulam, carbasulam, fenasulam and oryzalin; *antibiotic herbicides* such as bilanafos; *benzoic acid herbicides* such as chloramben, dicamba, 2,3,6-TBA and tricamba; *pyrimidinyloxybenzoic acid herbicides* such as bispyribac and pyriminobac; *pyrimidinylthiobenzoic acid herbicides* such as pyrithiobac; *phthalic acid herbicides* such as chlorthal; *picolinic acid herbicides* such as

aminopyralid, clopyralid and picloram; *quinolinecarboxylic acid herbicides* such as quinclorac and quinmerac; *arsenical herbicides* such as cacodylic acid, CMA, DSMA, hexaflurate, MAA, MAMA, MSMA, potassium arsenite and sodium arsenite; *benzoylcyclohexanedione herbicides* such as mesotrione, sulcotrione, tefuryltrione and tembotrione; *benzofuranyl alkylsulfonate herbicides* such as benfuresate and ethofumesate; *carbamate herbicides* such as asulam, carboxazole chlorprocarb, dichlormate, fenasulam, karbutilate and terbucarb; *carbanilate herbicides* such as barban, BCPC, carbasulam, carbetamide, CEPC, chlorbufam, chlorpropham, CPPC, desmedipham, phenisopham, phenmedipham, phenmedipham-ethyl, propham and swep; *cyclohexene oxime herbicides* such as alloxydim, butroxydim, clethodim, cloproxydim, cycloxydim, profoxydim, sethoxydim, tepraloxydim and tralkoxydim; *cyclopropylisoxazole herbicides* such as isoxachlortole and isoxaflutole; *dicarboximide herbicides* such as benzfendizone, cinidon-ethyl, flumezin, flumiclorac, flumioxazin and flumipropyn; *dinitroaniline herbicides* such as benfluralin, butralin, dinitramine, ethalfluralin, fluchloralin, isopropalin, methalpropalin, nitralin, oryzalin, pendimethalin, prodiamine, profluralin and trifluralin; *dinitrophenol herbicides* such as dinofenate, dinoprop, dinosam, dinoseb, dinoterb, DNOC, etinofen and medinoterb; *diphenyl ether herbicides* such as ethoxyfen; *nitrophenyl ether herbicides* such as acifluorfen, aclonifen, bifenox, chlomethoxyfen, chlornitrofen, etnipromid, fluorodifen, fluoroglycofen, fluoronitrofen, fomesafen, furyloxyfen, halosafen, lactofen,nitrofen, nitrofluorfen and oxyfluorfen; *dithiocarbamate herbicides* such as dazomet and metam; *halogenated aliphatic herbicides* such as alorac, chloropon, dalapon, flupropanate, hexachloroacetone, iodomethane, methyl bromide, monochloroacetic acid, SMA and TCA; *imidazolinone herbicides* such as imazamethabenz, imazamox, imazapic, imazapyr, imazaquin and imazethapyr; *inorganic herbicides* such as ammonium sulfamate, borax, calcium chlorate, copper sulfate, ferrous sulfate, potassium azide, potassium cyanate, sodium azide, sodium chlorate and sulfuric acid; *nitrile herbicides* such as bromobonil, bromoxynil, chloroxynil, dichlobenil, iodobonil, ioxynil and pyraclonil; *organophosphorus herbicides* such as amiprofos-methyl, anilofos, bensulide, bilanafos, butamifos, 2,4-DEP, DMPA, EBEP, fosamine, glufosinate, glyphosate and piperophos; *phenoxy herbicides* such as bromofenoxim, clomeprop, 2,4-DEB, 2,4-DEP, difenopenten,

disul, erbon, etnipromid, fenteracol and trifopsime; *phenoxyacetic herbicides* such as 4-CPA, 2,4-D, 3,4-DA, MCPA, MCPA-thioethyl and 2,4,5-T; *phenoxybutyric herbicides* such as 4-CPB, 2,4-DB, 3,4-DB, MCPB and 2,4,5-TB; *phenoxypropionic herbicides* such as cloprop, 4-CPP, dichlorprop, dichlorprop-P, 3,4-DP, fenoprop, mecoprop and mecoprop-P; *aryloxyphenoxypropionic herbicides* such as chlorazifop, clodinafop, clofop, cyhalofop, diclofop, fenoxaprop, fenoxaprop-P, fenthiaprop, fluazifop, fluazifop-P, haloxyfop, haloxyfop-P, isoxapyrifop, metamifop, propaquizafop, quizalofop, quizalofop-P and trifop; *phenylenediamine herbicides* such as dinitramine and prodiamine; *pyrazolyl herbicides* such as benzofenap, pyrazolynate, pyrasulfotole, pyrazoxyfen, pyroxasulfone and topramezone; *pyrazolylphenyl herbicides* such as fluazolate and pyraflufen; *pyridazine herbicides* such as credazine, pyridafol and pyridate; *pyridazinone herbicides* such as brompyrazon, chloridazon, dimidazon, flufenpyr, metflurazon, norflurazon, oxapyrazon and pydanon; *pyridine herbicides* such as aminopyralid, cliodinate, clopyralid, dithiopyr, fluroxypyr, haloxydine, picloram, picolinafen, pyriclor, thiazopyr and triclopyr; *pyrimidinediamine herbicides* such as iprymidam and tioclorim; *quaternary ammonium herbicides* such as cyperquat, diethamquat, difenzoquat, diquat, morfamquat and paraquat; *thiocarbamate herbicides* such as butylate, cycloate, di-allate, EPTC, esprocarb, ethiolate, isopolinate, methiobencarb, molinate, orbencarb, pebulate, prosulfocarb, pyributicarb, sulfallate, thiobencarb, tiocarbazil, tri-allate and vernolate; *thiocarbonate herbicides* such as dimexano, EXD and proxan; *thiourea herbicides* such as methiuron; *triazine herbicides* such as dipropetryn, triaziflam and trihydroxytriazine; *chlorotriazine herbicides* such as atrazine, chlorazine, cyanazine, cyprazine, eglinazine, ipazine, mesoprazine, procyazine, proglinazine, propazine, sebuthylazine, simazine, terbuthylazine and trietazine; *methoxytriazine herbicides* such as atraton, methometon, prometon, secbumeton, simeton and terbumeton; *methylthiotriazine herbicides* such as ametryn, aziprotryne, cyanatryn, desmetryn, dimethametryn, methoprotryne, prometryn, simetryn and terbutryn; *triazinone herbicides* such as ametridione, amibuzin, hexazinone, isomethiozin, metamitron and metribuzin; *triazole herbicides* such as amitrole, cafenstrole, epronaz and flupoxam; *triazolone herbicides* such as amicarbazone, bencarbazone, carfentrazone, flucarbazone, propoxycarbazone, sulfentrazone and thiencarbazone-methyl; *triazolopyrimidine*

herbicides such as cloransulam, diclosulam, florasulam, flumetsulam, metosulam, penoxsulam and pyroxsulam; *uracil herbicides* such as butafenacil, bromacil, flupropacil, isocil, lenacil and terbacil; *3-phenyluracils*; *urea herbicides* such as benzthiazuron, cumyluron, cycluron, dichloralurea, diflufenzopyr, isonoruron, isouron, methabenzthiazuron, monisouron and noruron; *phenylurea herbicides* such as anisuron, buturon, chlorbromuron, chloreturon, chlorotoluron, chloroxuron, daimuron, difenoxuron, dimefuron, diuron, fenuron, fluometuron, fluothiuron, isoproturon, linuron, methiuron, methyldymron, metobenzuron, metobromuron, metoxuron, monolinuron, monuron, neburon, parafluron, phenobenzuron, siduron, tetrafluron and thidiazuron; *pyrimidinylsulfonylurea herbicides* such as amidosulfuron, azimsulfuron, bensulfuron, chlorimuron, cyclosulfamuron, ethoxysulfuron, flazasulfuron, flucetosulfuron, flupyrsulfuron, foramsulfuron, halosulfuron, imazosulfuron, mesosulfuron, nicosulfuron, orthosulfamuron, oxasulfuron, primisulfuron, pyrazosulfuron, rimsulfuron, sulfometuron, sulfosulfuron and trifloxysulfuron; *triazinylsulfonylurea herbicides* such as chlorsulfuron, cinosulfuron, ethametsulfuron, iodosulfuron, metsulfuron, prosulfuron, thifensulfuron, triasulfuron, tribenuron, triflusulfuron and tritosulfuron; *thiadiazolylurea herbicides* such as buthiuron, ethidimuron, tebuthiuron, thiazafluron and thidiazuron; and *unclassified herbicides* such as acrolein, allyl alcohol, azafenidin, benazolin, bentazone, benzobicyclon, buthidazole, calcium cyanamide, cambendichlor, chlorfenac, chlorfenprop, chlorflurazole, chlorflurenol, cinmethylin, clomazone, CPMF, cresol, ortho-dichlorobenzene, dimepiperate, endothal, fluoromidine, fluridone, flurochloridone, flurtamone, fluthiacet, indanofan, methazole, methyl isothiocyanate, nipyraclofen, OCH, oxadiargyl, oxadiazon, oxaziclomefone, pentachlorophenol, pentoxazone, phenylmercury acetate, pinoxaden, prosulfalin, pyribenzoxim, pyriftalid, quinoclamine, rhodethanil, sulglycapin, thidiazimin, tridiphane, trimeturon, tripropindan and tritac.

Another embodiment of the present disclosure is a method for the control or prevention of fungal attack. This method comprises applying to the soil, plant, roots, foliage, seed or locus of the fungus, or to a locus in which the infestation is to be prevented (for example applying to cereal or grape plants), a fungicidal effective amount of one or more of the compounds of Formula I. The compounds are suitable for treatment of various plants at fungicidal levels, while exhibiting low phytotoxicity. The

compounds may be useful both in a protectant and/or an eradicant fashion.

The compounds have been found to have significant fungicidal effect particularly for agricultural use. Many of the compounds are particularly effective for use with agricultural crops and horticultural plants.

It will be understood by those in the art that the efficacy of the compound for the foregoing fungi establishes the general utility of the compounds as fungicides.

The compounds have broad ranges of activity against fungicidal pathogens. Exemplary pathogens may include, but are not limited to, wheat leaf blotch (*Septoria tritici*, also known as *Mycosphaerella graminicola*), apple scab (*Venturia inaequalis*), and Cercospora leaf spots of sugar beets (*Cercospora beticola*), peanuts (*Cercospora arachidicola* and *Cercosporidium personatum*) and other crops, and black sigatoka of bananas (*Mycosphaerella fujiensis*). The exact amount of the active material to be applied is dependent not only on the specific active material being applied, but also on the particular action desired, the fungal species to be controlled, and the stage of growth thereof, as well as the part of the plant or other product to be contacted with the compound. Thus, all the compounds, and formulations containing the same, may not be equally effective at similar concentrations or against the same fungal species.

The compounds are effective in use with plants in a disease-inhibiting and phytologically acceptable amount. The term "disease inhibiting and phytologically acceptable amount" refers to an amount of a compound that kills or inhibits the plant disease for which control is desired, but is not significantly toxic to the plant. This amount will generally be from about 0.1 to about 1000 ppm (parts per million), with 1 to 500 ppm being preferred. The exact concentration of compound required varies with the fungal disease to be controlled, the type of formulation employed, the method of application, the particular plant species, climate conditions, and the like. A suitable application rate is typically in the range from about 0.10 to about 4 pounds/acre (about 0.01 to 0.45 grams per square meter, g/m^2).

Any range or desired value given herein may be extended or altered without losing the effects sought, as is apparent to the skilled person for an understanding of the teachings herein.

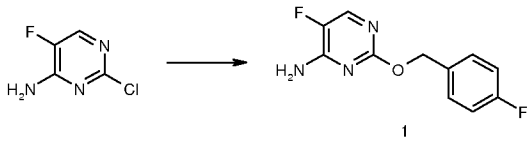
The compounds of Formula I may be made using well-known chemical

procedures. Intermediates not specifically mentioned in this disclosure are either commercially available, may be made by routes disclosed in the chemical literature, or may be readily synthesized from commercial starting materials utilizing standard procedures.

The following examples are presented to illustrate the various aspects of the compounds of the present disclosure and should not be construed as limitations to the claims.

Examples:

Preparation of 5-Fluoro-2-(4-fluorobenzyloxy)pyrmidin-4-amine (**1**):



1

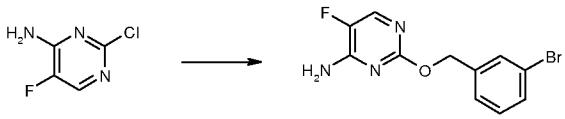
To a solution of 4-fluorobenzyl alcohol (2.56 g, 20.3 mmol) in 1,4-dioxane (20 mL) was added 60% NaH (0.813 g, 20.3 mmol) in several portions over a period of 10 min. To the magnetically stirred solution was added 2-Chloro-5-fluoropyrimidin-4-amine* (2.00 g, 13.6 mmol) and the mixture was stirred at room temperature until gas evolution subsided. The reaction mixture was then heated in a CEM Discover microwave reactor at 120 °C for 90 min. The cooled reaction mixture was partitioned between ethyl acetate and water, the organic phase was concentrated, and the product was purified by column chromatography (hexane / ethyl acetate gradient) to yield 5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-amine (1.66 g, 52% yield) as a white solid: mp 129-131 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 7.91 (d, J = 2.6 Hz, 1H), 7.42 (m, 2H), 7.03 (m, 2H), 5.27 (s, 2H), 5.05 (br s, 2H); MS (ESI) m/z 238 $(M+H)^+$.

*4-Amino-2-chloro-5-fluoropyrimidine can be purchased commercially or can be prepared through known literature methods.

1. Hayashi, T.; Kawakami, T. JP Patent 2005126389

2. Durr, G.J. *J. Med. Chem.* 1965, 8(2), 253.

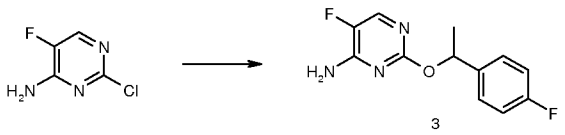
2-(3-Bromobenzyloxy)-5-fluoropyrimidin-4-ylamine (**2**):



2

To a magnetically stirred mixture of KO^{t}Bu (1.0 M in ^{t}BuOH, 1.36 ml, 1.36 mmol) was added (3-bromophenyl)methanol (0.25 g, 1.36 mmol). To the resulting solution was added 2-chloro-5-fluoropyrimidine-4-ylamine (0.10 g, 0.68 mmol) and the mixture was capped and stirred at 90 °C for 4 h. The reaction mixture was cooled to room temperature, diluted with water, and the resulting precipitate was collected by filtration. The solid was washed with water, washed with cyclohexane, and dried in the vacuum oven. A CH_2Cl_2 solution of the compound was loaded onto Biotage SCX column and eluted with CH_2Cl_2 followed by 2.0 M NH_3 in MeOH. The solvent was evaporated under reduced pressure to give the title compound (0.100 g, 49%) as an off-white solid: mp 143-145 °C; ^{1}H NMR (400MHz, DMSO-d_6) δ 7.90 (d, J = 2.5 Hz, 1H), 7.61 (s, 1H), 7.43 (d, J = 8.0 Hz, 1H), 7.36 (d, J = 7.7 Hz, 1H), 7.22 (t, J = 7.7 Hz, 1H), 5.28 (s, 2H), 5.20 (br s, 2H); GCMS (EI) *m/z* 297, 299 $(M)^+$.

Preparation of 5-Fluoro-2-[1-(4-fluorophenyl)ethoxy]pyrimidin-4-ylamine (**3**):

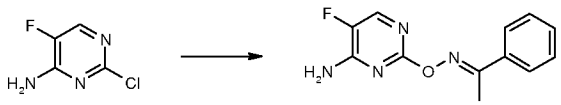


3

To a magnetically stirred mixture of 4-amino-2-chloro-5-fluoropyrimidine (11.10 g, 75.2 mmol) in 1-(4-Fluorophenyl)ethanol (11.70 g, 82.8 mmol) was added a 1.0 M solution of KO^{t}Bu in ^{t}BuOH (82.8 mL, 82.8 mmol) in one portion, and the resulting tan mixture was heated to reflux and stirred for 24 h. The solvent was removed *in vacuo* and the resulting red-orange oil was purified by flash chromatography (SiO_2, 0→10% MeOH / CH_2Cl_2) to

give 5.5 g of red-orange oil. The oil was suspended in hexanes (100 mL) and stirred for 16 h. Water (100 mL) was added to the unchanged mixture, and the biphasic system was stirred vigorously for 1 h. The resulting cream colored solid was collected by vacuum filtration, washed with warm water (55 °C, 2 x 100 mL), and dried under vacuum at 55 °C for 16 h to give 5-fluoro-2-[1-(4-fluorophenyl)ethoxy]pyrimidin-4-ylamine (3.30 g, 17.2% yield) as a white solid: mp 96-98 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 7.84 (d, J = 2.6 Hz, 1H), 7.42-7.38 (m, 2H), 7.03-6.97 (m, 2H), 5.99 (q, J = 6.6 Hz, 1H), 5.09 (br s, 2H), 1.61 (d, J = 6.6 Hz, 3H); MS (ESI) *m/z* 252 $(M+H)^+$, *m/z* 250 $(M-H)^-$.

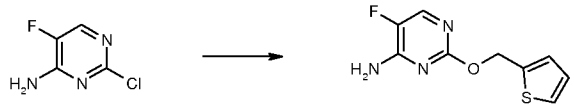
Preparation of 1-Phenyl-ethanone-O-(4-amino-5-fluoropyrimidin-2-yl)oxime (**4**):



4

To a magnetically stirred mixture of 4-amino-2-chloro-5-fluoropyrimidine (0.10 g, 0.68 mmol) and acetophenone oxime (0.092 g, 0.68 mmol) in dry DMF (3 mL) in a 5 mL Biotage Iniator microwave vessel was added NaH (0.027 g of a 60 wt. % suspension, 0.68 mmol) under a N_2 atmosphere. After gas evolution ceased, the resulting mixture was sealed with a Biotage Initiator microwave septa cap and heated to 100 °C in a Biotage Initiator microwave for 60 min. The contents were poured into a vial with water (5 mL) and CH_2Cl_2 (5 mL), and neutralized with a few drops of 2N HCl. The phases were separated and the organic extract was dried over $MgSO_4$, filtered, and evaporated under a stream of nitrogen. The crude contents were purified on silica (EtOAc/hexanes gradient) and evaporation of the product fractions gave 0.057 g (34%) of 1-Phenyl-ethanone-O-(4-amino-5-fluoro-pyrimidin-2-yl)oxime as an off-white solid: mp 163-165 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 8.04 (d, J = 2.6 Hz , 1H), 7.75 (m, 2H), 7.42 (m, 3H), 5.25 (bs, 2H), 2.51 (s, 3H); HPLC-MS (ESI) *m/z* 247 $(M+H)^+$.

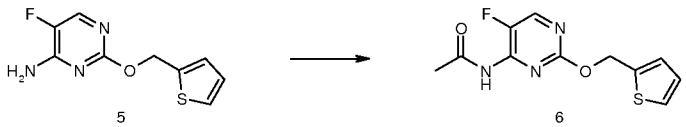
Preparation of 5-Fluoro-2-(thiophen-2-ylmethoxy)-pyrimidin-4-ylamine (**5**):



5

To a mixture of 2-chloro-5-fluoropyrimidin-4-ylamine (2.00 g, 13.5 mmol) and thiophen-2-ylmethanol (1.92 g, 16.9 mmol) with a magnetic stir bar in a 20 mL Biotage Initiator microwave reaction vessel was added KO^{t}Bu (17.0 mL of 1M in ^{t}BuOH, 17.0 mmol). The resulting mixture was sealed with a Biotage Initiator microwave septa cap and heated in a Biotage Initiator microwave to 100 °C for 30 min. The heating cycle was repeated (2x) for a total reaction time of 90 min. The contents were poured into ice-water and the pH was adjusted to neutral with 2N HCl. The resulting solid was filtered and washed with water (2x) and then 20% ether/hexanes (100 mL). The remaining solid was dried overnight at 50 °C under vacuum to give 4.17 g (68%) of 5-fluoro-2-(thiophen-2-ylmethoxy)pyrimidin-4-ylamine as a pale yellow powder: mp 92-94 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 7.92 (d, J = 2.7 Hz, 1H), 7.29 (m, 1H), 7.13 (d, J = 3.6 Hz, 1H), 6.97 (m, 1H), 5.46 (s, 2H), 5.17 (br s, 2H); MS (ESI) m/z 226 $(M+H)^+$.

Preparation of N-[5-Fluoro-2-(thiophen-2-ylmethoxy)pyrimidin-4-yl]acetamide (**6**):

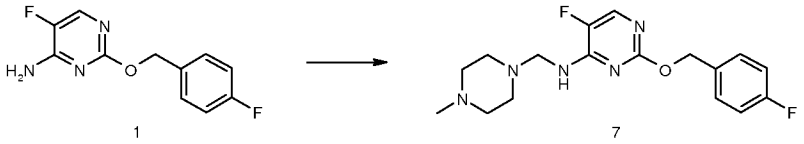


5 6

In a 2 dram screw cap vial, a solution of 5-fluoro-2-(thiophen-2-ylmethoxy)-pyrimidin-4-ylamine (0.10 g, 0.4 mmol) in CH_2Cl_2 was treated with acetyl chloride (0.032 g, 0.4 mmol,) and PS-NMM (0.42 g, 0.8 mmol), a resin-bound equivalent of *N*-methyl morpholine (NMM). The mixture was shaken at RT for 12 h. The reaction mixture was filtered and the solvent evaporated to yield 0.084 g (75%) of the title compound as white solid: mp 134-136 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 8.24 (d, J = 2.6 Hz,1H), 7.86 (bs,

1H), 7.31 (m, 1H), 7.23 (m, 1H), 7.00 (m, 1H), 5.54 (s, 2H), 2.58 (s, 3H); MS (ESI) *m/z* 268 $(M+H)^+$.

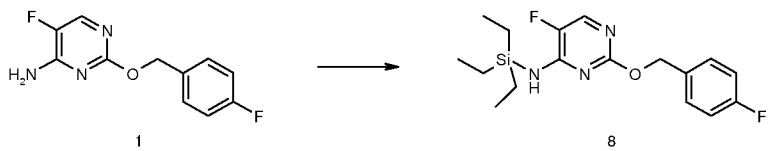
Preparation of [5-Fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]-(4-methylpiperazin-1-ylmethyl)amine (**7**):



1 7

To a magnetically stirred mixture of paraformaldehyde (0.24 g, 8 mmol) in CH_2Cl_2 (20 mL) was added *N*-methylpiperazine (0.80 g, 8.0 mmol). The suspension was stirred overnight at ambient temperature on an orbital shaker, and then 5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylamine (0.47 g, 2.0 mmol) was added. The resulting mixture was stirred over the weekend at RT. The solvent was evaporated and the crude residue was washed twice with 50% ether/petroleum ether and dried under a stream of N_2 to give 0.21 g (30%) of [5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl](4-methylpiperazin-1-ylmethyl)amine as a beige solid: mp 125-126 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 7.83 (d, J = 2.3 Hz, 1H), 7.43 (m, 2H), 7.03 (t, J = 8.5 Hz, 2H), 5.40 (bs, 1H), 5.27 (s, 2H), 4.41 (d, J = 6.8 Hz, 2H), 2.63 (bs, 4H), 2.47 (bs, 4H), 2.30 (s, 3H); HPLC-MS (ESI) *m/z* 350 $(M+H)^+$.

Preparation of [5-Fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]triethylsilanylamine (**8**):

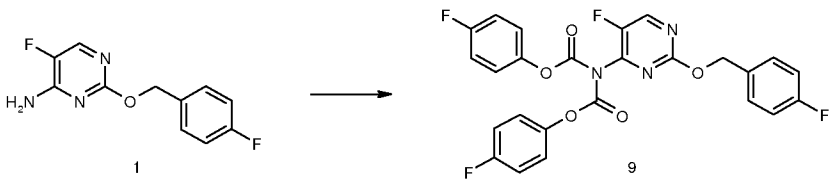


1 8

To a magnetically stirred mixture of 5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylamine (0.25 g, 1.05 mmol) in dry THF (5 mL) at 0 °C was added NaH (0.042 g of 60 wt. % suspension in mineral oil, 1.05 mmol). When bubbling ceased, triethylsilyl chloride

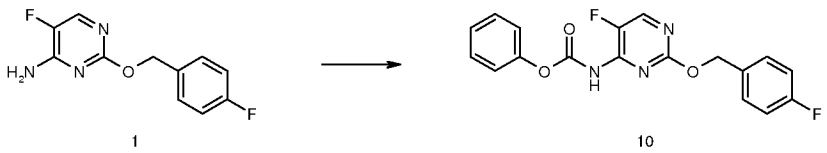
(0.158 g, 1.05 mmol) was added dropwise (neat) *via* syringe. After stirring overnight at ambient temperature, the reaction mixture was poured into ether and washed with a mixture of aqueous saturated sodium bicarbonate and brine solution. The organic layer was separated, dried over Na_2SO_4, filtered, and evaporated to give a white solid. This crude material was purified on silica by column chromatography (EtOAc / hexanes gradient) to give 0.121 g (33%) of [5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]-triethylsilanylamine as a clear yellow oil: ^{1}H NMR (300MHz, $CDCl_3$) δ 7.89 (d, J = 2.5 Hz, 1H), 7.39 (m, 2H), 7.03 (t, J = 8.6 Hz, 2H), 5.27 (s, 2H), 4.53 (s, 1H), 0.99 (m, 9H), 0.83 (m, 6H); HPLC-MS (ESI) *m/z* 352 $(M+H)^+$.

Preparation of [5-Fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]*bis*-carbamic acid 4-fluorophenyl ester (**9**):



To a magnetically stirred ice-cold mixture of 5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylamine (0.25 g, 1.05 mmol) in dry THF (5 mL) was added NaH (0.042 g of a 60 wt. % suspension in mineral oil, 1.05 mmol). After bubbling ceased, 4-fluorophenyl chloroformate (0.184 g, 1.05 mmol) was added dropwise as a solution in dry THF. After stirring one hour, the reaction was partitioned between EtOAc and brine solution. The organic extract was dried over Na_2SO_4, filtered, and evaporated. The crude material was purified on silica using a gradient of EtOAc/Hex and then MeOH/EtOAc to give 0.054 g (14%) of [5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]*bis*-carbamic acid 4-fluoro-phenyl ester as a white solid: mp 103-105 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 8.58 (d, J = 2.2 Hz, 1H), 7.43 (m, 2H), 7.08 (m, 10H), 5.40 (s, 2H); HPLC-MS (ESI) *m/z* 514 $(M+H)^+$.

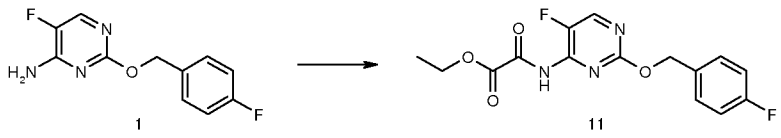
Preparation of [5-Fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]carbamic acid phenyl ester (**10**):



1 10

To a stirred mixture of 5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylamine (0.20 g, 0.84 mmol) in dry THF (3 mL) at ice-bath temperatures was added NaH (0.034 g of 60 wt. % suspension in mineral oil, 0.84 mmol). When bubbling ceased, the resulting mixture was transferred (dropwise) *via* cannula to an ice-cold, stirred mixture of diphenyl carbonate (1.8 g, 8.4 mmol) in dry THF (5 mL). The mixture was stirred overnight, poured into EtOAc, and washed with saturated aq. NH_4Cl solution followed by brine solution. The EtOAc layer was separated, dried over Na_2SO_4, filtered, and evaporated. The crude material was purified on silica gel using a gradient of EtOAc and hexanes to give 0.063 g (21%) of [5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]carbamic acid phenyl ester as a white solid: mp 129-131 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 8.28 (d, J = 2.3 Hz, 1H), 7.43 (m, 5H), 7.30-7.20 (m, 2H), 7.02 (t, J = 8.6 Hz, 2H), 5.38 (s, 2H); HPLC-MS (ESI) *m/z* 358 $(M+H)^+$.

Preparation of N-[5-Fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]oxalamic acid ethyl ester (**11**):

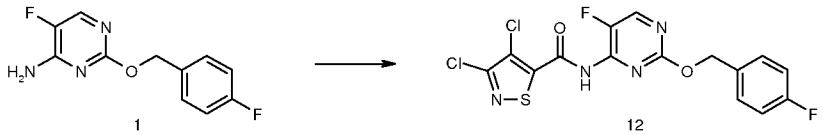


1 11

To a mixture of 5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylamine (0.235 g, 0.99 mmol), *N*-methyl morpholine on polystyrene (0.538 g, 1.24 mmol), and CH_2Cl_2 (5 mL) was added chloro-oxo-acetic acid ethyl ester (0.135 g, 0.99 mmol) and the resulting mixture was agitated on an orbital shaker for 16 h. The reaction contents were filtered

onto an acidic SPE cartridge and eluted with CH_2Cl_2. The CH_2Cl_2 filtrate was evaporated to give 0.165 g (50%) of N-[5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]oxalamic acid ethyl ester as a clear oil: ^{1}H NMR (300MHz, $CDCl_3$) δ 9.21 (bs, 1H), 8.38 (d, J = 2.3 Hz, 1H), 7.48 (m, 2H), 7.03 (t, J = 8.5 Hz, 2H), 5.40 (s, 2H), 4.48 (q, J = 7.1 Hz, 2H), 1.45 (t, J = 7.1 Hz, 3H); HPLC-MS (ESI) *m/z* 338 $(M+H)^+$.

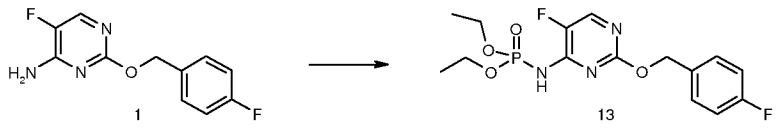
Preparation of 3,4-Dichloroisothiazole-5-carboxylic acid [5-fluoro-2-(4-fluorobenzyl-oxy)pyrimidin-4-yl]amide (**12**):



To a suspension of 3,4-dichloroisothiazole-5-carboxylic acid (0.15 g, 0.76 mmol) in oxalyl chloride (2 mL) was added a catalytic amount of dimethylformamide (2 drops) and the mixture was heated to 80 °C and stirred for 2 h. The excess oxalyl chloride was removed on the rotary evaporator. Meanwhile, 5-fluoro-2-(4-fluorobenzyloxy)-pyrimidin-4-ylamine (0.17 g, 0.68 mmol) was dissolved in THF (1 mL), treated with LiHMDS (1M in THF, 0.76 mL, 0.76 mmol) and stirred for 10 min. The freshly prepared 3,4-dichlorothiazole-5-carbonyl chloride*, dissolved in THF (1 mL), was added and the reaction was capped and stirred for 12 h. The reaction was diluted with water and the target compound was extracted with CH_2Cl_2 (3 x 5mL). The combined extracts were dried over $MgSO_4$ and then evaporated under reduced pressure. The mixture was eluted with CH_2Cl_2 through an anionic-exchange solid phase extraction column and then further purified by reverse-phase chromatography to give 3,4-dichloroisothiazole-5-carboxylic acid [5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]amide (0.035 g, 12%) as a tan solid: mp 87-90 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 11.78 (s, 1H), 8.67 (s, 1H), 7.51-7.48 (m, 2H), 7.24-7.19 (m, 2H), 5.25 (s, 2H); MS (ESI) *m/z* 417 $(M+H)^+$, 415 $(M-H)^-$.

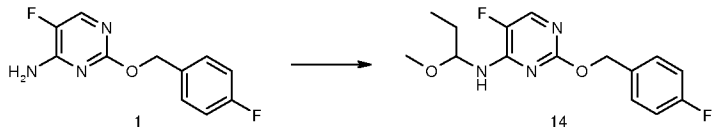
*Nagata, T.; Kogure, A.; Yonekura, N.; Hanai, R.; Kaneko, I.; Nakano, Y. JP 2007211002 A

Preparation of [5-Fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]phosphoramidic acid diethyl ester (**13**):



To a magnetically stirred solution of 5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylamine (0.10 g, 0.42 mmol) in dry THF (5 mL) under a nitrogen atmosphere was added NaH (0.017 g of a 60 wt.% suspension, 0.42 mmol) and the mixture was stirred until bubbling ceased. Diethyl chlorophosphate (0.073 g, 0.42 mmol) was added dropwise, and the mixture was stirred at ambient temperature for 1h. The reaction mixture was evaporated to dryness and the residue dissolved in EtOAc and washed saturated aqueous NH_4Cl solution. The organic layer was separated, dried over Na_2SO_4, filtered, and evaporated. The crude material was purified on silica (acetone/CH_2Cl_2 gradient) to give 0.017 g (11%) of [5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]phosphoramidic acid diethyl ester as a white solid: mp 109-111 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 8.10 (t, J = 1.8 Hz, 1H), 7.43 (m, 2H), 7.03 (t, J = 8.5 Hz, 2H), 6.18 (br s, 1H), 5.35 (s, 2H), 4.25 (m, 4H), 1.38 (t, J = 7.1 Hz, 6H); HPLC-MS (ESI) *m/z* 374 $(M+H)^+$.

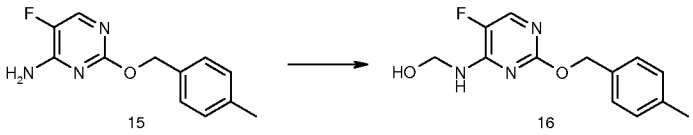
Preparation of [5-Fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl](1-methoxypropyl)amine (**14**):



To a solution of 5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylamine (0.10 g, 0.42 mmol) in propionaldehyde (2 mL) was added a catalytic amount of camphorsulfonic acid. The mixture was agitated on an orbital shaker at room temperature for 4 h and then evaporated to dryness. Methanol (2 mL) was added, and the resulting solution was

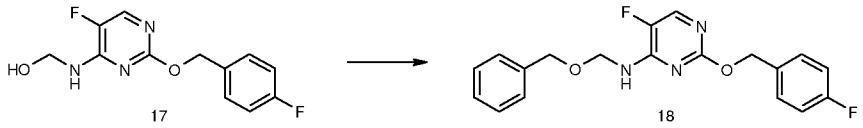
warmed to 60 °C for 1 h. After evaporation, the crude product was purified by reverse phase chromatography to yield the title compound (0.030 g, 24% yield) as a clear, colorless oil: ^{1}H NMR (300MHz, $CDCl_3$) δ 7.91 (d, J = 2.5 Hz, 1H), 7.47-7.41 (m, 2H), 7.09-7.01 (m, 2H), 5.41 (dt, J = 9.9 and 6.0 Hz, 1H), 5.30 (s, 2H), 5.2 (bd, J ~10 Hz, 1H), 3.12 (s, 3H), 1.88-1.60 (m, 2H), 0.98 (t, J = 7.1 Hz, 3H). HPLC-MS 308 (ES^-), 310 (ES^+).

Preparation of [5-Fluoro-2-(4-methylbenzyloxy)pyrimidin-4-ylamino]methanol (**16**):



To a solution of 5-fluoro-2-(4-methylbenzyloxy)pyrimidin-4-ylamine (0.10 g, 0.43 mmol) in dioxane (2 mL) was added paraformaldehyde (0.060 g, 2 mmol) and the mixture was agitated on an orbital shaker at 90 °C for 16 h, cooled, and evaporated to dryness. Purification by reverse phase chromatography afforded 0.070 g (63%) of the title compound as a white solid: mp 97-98°C; ^{1}H NMR ($CDCl_3$) δ 7.94 (d, J = 2.5Hz, 1H), 7.36 (d, J = 7.9Hz, 2H), 7.19 (d, J = 7.9Hz, 2H), 5.97 (bs, 1H), 5.33 (s, 2H), 5.04-4.99 (m, 2H), 3.39 (t, J = 8.0Hz, 1H), 2.37 (s, 3H); MS (ESI) m/z 264 $(M+H)^+$.

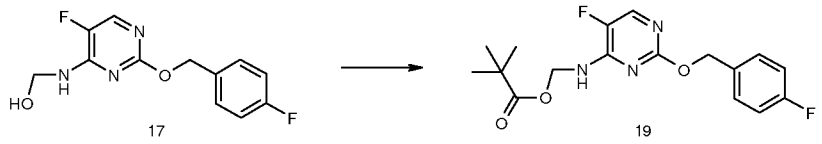
Preparation of Benzyloxymethyl[5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]amine (**18**):



To a mixture of [5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylamino]methanol (0.10 g, 3.7 mmol) in benzyl alcohol (1 mL) was added a catalytic amount of *p*-toluene sulfonic acid. After 30 min, the reaction was cooled to room temperature and partitioned between ethyl acetate and saturated sodium bicarbonate. The phases were separated and the organic portion was dried over anhydrous Na_2SO_4, filtered and evaporated to obtain the

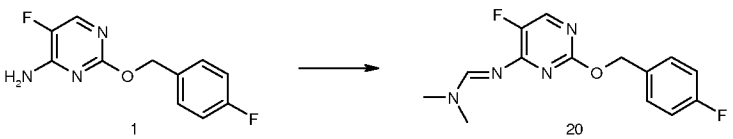
crude product. Purification by reverse phase chromatography afforded 0.094 g (70%) of the title compound as a white solid: mp 64-66 °C; ^{1}H NMR ($CDCl_3$) δ 7.93 (d, J = 2.7Hz, 1H), 7.47-7.40 (m, 2H), 7.37-7.29 (m, 5H), 7.08-7.00 (m, 2H), 5.81-5.70 (bm, 1H), 5.29 (s, 2H), 5.12 (d, J = 6.9Hz, 2H), 4.63 (s, 2H); MS (ESI) *m/z* 358 $(M+H)^+$.

Preparation of 2,2-Dimethylpropionic acid[5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylamino]methyl ester (**19**):



To a mixture of [5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylamino]methanol (0.10 g, 0.37 mmol) in pyridine (2 mL) was added trimethylacetyl chloride (0.048 g, 0.40 mmol), and the mixture was agitated on an orbital shaker at 60 °C for 4 h. The reaction mixture was cooled, evaporated to dryness, and partitioned between EtOAc and water. The organic layer was dried over Na_2SO_4, filtered, and evaporated to yield the title compound (0.078 g, 60% yield) as a white solid: mp 134-135 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 7.97 (d, J = 2.5 Hz, 1H), 7.49-7.44 (m, 2H), 7.11-7.03 (m, 2H), 6.17 (bt, $J \approx 7$ Hz, 1H), 6.17 (d, J = 7.4 Hz, 2H), 5.33 (s, 2H), 1.20 (s, 9H); HPLC-MS *m/z* 352 $(M+H)^+$.

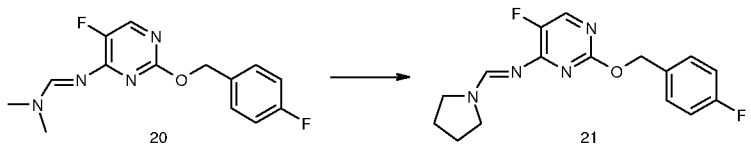
Preparation of *N*'-[5-Fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]-*N,N* dimethyl-formamidine (**20**):



To a magnetically stirred solution of 5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylamine (1.00 g, 4.2 mmol) in *N,N*-dimethylformamide (DMF, 20 mL) was added *N,N*-dimethylformamide dimethyl acetal (0.55 g, 4.6 mmol) and stirring was continued 16 h at

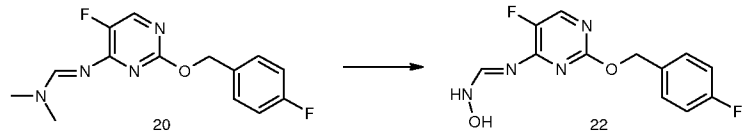
RT. The solution was poured into 100 mL of ice water, whereupon a white precipitate was produced. The mixture was cooled at 0 °C for 1 h and then filtered to produce the title compound (1.10 g, 89%) as a white solid: mp 113-115 °C; ^{1}H NMR ($CDCl_3$) δ 8.65 (s, 1H), 8.04 (d, J = 2.6 Hz, 1H), 7.46-7.40 (m, 2H), 7.07-6.98 (m, 2H), 5.30 (s, 2H), 3.17 (s, 3H), 3.16 (s, 3H); MS (ESI) m/z 292 $(M+H)^+$. Anal. Calcd for $C_{14}H_{14}F_2N_4O$: C, 57.53; H, 4.83; N, 19.17. Found: C, 57.67; H, 4.84; N, 19.09.

Preparation of [5-Fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]-[1-pyrrolidin-1-yl-methylidene]amine (**21**):



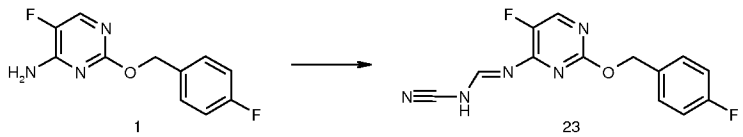
To a solution of N'-[5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]-N,N-dimethylformamidine (0.10 g, 0.36 mmol) in toluene (2 mL) was added pyrrolidine (0.051 g, 0.72 mmol) and a catalytic amount of camphorsulfonic acid. The vented vial was placed on an orbital shaker, agitated at 90 °C for 16 h, cooled, and evaporated to dryness. Purification by reverse phase chromatography afforded the title compound (0.060 g, 53% yield) as a white solid: mp 102-103 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 8.87 (s, 1H), 8.06 (d, J = 2.7 Hz, 1H), 7.49-7.42 (m, 2H), 7.09-7.01 (m, 2H), 5.32 (s, 2H), 3.73-3.62 (m, 4H), 2.07-1.96 (m, 4H); HPLC-MS (ESI) m/z 319 $(M+H)^+$.

Preparation of N-[5-Fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]-N'-hydroxy-formamidine (**22**):



To a solution of N'-[5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]-N,N-dimethyl-formamidine (0.10 g, 0.34 mmol) in EtOH (2 mL) was added hydroxylamine hydrochloride (0.047 g, 0.68 mmol) and the mixture was agitated on an orbital shaker for 1.5 h at 50 °C. The reaction mixture was cooled and evaporated to dryness. Water was added to produce a slurry which was filtered to isolate the title compound (0.090 g, 94% yield) as a white solid: mp 169-171 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 8.15 (d, J = 2.2 Hz, 1H), 8.02 (bs, 2H), 7.49-7.43 (m, 2H), 7.11-7.02 (m, 3H), 5.35 (s, 2H); HPLC-MS (ESI) *m/z* 281 $(M+H)^+$, 279 $(M-H)^-$.

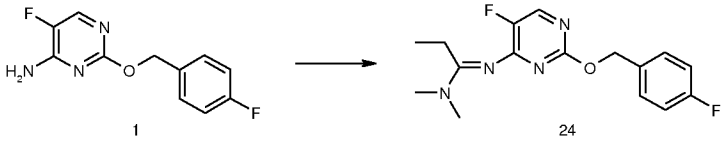
Preparation of N-[5-Fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]-N'-cyanoformamidine (**23**):



Cyanamide (8.00 g, 190.0 mmol) was stirred at reflux in triethylorthoformate (60 mL) for 2 h. The reaction was cooled to room temperature and distilled to provide ethyl-N-cyanoimidate (12.5 g, bp = 110-112 °C/45 mm Hg).* To this imidate (1 mL) was added 5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylamine (0.05 g, 0.2 mmol) and the mixture was heated at 90 °C for 4 h, cooled, diluted with chloroform, filtered, and evaporated. The crude product was purified by reverse phase chromatography to furnish 0.053 g (17%) of the title compound as an off white solid: mp 148-149 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 9.45 and 9.33 (bd, bs, $J \approx$ 10 Hz, 1H), 8.33 and 8.25 (2d, $J \approx$ 2Hz, 1H), 7.46-7.38 (m, 2H), 7.11-7.01 (m, 2H), 5.35 and 5.33 (2s, 2H); HPLC-MS (ESI) *m/z* 290 $(M+H)^+$, 288 $(M-H)^-$.

* Bridsen, Peter K., and Wang, Xiaodong, *Synthesis,* **1995**, 855-8.

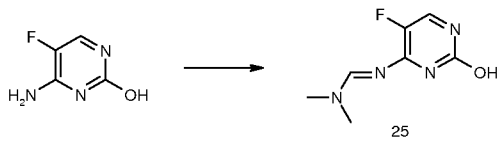
Preparation of N'-[5-Fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]-N,N-dimethyl-propionamidine (**24**):



1 24

To a solution of *N,N*-Dimethylpropionamide (0.202 g, 2.0 mmol) in $CHCl_3$ (2 mL) was added phosphorous oxychloride ($POCl_3$, 0.066 g, 0.43 mmol) and the mixture was agitated on an orbital shaker at room temperature for 1 h. Triethylamine (0.22 g, 2.2 mmol) and 5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylamine (0.10 g, 0.40 mmol) were added, and the mixture was agitated at 50 °C for 3 h, cooled to room temperature, partitioned between chloroform and water, the phases separated, and the organics evaporated under reduced pressure. Purification by reverse phase chromatography afforded the title compound (0.042 g, 31% yield) as a yellow oil: ^{1}H NMR (300MHz, $CDCl_3$) δ 8.87 (s, 1H), 8.04 (d, *J* = 2.5 Hz, 1H), 7.46-7.40 (m, 2H), 7.07-6.99 (m, 2H), 5.30 (s, 2H), 3.13 (s, 6H), 2.55 (q, *J* = 7.7 Hz, 2H), 1.15 (t, *J* = 7.7 Hz, 3H); HPLC-MS (ESI) *m/z* 321 $(M+H)^+$.

Preparation of N'-(5-Fluoro-2-hydroxy-pyrimidin-4-yl)-N,N-dimethyl-formamidine (**25**):

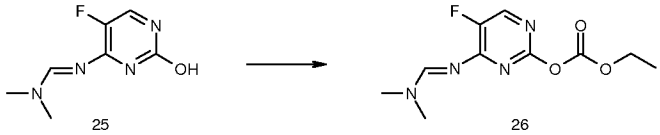


25

To a magnetically stirred solution of 4-amino-5-fluoro-pyrimidin-2-ol* (4.00 g, 31.0 mmol) in DMF (100 mL) was added *N,N*-dimethylformamide dimethyl acetal (4.00 g, 34.0 mmol). The mixture was stirred at room temperature for 72 h, diluted with diethyl ether (200 mL), and filtered. The solid product was washed with heptane to give the title compound (5.23 g, 92% yield) as a white solid: mp 240-243 °C; ^{1}H NMR (300MHz, DMSO-d_6) δ 10.7 (bs, 1H), 8.59 (s, 1H), 7.7 (d, *J* = 5.6 Hz, 1H), 3.18 (s, 3H), 3.06 (s, 3H); HPLC-MS (ESI) *m/z* 185 $(M+H)^+$, 183 $(M-H)^-$.

*4-amino-5-fluoro-pyrimidin-2-ol can be purchased commercially.

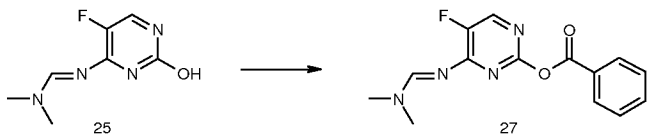
Preparation of Carbonic acid 4-(dimethylamino-methyleneamino)-5-fluoropyrimidin-2-yl ester ethyl ester (**26**):



25 26

To a solution of N'-(5-fluoro-2-hydroxy-pyrimidin-4-yl)-N,N-dimethylformamidine (0.10, 0.54 mmol) in CH_2Cl_2 (2 mL) were added triethylamine (0.20 g, 2.0 mmol) and ethyl chloroformate (0.065 g, 0.60 mmol), and the mixture was agitated on an orbital shaker at room temperature overnight. The reaction was diluted with CH_2Cl_2 and the solution was washed with water, dried over $MgSO_4$, filtered and evaporated. The crude product was purified by silica gel column chromatography (EtOAc / petroleum ether gradient) to yield 0.031 g (22%) of the title compound as a white solid: mp 124-126 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 8.67 (s, 1H), 8.19 (d, J = 2.2 Hz, 1H), 4.35 (q, J = 7.14 Hz, 2H), 3.21 (s, 6H), 1.40 (t, J = 7.14 Hz, 3H); HPLC-MS (ESI) *m/z* 258 $(M+H)^+$.

Preparation of Benzoic acid 4-(dimethylamino-methyleneamino)-5-fluoropyrimidin-2-yl ester (**27**):

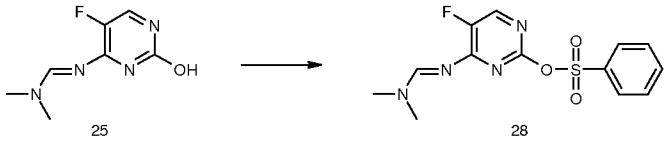


25 27

To a suspension of N'-(5-fluoro-2-hydroxypyrimidin-4-yl)-N,N-dimethylformamidine (0.10 g, 0.54 mmol) in pyridine (2 mL) was added benzoyl chloride (0.084 g, 0.60 mmol), and the mixture was agitated on an orbital shaker for 16 h at RT. The reaction mixture was partitioned between EtOAc and saturated aq $NaHCO_3$, and the organic phase was dried over solid $MgSO_4$, filtered, and evaporated to give the title compound (0.147 g 94%) as a white solid: mp 136-138 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 8.69 (s, 1H), 8.27

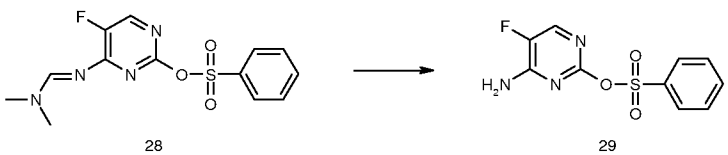
(d, J = 2.4Hz, 2H), 8.25-8.20 (m, 2H), 7.69-7.63 (m, 1H), 7.56-7.49 (m, 2H), 3.23 (s, 3H), 3.20 (s, 3H); HPLC-MS(ESI) *m/z* 289 $(M+H)^+$.

Preparation of Benzenesulfonic acid 4-(dimethylamino-methyleneamino)-5-fluoro-pyrimidin-2-yl ester (**28**):



To a suspension of N'-(5-fluoro-2-hydroxypyrimidin-4-yl)-N,N-dimethylformamidine (0.10 g, 0.54 mmol) in pyridine (2 mL) was added benzene sulfonyl chloride (0.106 g, 0.60 mmol) and the mixture was agitated on an orbital shaker for 16 h at room temperature. The reaction mixture was partitioned between EtOAc and saturated aq $NaHCO_3$, and the organic phase was dried over solid $MgSO_4$, filtered, and concentrated under reduced pressure. Purification by reverse phase chromatography (H_2O / MeCN gradient) afforded the title compound (0.089 g, 46% yield) as a white solid: mp 124-125 °C; ^1H NMR (300MHz, $CDCl_3$) δ 8.54 (s, 1H), 8.12-8.07 (m, 3H), 7.73-7.66 (m, 1H), 7.62-7.56 (m, 2H), 3.21 (s, 6H); HPLC-MS (ESI) *m/z* 325 $(M+H)^+$.

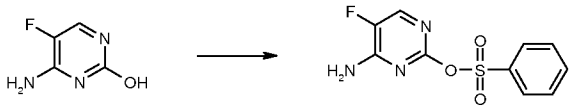
Preparation of Benzenesulfonic acid 4-amino-5-fluoropyrimidin-2-yl ester (**29**):



To a solution of HCl in doxane (3 mL of 10%) was added benzenesulfonic acid 4-(dimethylamino-methyleneamino)-5-fluoropyrimidin-2-yl ester (0.090, 0.3 mmol) and the mixture was agitated on an orbital shaker at room temperature for 1.5 h. The solvent was removed by evaporation and the residue was dissolved in a 1:1 solution of dioxane and water (2.5 mL) and treated with saturated aq $NaHCO_3$ (0.5 mL). After 16 h, the

reaction mixture was partitioned between EtOAc and water and the organic phase was dried over Na_2SO_4, filtered, and the solvent evaporated to yield the title compound (0.059 g, 79% yield) as a white solid: mp 139-141 °C; ^{1}H NMR (300MHz, DMSO- d_6) δ 8.05-8.00 (m, 3H), 7.90-7.75 (m, 3H), 7.70-7.63 (m, 2H); HPLC-MS (ESI) *m/z* 268 $(M-H)^-$, 270 $(M+H)^+$.

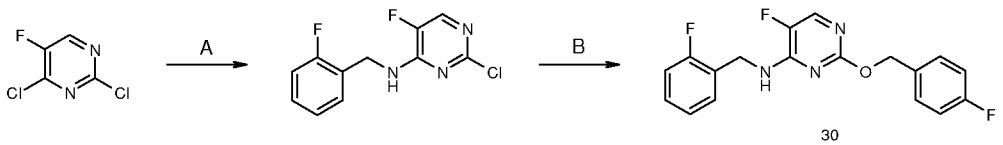
Preparation of Benzenesulfonic acid 4-amino-5-fluoropyrimidin-2-yl ester (**29**):



29

To a suspension of 5-fluorocytosine (0.177 g, 1.4 mmol) in pyridine (5 mL) was added and benzene sulfonyl chloride (0.284 g, 1.6 mmol) and the mixture was stirred at room temperature for 2 h. The reaction mixture was evaporated to dryness and the crude material purified by reverse phase chromatography to yield the title compound (0.106 g, 29% yield) as a white solid: mp 145-146 °C; ^{1}H NMR (300MHz, DMSO- d_6) δ 8.05-8.00 (m, 3H), 7.9-7.75 (m, 3H), 7.70-7.63 (m, 2H); HPLC-MS (ESI) *m/z* 270 $(M+H)^+$, 268 $(M-H)^-$.

Preparation of (2-Fluorobenzyl)-[5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl]amine (**30**):



30

A) A magnetically stirred solution of 2,4-dichloro-5-fluoropyrimidine* (0.105 g, 0.63 mmol) in 5 mL of dry THF was treated with 2-fluorobenzylamine (0.085 g, 0.68 mmol) and excess triethylamine, and the resulting mixture was heated at 80 °C for 5 h. The reaction mixture was partitioned between CH_2Cl_2 and dilute HCl, and the organic phase

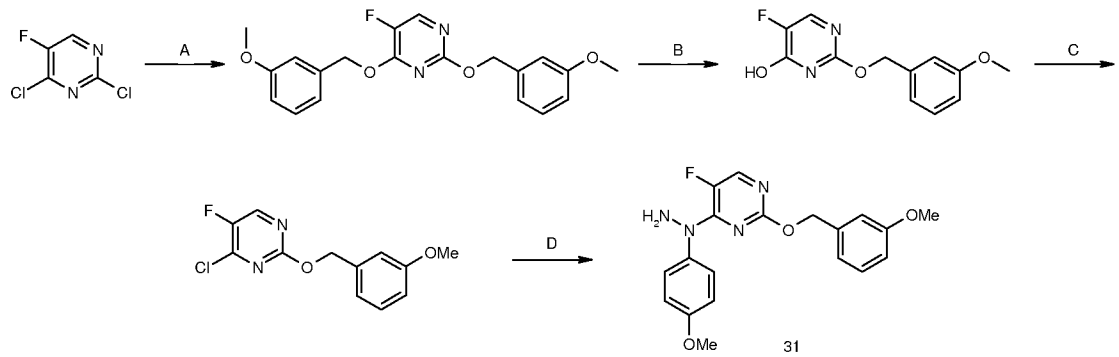
was washed with brine, dried over Na_2SO_4, and filtered. The solvent was removed under reduced pressure to yield 0.157 g (97%) of the title compound as a yellow solid: mp 117-118 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 7.90 (d, J = 2.6, 1H), 7.47 – 7.27 (m, 2H), 7.21 – 7.01 (m, 2H), 5.54 (s, 1H), 4.76 (d, J = 5.9, 2H); MS (ESI) m/z 256 $(M+H)^+$.

*2,4-Dichloro-5-fluoropyrimidine can be purchased commercially.

B) A solution of (2-chloro-5-fluoropyrimidin-4-yl)-(2-fluorobenzyl)amine* (0.103 g, 0.40 mmol) in 5 mL of dry THF was treated with 4-fluorobenzylalcohol (0.062 g, 0.49 mmol) and a 1.0 M solution of KO^{t}Bu in ^{t}BuOH (0.4 mL , 0.4 mmol). The mixture was heated at 80 °C in a sealed vial for 18 h, partitioned between CH_2Cl_2 and water, and the organic phase was washed with brine, dried over Na_2SO_4, and filtered. The solvent was removed under reduced pressure and the residue purified by flash column chromatography (SiO_2, 10→20% EtOAc / petroleum ether) to yield the title compound (0.157 g, 42%) as a white solid: mp 83-84 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 7.83 (d, J = 2.8, 1H), 7.45 – 7.27 (m, 5H), 7.15 – 6.96 (m, 5H), 5.37 (br s, 1H), 5.29 (s, 3H), 4.74 (d, J = 5.9, 3H); MS (ESI) m/z 346 $(M+H)^+$

*Singh, R.; Argade, A.; Payan, D.G.; Clough, J.; Keim, H.; Sylvain, C.; Li, H.; Bhamidipati, S., WO 2004014382 A1 20040219

Preparation of 5-fluoro-2-(3-methoxybenzyloxy)-4-(1-(4-methoxyphenyl)-hydrazinyl)pyrimidine (**31**):



A) A 1.0 M solution of KO^{t}Bu in KO^{t}Bu (66 mL, 66 mmol) was added to a mixture of 2,4-dichloro-5-fluoropyrimidine (5.04 g, 30.1 mmol) and 3-methoxybenzyl alcohol (7.8 mL, 62.8 mmol) in a 250 mL round bottom flask. A significant exotherm was observed and the resulting mixture was stirred at room temperature for 2 h. The reaction was diluted with EtOAc (100 mL) and washed with brine (50 mL x 2). The organic layer was dried over $MgSO_4$, filtered, and concentrated under reduced pressure. Crystallization from hot EtOH provided a material which was collected on a fritted funnel and rinsed with ice-cold EtOH to provide the title compound (7.94 g, 71%) as a white solid: mp 81-83 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.10 (d, J = 2.3 Hz, 1H), 7.29 (m, 2H), 7.02 (m, 4H), 6.87 (dt, J = 2.2, 7.8 Hz, 2H), 5.44 (s, 2H), 5.35 (s, 2H), 3.82 (s, 3H), 3.82 (s, 3H); MS (ESI) *m/z* 371 $(M+H)^+$.

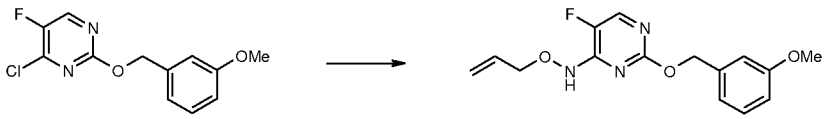
B) A solution of 2.0 N KOH in water (85 mL, 170 mmol) was added to a mixture of 5-fluoro-2,4-bis(3-methoxybenzyloxy)pyrimidine (7.9 g, 21.3 mmol) and EtOH (21 mL) in a 500 mL round bottom flask. A reflux condenser was attached, and the reaction was heated at 95 °C for 16 h. After cooling to room temperature, the reaction mixture was washed with Et_2O (2 x 50 mL), and then acidified with 1 N HCl to pH 3. The resulting solid material was collected on a fritted funnel. Subsequent extraction with excess EtOAC, and concentration under reduced pressure provided the title compound (3.63 g, 68%) as a white solid: mp 136-139; ^{1}H NMR (300 MHz, DMSO-d_6) δ 12.97 (br s, 1H), 7.87 (d, J = 3.7 Hz, 1H), 7.30 (t, J = 7.9 Hz, 1H), 7.00 (m, 2H), 6.91 (dd, J = 1.8, 8.0 Hz, 1H), 5.29 (s, 2H), 3.74 (s, 3H); MS (ESI) *m/z* 251 $(M+H)^+$.

C) An oven-dried 100 mL Schlenk flask was charged with 5-fluoro-2-(3-methoxybenzyloxy)pyrimidin-4-ol (3.63 g, 14.5 mmol) and *N,N*-dimethylaniline (3.7 mL, 29.2 mL). Phosphorous oxychloride ($POCl_3$, 40 mL, 429 mmol) was added, and resulting solution was heated to 95 °C under nitrogen. After 2 h, the reaction was cooled to room temperature and concentrated to constant volume under reduced pressure at 50 °C. The remaining residue was diluted with Et_2O (50 mL) and washed with 1 N HCl (2 x 50 mL). Concentration at reduced pressure provided a solid, which was washed with water and

collected by vacuum filtration. The title compound (4.09 g, 105%) was isolated as a white solid: mp 96-100 °C; ^{1}H NMR (300 MHz, DMSO-d_6) δ 8.81 (d, J = 0.8 Hz, 1H), 7.30 (t, J = 8.1 Hz, 1H), 7.02 (m, 2H), 6.91 (dd, J = 2.3, 8.3 Hz, 1H), 5.34 (s, 2H), 3.75 (s, 3H); MS (ESI) m/z 269 $(M+H)^+$.

D) To a mixture of 4-chloro-2-(3-methoxybenzyl)-5-fluoropyrimidine (0.153 g, 0.568 mmol) and 4-methoxyphenyl-hydrazine hydrochloride (0.324 g, 1.85 mmol) in ethanol (5 mL) was added triethylamine (0.272, 2.69 mmol) and the mixture was heated to 50 °C for 16 h. The reaction was cooled to room temperature and diluted with Et_2O (50 mL). The Et_2O solution was washed with water (2 x 50 mL), dried over $MgSO_4$, filtered, and concentrated. The residue was triturated with Et_2O to obtain 5-fluoro-2-(3-methoxy-benzyloxy)-4-(1-(4-methoxyphenyl)hydrazinyl)pyrimidine (0.113 g, 54% yield) as a white solid: mp 121-123.5 °C; ^{1}H NMR (300 MHz, DMSO-d_6) δ 8.02 (d, J = 5.4 Hz, 1H), 7.28 (t, J =8.1 Hz, 1H), 7.22 (d, J = 8.5 Hz, 2H), 6.99-6.93 (m, 2H), 6.93-6.85 (m, 3H), 5.25 (s, 2H), 3.75 (s, 3H), 3.74 (s, 3H); MS (ESI) m/z 371 $(M+H)^+$, 354 $(M-NH_2)^-$.

Preparation of O-allyl-N-(5-fluoro-2-(3-methoxybenzyloxy)pyrimidin-4-yl)hydroxyl-amine (**32**):

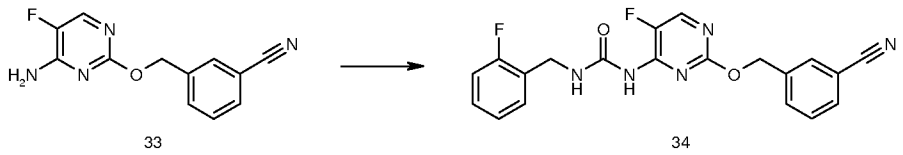


32

To a mixture of 4-chloro-2-(3-methoxybenzyl)-5-fluoropyrimidine (0.151 g, 0.558 mmol) and *O*-allyl hydroxylamine hydrochloride (0.201 g, 1.83 mmol) in 5:1 MeOH:CH_3CN (5 mL) was added triethylamine (0.273 g, 2.70 mmol) and the mixture was heated at 50 °C for18 h. The reaction was cooled to room temperature and diluted with Et_2O (50 mL). The organic solution was washed with water (2 x 50 mL), dried over $MgSO_4$, filtered, and concentrated. Purification by flash chromatography (SiO_2, 17%-->50% EtOAc /

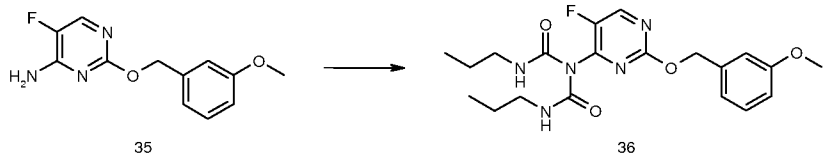
hexane) afforded O-allyl-N-(5-fluoro-2-(3-methoxybenzyloxy)-pyrimidin-4-yl)hydroxylamine (0.113 g, 66% yield) as a colorless oil: ^{1}H NMR (300 MHz, DMSO-d_6) δ 10.94 (broad singlet, 1H), 7.94 (broad singlet, 1H), 7.28 (t, J = 8.0 Hz, 1H), 6.95-7.03 (m, 2H), 6.88 (dd, J = 2.5, 7.9 Hz, 1H), 5.97 (tdd, J = 5.8, 10.6, 17.0 Hz, 1H), 5.32 (dd, J = 1.5, 17.4 Hz, 1H), 5.24 (s, 2H), 5.22 (dd, J = 1.2, 10.6 Hz, 1H), 4.39 (d, J = 6.0 Hz, 2H), 3.74 (s, 3H); MS (ESI) m/z 306 $(M+H)^+$, 304 $(M-H)^-$.

Preparation of 1-[2-(3-Cyanobenzyloxy)-5-fluoropyrimidin-4-yl]-3-(2-fluorobenzyl)urea (**34**):



To a magnetically stirred mixture of 3-(4-amino-5-fluoropyrimidin-2-yloxymethyl)-benzonitrile (0.075 g, 0.31 mmol) and 2-fluorobenzylisocyanate (0.59 mL, 0.46 mmol) in dry DMF (1.5 mL) was added LiHMDS (1.0 M in THF, 0.31 ml, 0.30 mmol). The vial was capped and the mixture stirred at room temperature for 8 h. Saturated aq. NH_4Cl (3 ml) was added and the mixture was stirred for 4 h. The heterogeneous mixture was filtered, and the solid was washed with hot water, washed with E_2O, and then dried under vacuum to give the title compound (0.075 g, 62%) as a white solid: mp 177-178 °C; ^{1}H NMR (400MHz, DMSO-d_6) δ 10.04 (s, 1H), 8.90 (t, J = 5.7 Hz, 1H), 8.37 (d, J = 2.8 Hz, 1H), 7.85 (br s, 1H), 7.80 (d, J = 7.5 Hz, 1H), 7.74 (d, J = 8.0 Hz, 1H), 7.60 (t, J = 7.8 Hz, 1H), 7.42-7.38 (m,1H), 7.35-7.29 (m, 1H), 7.20-7.14 (m, 2H), 5.33 (s, 2H), 4.49 (d, J = 5.8 Hz, 2H); HPLC-MS (ESI) m/z 396.3 $(M+H)^+$, 394.3 $(M-H)^-$.

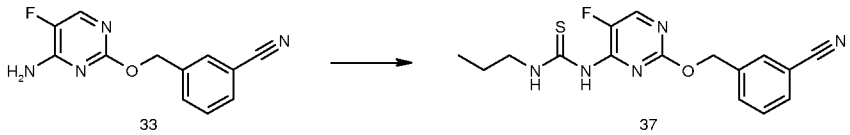
Preparation of 1-[5-Fluoro-2-(3-methoxybenzyloxy)pyrimidin-4-yl](3'-propyl carbamoyl)-3-propyl-urea (**36**)



35 36

To a magnetically stirred mixture of 5-fluoro-2-(3-methoxybenzyloxy)pyrimidin-4-ylamine (0.075 g, 0.30 mmol) and propylisocyanate (0.057 mL, 0.60 mmol) in dry DMF (1.5 mL) was added LiHMDS (1.0 M in THF, 0.60 ml, 0.60 mmol). The vial was capped and the reaction was stirred at room temperature for 8 h. The solvent was evaporated under reduced pressure and the crude material was purified by reverse-phase chromatography to give the title compound (0.043 g, 10%) as a tan solid: mp 75-78 °C; ^{1}H NMR (400MHz, DMSO-d_6) δ 12.34 (s, 1H), 8.49 (s, 1H), 7.89 (s, 1H), 7.29 (t, J = 7.8 Hz, 1H), 7.05-7.01 (m, 2H), 6.90 (dd, J = 6.9Hz, J = 2.5 Hz, 1H), 5.30 (s, 2H), 3.75 (s, 3H), 3.74-3.68 (m, 2H), 3.15-3.10 (m, 2H), 1.58-1.44 (m, 4H), 0.89-0.85 (m, 6H); HPLC-MS (ESI) *m/z* 420.4 $(M+H)^+$, 418.4 $(M-H)^-$.

Preparation of 1-[2-(3-Cyanobenzyloxy)-5-fluoropyrimidin-4-yl]-3-propylthiourea (**37**)

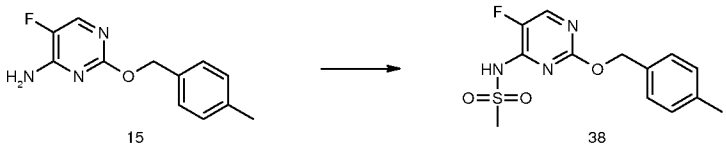


33 37

To a magnetically stirred mixture of 3-(4-amino-5-fluoropyrimidin-2-yloxymethyl)-benzonitrile (0.075 g, 0.31 mmol) and propylisothiocyanate (0.047 mL, 0.46 mmol) in dry DMF (1.5 mL) was added LiHMDS (1.0 M in THF, 0.31 ml, 0.31 mmol). The vial was capped and reaction was stirred for 8 h. Saturated aq NH_4Cl (3 ml) was added to the vial and the mixture was stirred for 4 h. The heterogeneous mixture was filtered and the solid was washed with hot water, washed with hexanes, and dried under vacuum to give the title compound (0.055 g, 52%) as a pale-yellow solid: mp 163-165 °C; ^{1}H NMR (400MHz, DMSO-d_6) δ 10.77 (s, 1H), 10.38 (s, 1H), 8.47 (d, J = 2.7 Hz, 1H), 7.90 (s, 1H), 7.82 (d, J = 7.5 Hz, 1H), 7.78 (d, J = 8.1 Hz, 1H), 7.62 (t,

J = 7.7 Hz, 1 H), 5.42 (s, 2H), 3.55 (dd, *J* = 12.4, 6.8 Hz, 2H), 1.65-1.59 (m, 2H), 0.95 (t, *J* = 7.5 Hz, 3H): HPLC-MS (ESI) *m/z* 346.3 $(M+H)^+$, 344.2 $(M-H)^-$.

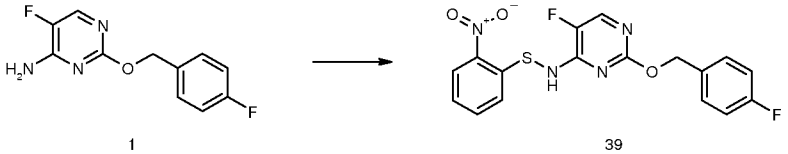
Preparation of N-[5-Fluoro-2-(4-methylbenzyloxy)pyrimidin-4-yl]methanesulfonamide (**38**):



15 38

To a solution of 5-fluoro-2-(4-methylbenzyloxy)pyrimidin-4-ylamine (0.100 g, 0.43 mmol) in anhydrous THF (4 mL) was added LiHMDS (1.07 mL of 1.0M, 1.07 mmol) dropwise at room temperature, and the resulting orange solution was stirred for 20 min. Methanesulfonyl chloride (0.108 g, 0.94 mmol) was added in one portion and the turbid, light orange solution was stirred for 60 min. The reaction was quenched with brine (5 mL) and the THF phase was separated. The aq. phase was extracted w/ EtOAc (5 mL), and the organics were combined, dried over Na_2SO_4, filtered, and concentrated to an orange gummy residue. The residue was purified by flash chromatography (SiO_2, 0→100% EtOac / hexanes) to give 0.034 g (26%) of the title compound as a white solid: mp 145-148 °C; ^1H NMR (400MHz, $CDCl_3$) δ 8.19 (s, 1H), 7.33 (d, *J* = 7.9 Hz, 2H), 7.17 (d, *J* = 7.9 Hz, 2H), 5.35 (s, 2H), 3.37 (s, 3H), 2.35 (s, 3H); HPLC-MS (ESI) *m/z* 312 $(M+H)^+$, 310 $(M-H)^-$.

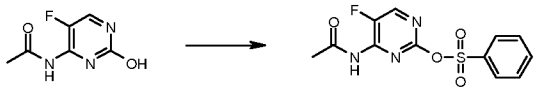
Preparation of N-[5-Fluoro-2-(4-fluorobenzyloxy)-pyrimidin-4-yl]-S-(2-nitrophenyl)-thiohydroxylamine (**39**):



1 39

To a solution of 5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylamine (0.05 g, 0.2mmol) and a 1.0 M solution of KO^{t}Bu in ^{t}BuOH (1.0 mL, 1.0 mmol) was added nitrobenzene-sulfenyl chloride (0.044 g, 0.23 mmol) in one portion, and the resulting brown solution was stirred for 60 min. The reaction was diluted with water (2 mL) and neturalized to pH 7 with 1N HCl. The aq. phase was extracted with EtOAc (5 mL), and the organics were combined, dried over Na_2SO_4, filtered, and concentrated. The crude material was purified by reverse phase chromatography to yield the title compound (0.020 g, 26%) as a yellow solid: mp 184 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 8.36 (d, J = 7.25 Hz, 1H), 8.09 (d, J = 2.3 Hz, 1H), 7.59 (m, 1H), 7.36 (m 2H), 7.29 (m, 2H), 6.88 (m, 2H), 6.23 (bs, 1H), 5.19 (s, 2H); HPLC-MS (ESI) *m/z* 391(M+H)$^+$, 389 (M-H)$^-$.

Preparation of benzenesulfonic acid 4-acetylamino-5-fluoro-pyrimidin-2-yl ester (**40**):



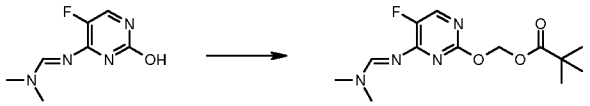
40

N-(5-fluoro-2-hydroxypyrimidin-4-yl)-acetamide* (200 mg, 1.17 mmol) was suspended in pyridine (5 mL) and stirred at ambient temperature. To the stirred suspension was added benzenesulfonyl chloride (226 mg, 1.29 mmol) and agitation was continued for 16 hours. The solvent was evaporated under a stream of nitrogen and the residue was suspended in dichloromethane (2-3 mL), placed directly onto a silica gel column, and eluted with ethyl acetate in petroleum ether (0-50% gradient) to isolate 180 mg, 0.58mmol (49%) of the title compound as a white solid: mp 142-143 °C; ^{1}H NMR (DMSO-d_6) δ 10.96 (s, 1H), 8.67 (d, J = 2.6 Hz, 1H), 8.12-8.06 (m, 2H), 7.86-7.79 (m, 1H), 7.73-7.65 (m, 2H), 2.98 (s, 3H); HPLC-MS (ESI) *m/z* 312 (M+H)$^+$, 310 (M-H)$^-$.

* N-(5-fluoro-2-hydroxypyrimidin-4-yl)-acetamide can be prepared through known literature methods.

1. Duschinsky, R., Fells, E., Hoffer, M. US Patent 3,309,359

Preparation of 2,2-dimethylpropionic acid 4-(dimethylamino-methyleneamino)-5-fluoro-pyrimidin-2-yloxymethyl ester (**41**):



25 41

N'-(5-fluoro-2-hydroxypyrimidin-4-yl)-N,N-dimethylformamidine (100 mg, 0.54 mmol), cesium carbonate (196 mg, 0.60 mmol), and chloromethyl pivalate (90 mg, 0.6 mmol) were shaken together in DMF (3 mL) at ambient temperature for 16 hours. The reaction mixture was partitioned between ethyl acetate and water, dried over magnesium sulfate, filtered and evaporated to yield a colorless oil which was treated with diethyl ether (3-4 mL) to produce a solid. The solid was removed and the ether solution was placed onto a silica gel column and eluted with ethyl acetate in petroleum ether (0-50% gradient) to isolate 14 mg, 0.05 mmol (9%) of the title compound as a white solid: mp 86-88 °C; ^{1}H NMR ($CDCl_3$) δ 8.73 (s, 1H), 8.06 (d, J = 2.6 Hz, 1H), 6.04 (s, 2H), 3.20 (s, 3H), 3.18 (s, 3H), 1.16 (s, 9H); HPLC-MS (ESI) m/z 299 $(M+H)^+$.

Preparation of N'-(5-fluoro-2-methoxymethoxypyrimidin-4-yl)-N,N-dimethyl-formamidine (**42**):

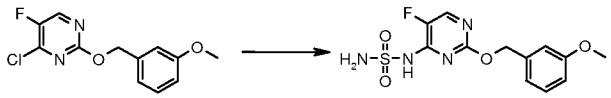


25 42

N'-(5-fluoro-2-hydroxypyrimidin-4-yl)-N,N-dimethylformamidine (100 mg, 0.54 mmol), cesium carbonate (196 mg, 0.60 mmol), and bromomethyl methyl ether (75 mg, 0.6 mmol) were shaken together in DMF (3 mL) at ambient temperature for 4 hours. The reaction mixture was partitioned between ethyl acetate and water, dried over magnesium sulfate, filtered and evaporated to yield a colorless oil which was placed directly onto a silica gel column and eluted with ethyl acetate in petroleum ether (0-80% gradient) to

isolate 23mg, 0.1 mmol (19%) of the title compound as a colorless oil: ^{1}H NMR ($CDCl_3$) δ 8.66 (s, 1H), 8.05 (d, J = 2.6Hz, 1H), 5.46 (s, 2H), 3.53 (s, 3H), 3.17 (s, 3H), 3.16 (s, 3H); HPLC-MS (ESI) *m/z* 229 $(M+H)^+$.

Preparation of [5-Fluoro-2-(3-methoxybenzyloxy)pyrimidin-4-yl]sulfamide (**43**):



43

To a magnetically stirred solution of 4-chloro-5-fluoro-2-(3-methoxybenzyloxy) pyrimidine* (1.3g, 4.84 mmol) in dry DMF (5mL) was added a pre-mixed suspension of 60% NaH (0.45 g, 10.65 mmol) and sulfamide (0.93g, 9.68 mmol) in dry DMF (5mL). The resulting off-white suspension was stirred at room temperature for 72hrs. The orange suspension was then heated to 50°C for 48 hours and cooled to room temperature. The reaction mixture was partitioned between ethyl acetate and brine solution. The organic extract was dried over Na_2SO_4, filtered, and evaporated. The crude material was purified by column chromatography on normal phase silica using a gradient of EtOAc/Hex and reverse phase using a gradient of H_2O/ACN to yield [5-Fluoro-2-(3-methoxybenzyloxy) pyrimidin-4-yl]sulfamide (115 mg, 7.2% yield) as a white solid: mp 126-130 °C; ^{1}H NMR (300MHz, CD_3OD) δ 8.01 (d, J = 3.63 Hz, 1H), 7.25 (m, 1H), 7.01 (m, 2H), 6.88 (m, 1H), 5.37 (s, 2H), 3.78 (s, 3H); MS (ESI) *m/z* 326.9 $(M-H)^-$.

* The 4-chloro-5-fluoro-2-(3-methoxybenzyloxy) pyrimidine intermediate was prepared as described in the synthesis of **31**.

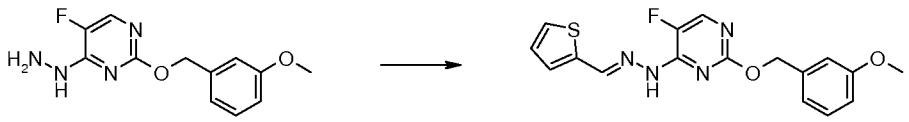
Preparation of 5-fluoro-4-hydrazinyl-2-(3-methoxybenzyloxy)pyrimidine (**44**):



44

A 125 mL Erlenmeyer flask was charged with 4-chloro-5-fluoro-2-(3-methoxybenzyl-oxy)pyrimidine (1.50 g, 5.58 mmol) and EtOH (50 mL). Hydrazine monohydrate (900 μL, 18.5 mmol) was added, and the resulting mixture was allowed to stir at room temperature. After 22 h, the reaction was transferred to a 500 mL Erlenmeyer flask and diluted with water (200 mL), whereupon a white solid began to precipitate from solution. After stirring for 7 h, solid product was collected in a fritted funnel and rinsed with excess water. After drying on the frit, the title compound was obtained (1.23 g, 83%) as a white solid: mp 103-106 °C; ^{1}H NMR (300 MHz, DMSO-d_6) δ 8.92 (bs, 1H), 7.86 (d, J = 3.6 Hz, 1H), 7.27 (t, J = 8.1 Hz, 1H), 6.94 – 7.01 (m, 2H), 6.87 (dd, J = 2.4, 7.9 Hz, 1H), 5.24 (s, 2H), 4.46 (bs, 2H), 3.74 (s, 3H); MS (ESI) *m/z* 265.2 $(M+H)^+$, 263.2 $(M-H)^-$.

Preparation of (E)-5-Fluoro-2-(3-methoxybenzyloxy)-4-(2-(thiophen-2-ylmethylene)-hydrazinyl)pyrimidine(**45**):



44 45

A 20 mL vial was charged with 5-fluoro-4-hydrazinyl-2-(3-methoxybenzyloxy)-pyrimidine (74.7 mg, 0.283 mmol), EtOH (2 mL), thiophene-2-carbaldehyde (26 μL, 0.284 mmol) and 1 M HCl in Et_2O (14 μL, 0.014 mmol) and heated at 50 °C on shaker. After 90 minutes, the reaction was cooled to room temperature concentrated on high vacuum to provide the title compound (77.8 mg, 77%) as a yellow solid: mp 136-139 °C; ^{1}H NMR (300 MHz, DMSO-d_6) δ 11.46 (bs, 1H), 8.50 (bs, 1H), 8.16 (d, J = 3.6 Hz, 1H), 7.64 (d, *J* = 5.0 Hz, 1H), 7.41 (d, *J* = 3.4 Hz, 1H), 7.28 (t, *J* = 8.0 Hz, 1H), 7.12 (dd, *J* = 3.8, 4.8 Hz, 1H), 7.04 (m, 2H), 6.88 (dd, *J* = 2.4, 8.3 Hz, 1H), 5.27 (s, 2H), 3.73 (s, 3H); MS (ESI) *m/z* 359.2 $(M+H)^+$, 357.2 $(M-H)^-$.

Preparation of 2-(benzyloxy)-4-[(dimethyl-λ^4-sulfanylidene)amino]-5-fluoropyrimidine (**47**):

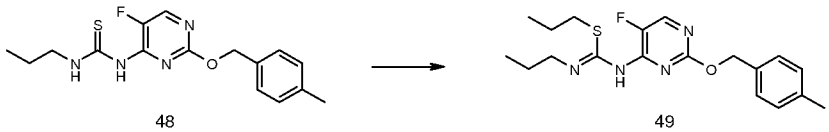


46 47

A 10 mL oven-dried Schlenk flask was charged with 2-(benzyloxy)-5-fluoropyrimidin-4-amine (101 mg, 0.462 mmol), CH_2Cl_2 (2 mL), and dimethylsulfide (75.0 µL, 1.02 mmol) and was cooled to 0 °C in an ice bath. *N*-Chlorosuccinimide (122 mg, 0.914 mmol) was added and the resulting mixture was allowed to stir at 0 °C for 45 minutes, and then at room temperature for 30 minutes. A solution of NaOMe in MeOH (25% , 360 µL, 1.35 mmol) was added. After 20 minutes, the reaction was quenched with water (3 mL) and allowed to stir for 1 hour. The crude reaction mixture was then diluted with CH_2Cl_2 and washed with water (50 mL x2), dried over anhydrous Na_2SO_4, filtered, and concentrated by rotary evaporation and then on high vacuum to give the title compound (120 mg, 93%) as an off white solid: mp 125-129 °C; ^{1}H NMR (300 MHz, DMSO-d_6): δ 7.70 (d, J = 3.9 Hz, 1H), 7.25-7.44 (m, 5H), 5.21 (s, 2H), 2.75 (s, 6H); MS (ESI) m/z 281.1 $(M+H)^+$.

*Yamamoto, Y.; Yamamoto, H. *J. Am. Chem. Soc.* **2004**, *126*, 4128-4129.

Preparation of 1-[5-fluoro-2-(4-methylbenzyloxy)-pyrimidin-4-yl]-2,3-dipropyl-isothiourea (**49**)

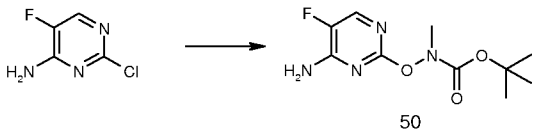


48 49

To a magnetically stirred solution of 1-[5-Fluoro-2-(4-methyl-benzyloxy)-pyrimidin-4-yl]-3-propyl-thiourea (0.50 g, 1.40 mmol) in CH_3CN (4 mL), was added potassium carbonate (0.20 g, 1.40 mmol) at room temperature and the mixture was stirred for 20 min. *N*-Propylbromide (0.19 g, 1.40 mmol) was added at room temperature and the resulting mixture stirred for 15 h. The reaction mixture was diluted with H_2O and extracted with CH_2Cl_2 (3 x 20 mL). The combined organic

layers were dried over Na_2SO_4, filtered, and the solvent evaporated. The crude mixture was purified on silica (EtOAc/hexanes gradient) and evaporation of the product fractions gave 0.335 g (63 %) of 1-[5-Fluoro-2-(4-methyl-benzyloxy)-pyrimidin-4-yl]-2,3-dipropyl-isothiourea as a pale yellow viscous liquid: ^{1}H NMR (300MHz, $CDCl_3$) δ 10.56 (bs, 1H), 8.09 (d, J = 2.6 Hz, 1H), 7.31 (m, 2H), 7.24 (m, 2H), 5.28 (s, 2H), 3.28 (dd, J = 13.6, 6.5 Hz, 4H), 2.36 (s, 3H), 1.62 (m, 4H), 1.0 (t, J = 7.4 Hz, 4H); HPLC-MS (ESI) m/z 377(M+H)$^+$.

Preparation of O-(4-amino-5-fluoropyrimidin-2-yl)-*t*-butyl *N*-methyl-*N*-hydroxycarbamate (**50**)



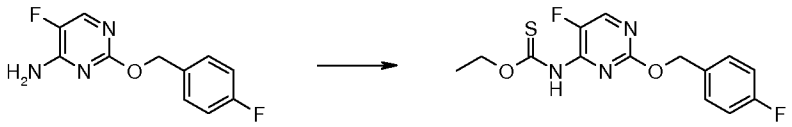
50

In a 2 dram screw cap vial, a solution of 4-amino-2-chloro-5-fluoropyrimidine (0.1 g, 0.68 mmol) and *t*-butyl *N*-methyl-*N*-hydroxycarbamate * (0.11 g, 0.75 mmol) was treated with a 1.0 M solution of KO^{t}Bu in ^{t}BuOH (1.0 mL, 1.0 mmol) in one portion, and the resulting yellow solution was heated at 100 °C and shaken for 24 h. The reaction mixture was cooled, extracted with EtOAC (3 x 5 mL), and the solvent evaporated. The crude mixture was purified via reverse phase chromatography to yield 0.10 g (56.9%) of the title compound as yellow solid: mp 123-125 °C; ^{1}H NMR (300MHz, $CDCl_3$) δ 7.96 (d, J = 2.3 Hz,1H), 5.26 (bs, 2H), 3.32 (s, 3H), 1.43 (s, 9H); MS (ESI) m/z 259 (M+H)$^+$.

* *t*-butyl *N*-methyl-*N*-hydroxycarbamate can be prepared through known literature methods:

1. Carrasco, M. R.; Brown, R. T.; Serafimova, I. M.; Silva O. *J. Org. Chem.*, **2003**, 68 (1), 195.

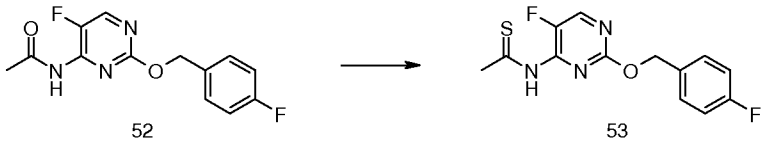
Preparation of *O*-ethyl 5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylcarbamothioate (**51**):



1 51

5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-amine (300 mg, 1.26 mmol) was stirred in chloroform (25 mL) and water (12 mL). Sodium bicarbonate (870 mg, 10.12 mmol) was added followed by dropwise addition of thiophosgene (218 mg, 1.9 mmol). The reaction mixture was stirred at room temperature for 16 hours, then diluted with chloroform (20 mL) and the phases were separated. The organic extract was dried over sodium sulfate, filtered, and concentrated by rotary evaporation to 1/3 volume. To this chloroform solution of crude isothiocyanate was added abs. ethanol (10 mL) and the mixture was heated in a sealed tube for 1h. The reaction mixture was cooled to room temperature, concentrated and purified by flash chromatography on silica, to give 45 mg (11%) of *O*-ethyl 5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-ylcarbamothioate as a pale yellow solid: mp 109-119 °C; ^{1}H NMR ($CDCl_3$) δ 8.30 (bs, 2H), 7.44 (m, 2H), 7.06 (m, 2H), 5.36 (s, 2H), 4.66 (q, J = 6 Hz, 2H), 1.45 (t, J = 6 Hz, 3H); HPLC-MS (ESI): *m/z* 326 (ES^+).

Preparation of *N*-(5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl)ethanethioamide (**53**):



52 53

N-(5-fluoro-2-(4-fluorobenzyloxy)pyrimidin-4-yl)acetamide (50 mg, 0.42 mmol) was stirred in a Biotage Initiator® microwave vessel with 1,2-dichloroethane (3 mL) and Lawesson's reagent (170 mg, 0.42 mmol). The vessel was heated in a Biotage Initiator® microwave to 100 °C for 5 minutes then cooled room temperature, filtered, and diluted with CH_2Cl_2. The reaction mixture was then washed brine, and the layers were separated. The organic extract was dried onto silica and purified by flash chromatography. The product-containing fractions were then evaporated to dryness and

purified again by reverse-phase HPLC to give 4 mg of *N*-(5-fluoro-2-(4-fluorobenzyl-oxy)pyrimidin-4-yl)ethanethioamide (4%) as a yellow glass: ^{1}H NMR ($CDCl_3$) δ 9.34 (b, 1H), 8.29 (d, J = 3 Hz, 1H), 7.41 (m, 2H), 7.06 (m, 2H), 5.33 (s, 2H), 3.13 (s, 3H); HPLC-MS (ESI): *m/z* 294 (ES^-).

Biological testing Protocols:

1. Evaluation of Fungicidal Activity: Leaf Blotch of Wheat (*Mycosphaerella graminicola;* anamorph: *Septoria tritici;* Bayer code SEPTTR):

Wheat plants (variety Yuma) were grown from seed in a greenhouse in 50% mineral soil/50% soil-less Metro mix until the first leaf was fully emerged, with 7-10 seedlings per pot. These plants were inoculated with an aqueous spore suspension of *Septoria tritici* either prior to or after fungicide treatments. After inoculation the plants were kept in 100% relative humidity (one day in a dark dew chamber followed by two to three days in a lighted dew chamber) to permit spores to germinate and infect the leaf. The plants were then transferred to a greenhouse for disease to develop.

2. Evaluation of Fungicidal Activity: Leaf Spot of Sugar Beets (*Cercospora beticola*; Bayer code CERCBE):

Sugar beets (variety HH-88) were grown in soil-less Metro mix in a greenhouse. The spores were harvested from moisturized infected leaf surface by washing whole leaves in water, and then filtered through two layers of cheesecloth. The young seedlings were inoculated with the spore suspension. The plants were kept in a dark dew room for 48 hrs, and then placed under a plastic hood in a greenhouse with a temperature of 26 °C.

3. Evaluation of Fungicidal Activity: Leaf Spot of Peanut (*Mycosphaerella arachidis*; Bayer code MYCOAR; anamorph: *Cercospora arachidicola*):

Peanuts seedlings (variety Star) were grown in soil-less Metro mix. The spores were harvested from moisturized infected leaf surface by washing whole leaves in water, and then filtered through two layers of cheesecloth. The young seedlings were inoculated with the spore suspension. The plants were kept in a dark dew room for 48 hrs, and then placed under a plastic hood in a greenhouse with a temperature of 26 °C.

4. Evaluation of Fungicidal Activity: Apple Scab (*Venturia inaequalis*; Bayer code VENTIN):

Apple seedlings (McIntosh or Golden Delicious) were grown in Metro mix in a greenhouse. Fungal spores were collected from infected leaf tissue. Plants were inoculated with the spore suspension. Plants were placed in a dew room for 24 hours with 100% relative humidity and then transferred to a greenhouse with a temperature of 18 °C for disease to develop.

5. Evaluation of fungicidal activity: Black Sigatoka Disease of Banana (*Mycosphaerella fijiensis*; BAYER code MYCOFI):

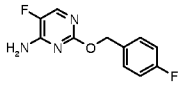
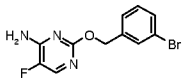
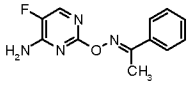
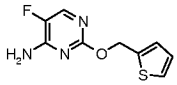
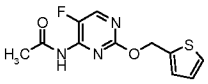
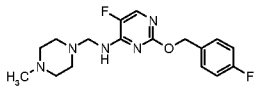
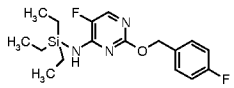
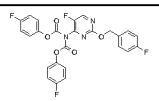
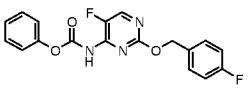
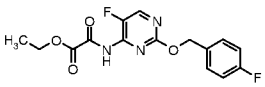
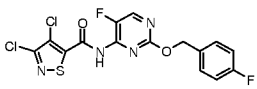
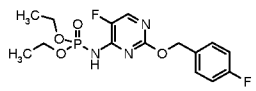
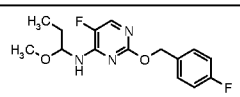
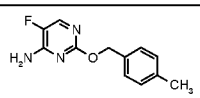
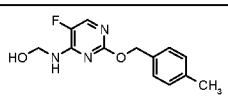
Efficacy against *Mycosphaerella fijiensis* was tested using newly emerged leaves of field grown banana plants. 20 ml of a diluted formulation of compound **1** of the required concentration were sprayed onto each test leaf over a delineated area of 20 x 20 cm. The leaves were subsequently allowed to become infected by natural inoculum, and were visually assessed for percent disease control ~ 40 - 45 days later.

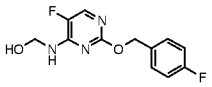
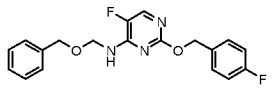
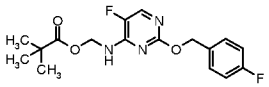
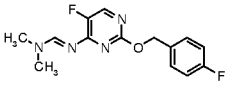
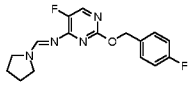
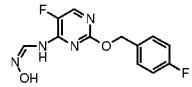
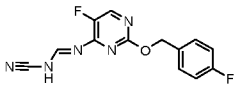
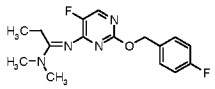
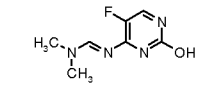
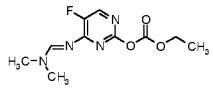
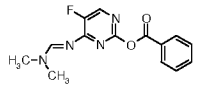
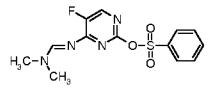
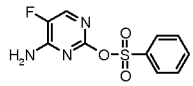
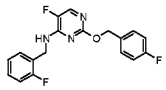
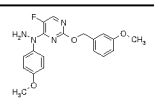
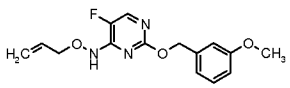
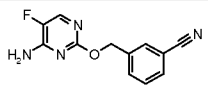
The following table presents the activity of typical compounds of the present disclosure when evaluated in these experiments. The effectiveness of the test compounds in controlling disease was determined by assessing the severity of disease on treated plants, then converting the severity to percent control based on the level of disease on untreated, inoculated plants.

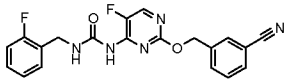
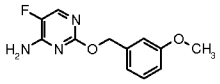
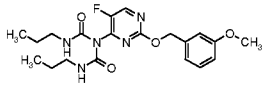
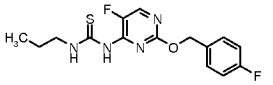
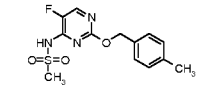
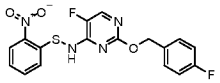
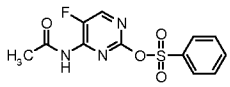
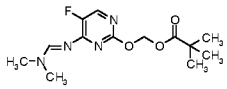
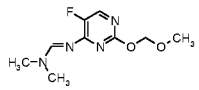
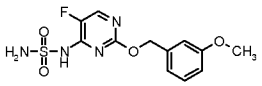
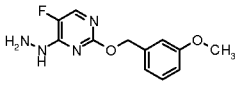
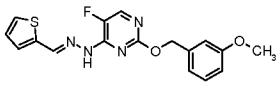
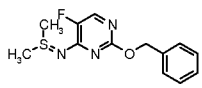
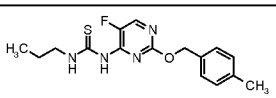
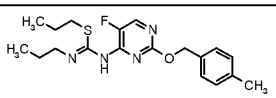
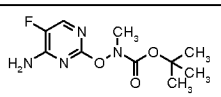
In each case of Tables I-III the rating scale is as follows:

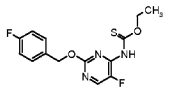
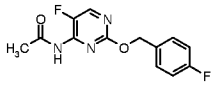
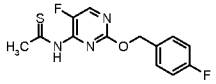
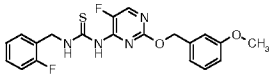
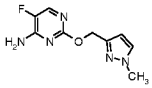
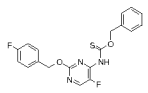
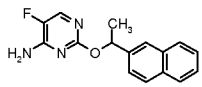
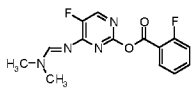
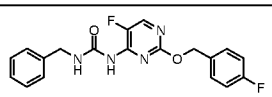
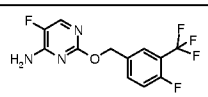
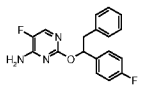
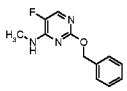
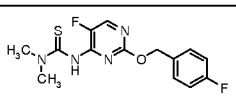
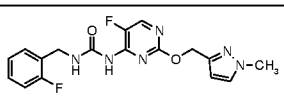
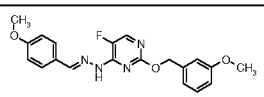
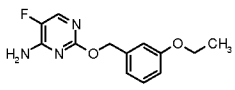
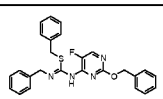
% Disease Control	Rating
76-100	A
51-75	B
26-50	C
0-25	D
Not Tested	E

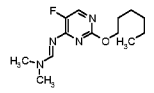
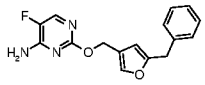
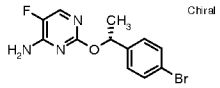
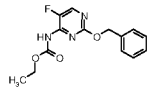
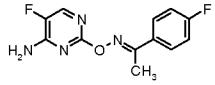
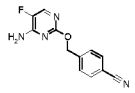
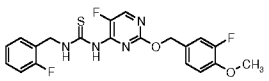
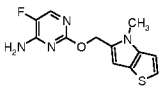
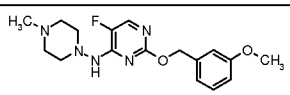
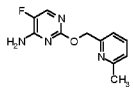
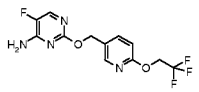
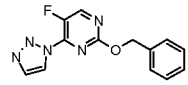
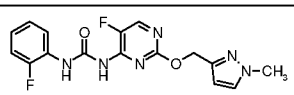
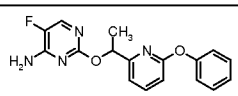
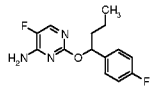
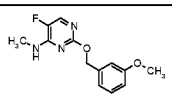
TABLE I: 3 DC and 1 DP Activity of Compounds on SEPTTR at 25 and 100 ppm

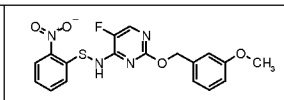
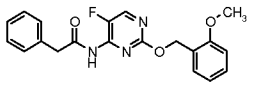
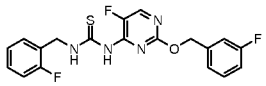
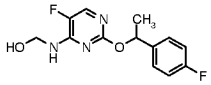
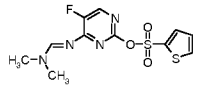
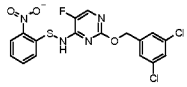
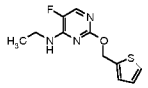
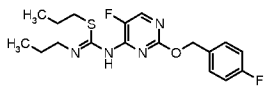
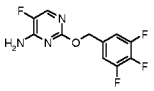
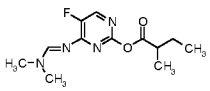
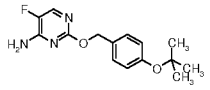
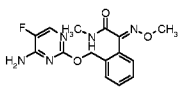
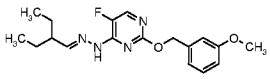
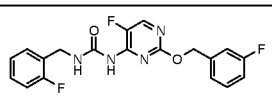
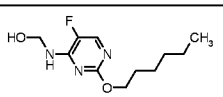
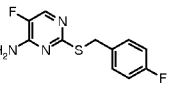
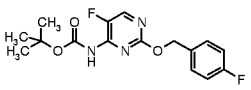
Cmpd	Structure	SEPTTR 3DC 25 ppm	SEPTTR 3DC 100 ppm	SETTTR 1DP 25 ppm	SEPTTR 1DP 100 ppm	Phys. App.	MP	Mass Spec. (ES+)	Mass Spec. (ES-)	GCMS
1		A	A	A	A	white solid	130-132	238	236	
2		A	A	A	A	off-white powder	143-145			297, 298
3		A	A	A	A	oil product			250	
4		A	A	A	A	off-white solid	163-165	247		
5		A	A	A	A	White Solid	90-92	226		
6		A	A	A	A	white solid	134-136	268	266	
7		A	A	A	A	beige solid	125-126	350	348	
8		A	A	A	A	clear yellow oil		352	350	
9		A	A	A	A	white solid	103-105	514		
10		A	A	A	A	white solid	129-131	358	356	
11		A	A	A	A	clear oil		338	336	
12		A	A	A	A	tan solid	87-90	417	415	
13		D	D	C	B	white solid	109-111	374	372	
14		A	A	A	A	clear colorless oil		310	308	
15		A	A	A	A	White Solid	135-137	234	232	
16		A	A	A	A	white solid	97-98	264	262	

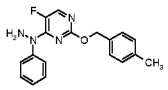
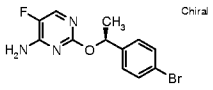
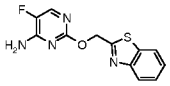
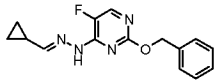
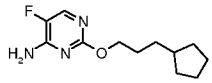
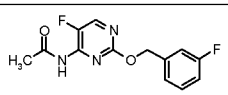
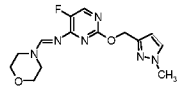
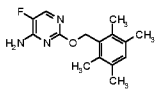
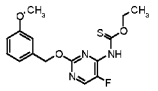
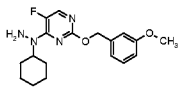
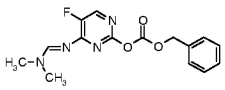
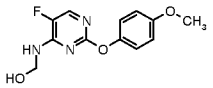
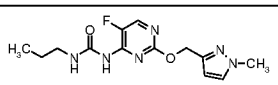
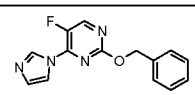
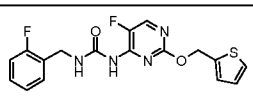
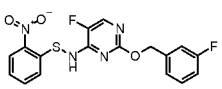
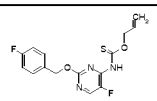
17		A	A	A	A	white solid	108-110	268	266	
18		B	B	B	A	white solid	64-66	358	356	
19		B	A	A	A	white solid	134-135	352		
20		A	A	A	A	white powder	115-116	293		
21		A	A	A	A	off white solid	102-103	319		
22		A	A	A	A	white solid	169-171	281	279	
23		A	A	A	A	off white solid	148-149	290	288	
24		A	A	A	A	clear yellow oil		321		
25		A	A	A	A	tan solid	240-243		183	
26		A	A	A	A	white solid	124-126	258		
27		A	A	A	A	white crystalline solid	136-138	289		
28		A	A	A	A	white solid	124-125	325		
29		B	A	A	A	white solid	139-140	270	268	
30		B	A	B	A	white solid	88-90	346	344	
31		D	D	D	D	off white solid	121-123.5	371	354	
32		D	A	C	A	colorless oil		306	304	
33		A	A	A	A	fluffy white solid	184-186	243	245	

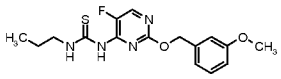
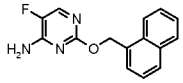
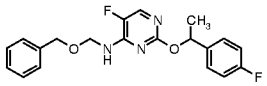
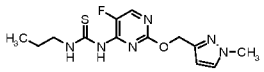
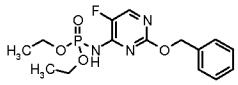
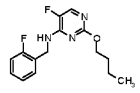
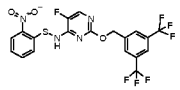
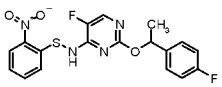
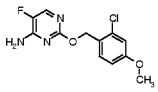
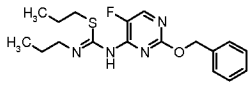
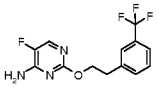
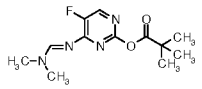
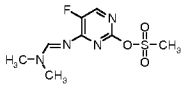
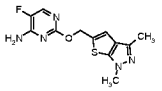
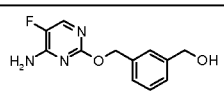
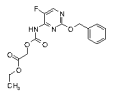
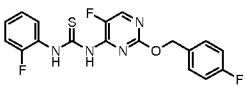
34		D	D	D	D	white solid	177-178	396	394	
35		A	A	A	A	yellow solid	104-106	250	248	
36		B	A	C	A	tan solid	75-78	420	418	
37		A	A	A	A	white needles	150-151	339	337	
38		D	C	C	C	White Solid	145-148	312	310	
39		D	D	A	A	yellow solid	184	391	389	
40		E	E	E	E	white solid	142-143	312	310	
41		E	E	E	E	white solid	86-88	299		
42		E	E	E	E	colorless oil		229		
43		B	B	C	B	yellow glassy solid	126-130		327	
44		B	A	D	A	off white solid	102-105	265	263	
45		C	C	B	A	yellow solid	136-139	359	357	
46		A	A	A	A	orange-white solid		220	218	
47		E	E	E	E	off white solid	125-129	281		
48		A	A	A	A	off-white solid	149-150	335	333	
49		E	E	E	E	Pale yellow viscous liquid		377		
50		C	A	C	A	pale yellow solid	123-125	259		

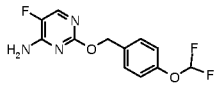
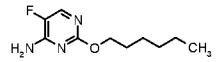
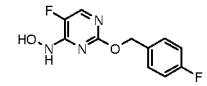
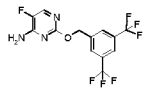
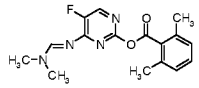
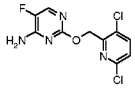
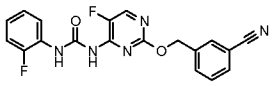
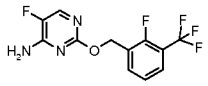
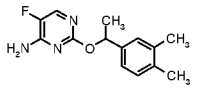
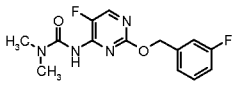
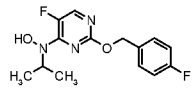
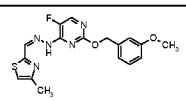
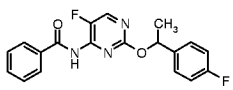
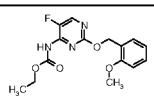
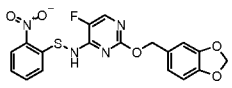
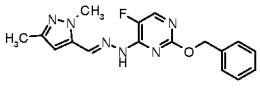
51		E	E	E	E	Pale yellow solid		326		
52		B	B	A	A	white solid	160-162	280	278	
53		A	A	A	A	yellow glass			294	
54		D	D	B	A	white solid	118-121	417	415	
55		A	A	A	A	white solid	124	224		
56		E	E	E	E	Pale yellow solid		388		
57		A	A	A	A	white solid	122-124		282	
58		A	A	A	A	white solid	170 (dec)	307		
59		D	C	D	D	white solid	190-191	371	369	
60		A	A	A	A	white solid	143	306	304	
61		D	D	A	A	white solid	111-113		326	
62		E	E	E	E	Off white solid		234		
63		E	E	E	E	yellow oil		325		
64		D	C	D	D	white solid	170-172	375	373	
65		C	B	C	B	brown/orange solid	60-64	383	381	
66		A	A	A	A	yellow solid	76-79	264	262	
67		E	E	E	E	Pale yellow solid		459		

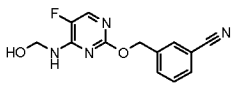
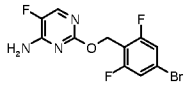
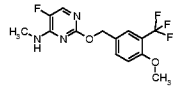
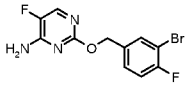
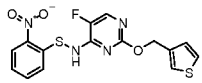
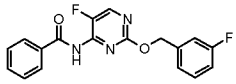
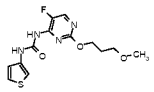
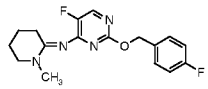
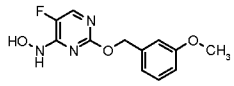
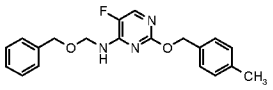
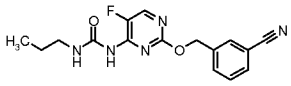
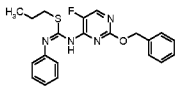
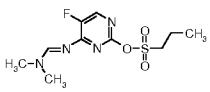
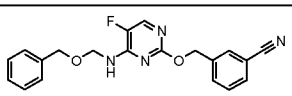
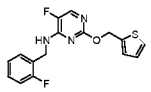
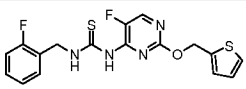
68		D	B	D	B	WHITE SOLID	128-130	269		
69		B	A	A	A	beige wax		300	298	
70		C	A	C	A	white solid	94-97		312	
71		A	A	A	A			292	290	
72		A	A	A	A	beige solid	155-156	265	263	
73		E	E	E	E	Gummy liquid		310		
74		D	D	B	A	white solid		245	243	
75		A	A	C	A	off-white solid	164-166	435	433	
76		C	C	C	C	black semi-solid			277	
77		C	A	D	A	colorless oil		348	346	
78		A	A	A	A	white solid	125-127	234		
79		A	A	A	A	white solid	134-135	319		
80		D	B	D	D	white solid	63-69*	272		
81		D	D	D	D	off-white solid	187-189	361	359	
82		D	C	C	C	orange oil			325	
83		A	A	A	A	clear oil			278	
84		E	E	E	E	Gummy liquid			262	

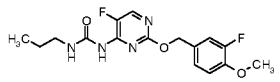
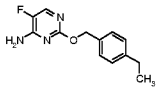
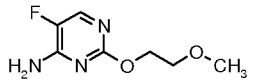
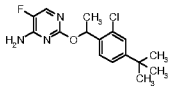
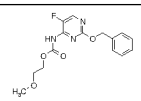
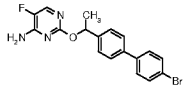
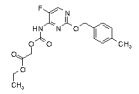
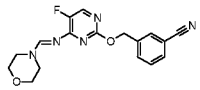
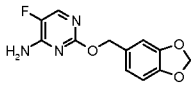
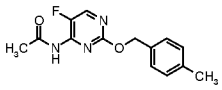
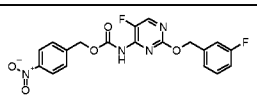
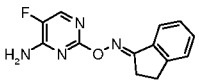
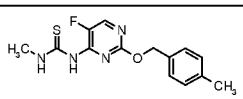
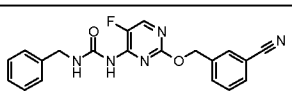
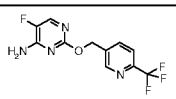
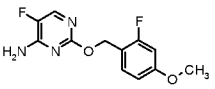
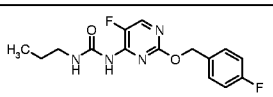
85		A	A	C	A	yellow solid	151-156	403	401	
86		D	D	C	B	white solid		368	366	
87		D	A	B	A	yellow solid	154-155	379	377	
88		C	A	C	A	clear colorless oil		282	280	
89		A	A	A	A	tan solid	129-130	331		
90		C	B	A	A	yellow solid	180-187	441	439	
91		E	E	E	E	Gummy liquid		276 [M+Na]		
92		E	E	E	E	Off white solid		381		
93		A	A	A	A	white solid	122	274	272	
94		A	A	A	A	off white solid	63-65	291		
95		A	A	A	A	yellow solid	118-120	292	--	
96		D	D	D	D	brown oil		334		
97		D	D	D	B	white solid	104-107	348	345	
98		D	D	D	D	white solid	168-169	389	387	
99		D	B	D	A	WHITE SOLID	74-77	244		
100		D	D	D	D	white solid	163-164	254	252	
101		D	D	B	B	white solid	127-129	338		

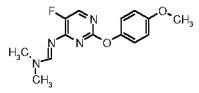
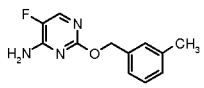
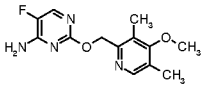
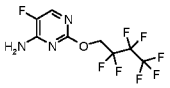
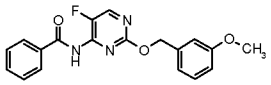
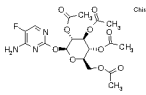
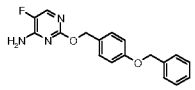
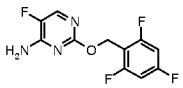
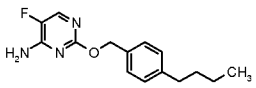
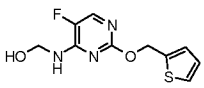
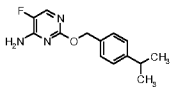
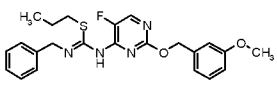
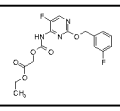
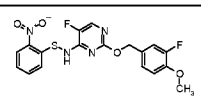
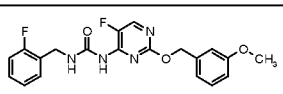
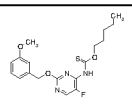
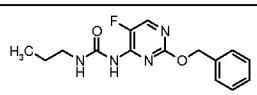
102		D	C	D	D	dark brown solid	118-122	325	
103		B	A	A	A	yellow solid	90-92		312
104		A	A	A	A	yellow solid	179-181	277	275
105		D	D	D	D	brown solid	143-148	288	285
106		D	C	D	D	yellow clear oil		240	238
107		A	A	A	A	white solid		280	278
108		A	A	A	A	white solid	123-124	321	
109		E	E	E	E	white solid	188-192	276	274
110		E	E	E	E	Pale yellow solid		338	
111		D	D	D	D	pale yellow oil		347	
112		A	A	A	A	white solid	128-131	340.8 (Na+)	
113		D	C	B	A	PALE YELLOW GUMMY SOLID		266	
114		D	D	D	D	white solid	133-135	389	307
115		A	A	A	A	yellow-white wax		271	
116		D	D	D	D	white solid	162-164	377	375
117		C	C	C	B	yellow solid	173-178	391	389
118		E	E	E	E	Off white solid		338	

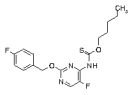
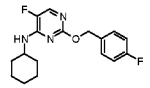
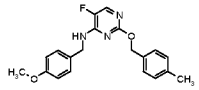
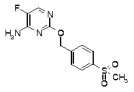
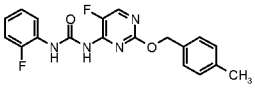
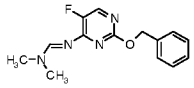
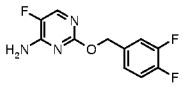
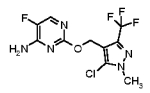
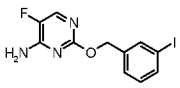
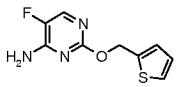
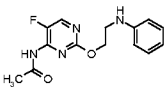
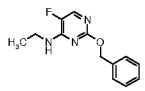
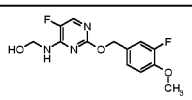
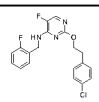
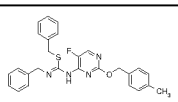
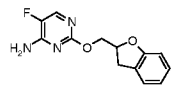
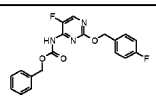
119		B	A	C	A	white powder	122-123	351	349	
120		A	A	A	A	off-white solid	173-174	270	268	
121		B	A	B	A	clear pale yellow oil		372	370	
122		C	A	D	B	white solid	107-108	325	323	
123		C	A	D	C	clear yellow oil		356	354	
124		E	E	E	E	Pale yellow liquid		294		
125		D	D	C	C	yellow solid	175-180	509	507	
126		A	A	A	A	brown oil		405	403	
127		A	A	A	A	white solid	126	284	282	
128		E	E	E	E	Off white solid		363		
129		A	A	C	A	white solid	119-120	302	300	
130		A	A	A	A	white solid	139-141	269		
131		C	A	C	B	white crystals	133-134	263		
132		A	A	A	A	beige solid	171-173	316 (M+Na)		
133		B	A	B	A	white solid	120-123		248	
134		B	A	D	B			350	348	
135		B	A	A	A	off-white solid	144-146	391	389	

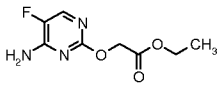
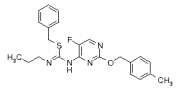
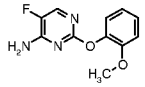
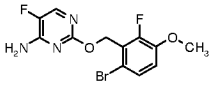
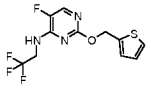
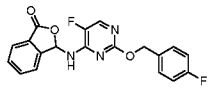
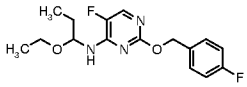
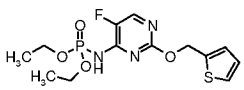
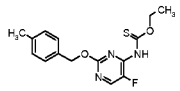
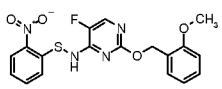
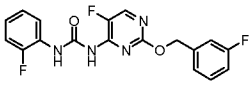
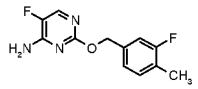
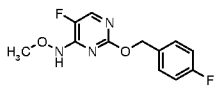
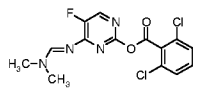
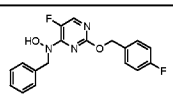
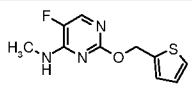
136		A	A	A	A	off-white solid	103-105	286	284	
137		C	A	C	A	white solid	55-57	214	212	
138		A	A	A	A	off white solid	111-116	254	252	
139		D	C	C	B	white solid	106	356	354	
140		A	A	A	A	white solid	120-125	317		
141		B	C	D	A	beige solid	175-176	290		
142		D	D	D	D	off-white solid	204-205	382	380	
143		E	E	E	E	Off white solid		296		
144		A	A	A	A	white solid	101	306	304	
145		A	A	A	A	clear oil			260	
146		A	A	A	A	white solid		295		
147		C	C	D	B	off white solid	146.8-149.4	297	294	
148		D	D	B	B	yellow solid	125-129	374	372	
149		D	B	C	A	yellow oil		356	354	
150		C	A	D	A			322	320	
151		C	C	D	D	yellow oil		417	415	
152		C	A	C	A	white solid	157-161	341	339	

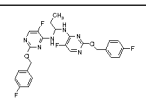
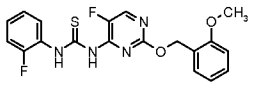
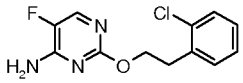
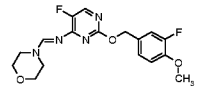
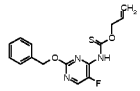
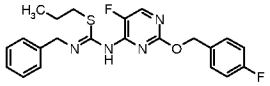
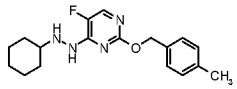
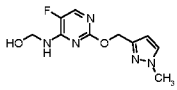
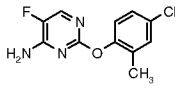
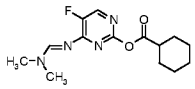
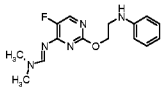
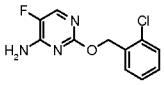
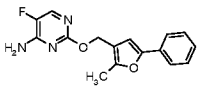
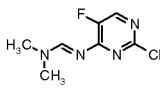
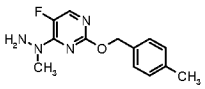
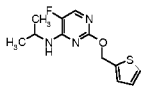
153		A	A	A	A	white solid	144-145	275	273	
154		A	A	A	A	white solid	158	335		
155		A	A	B	A	white solid	94-96		330	
156		A	A	A	A	white solid	128-130	318	316	
157		C	C	C	A	yellow solid	170-175	379	377	
158		A	A	A	A	white solid	91-93	342	340	
159		C	D	D	D	OFF WHITE SOLID		327		
160		A	A	A	A	clear yellow oil		333		
161		C	A	A	A	white solid	121.5-125	267	264	
162		D	D	C	A	white solid	71-73	354	352	
163		D	D	D	D	off-white solid	161-162	330	328	
164		D	B	C	B	clear oil		360		
165		E	E	E	E	Off white solid		397		
166		A	A	A	A	brown semi-solid		291		
167		D	D	D	C	white tacky solid		365	363	
168		D	C	D	C			334		
169		D	D	B	A	off-white solid	154-155	393	391	

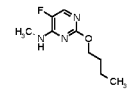
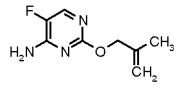
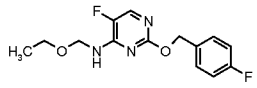
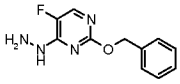
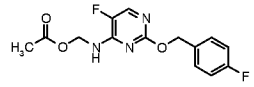
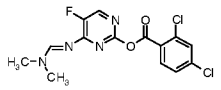
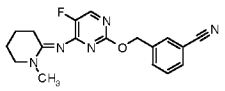
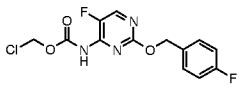
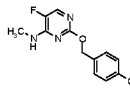
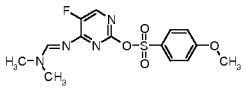
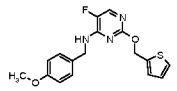
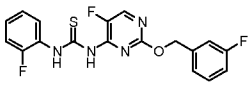
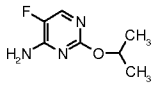
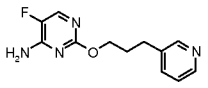
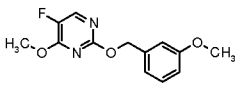
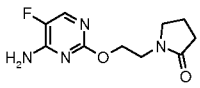
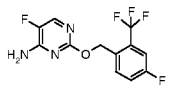
170		D	D	D	D	off-white solid	169-171	353	351	
171		A	A	A	A	off-white solid	85-87	248	246	
172		D	D	D	D	white solid	77-78	188	186	
173		D	B	B	A	white solid	141-147		322	
174		A	A	A	A			322	320	
175		D	D	A	A	yellow solid	177-179		388	
176		A	A	B	A				362	
177		A	A	A	A	white solid	119-120	342		
178		A	A	A	A	white solid	153	264	262	
179		A	A	A	A	white solid	155-156	276	274	
180		D	D	D	B	white solid	163-165	417	415	
181		A	A	A	A	white solid	203-205	259	257	
182		A	A	A	A	white solid	160-161	307	305	
183		D	D	D	D	white solid	175-177	378	376	
184		B	A	A	A	white solid	147-148	289		
185		A	A	A	A	pale yellow glass		268		
186		D	D	B	B	fluffy white solid	172-173	323	321	

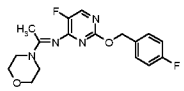
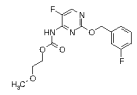
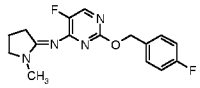
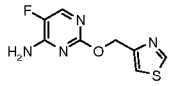
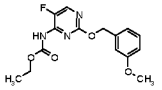
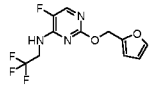
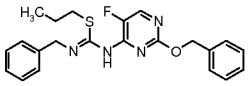
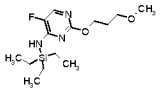
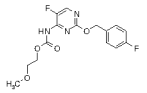
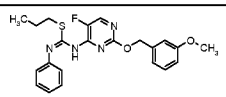
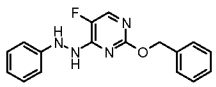
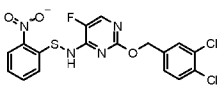
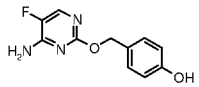
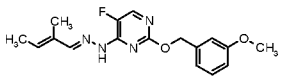
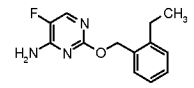
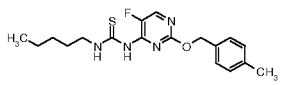
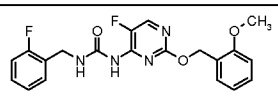
187		D	B	D	D	LIGHT GREEN SOLID	90-92	291		
188		A	A	A	A	white solid	92-94	234	232	
189		B	A	B	A	white solid	163-164	279		
190		D	D	D	D	white solid	74-75	312	310	
191		A	A	A	A	viscous yellow oil		354	352	
192		B	A	A	A	white solid foam				
193		A	A	A	A	yellow solid	120	326	324	
194		A	A	A	A	white solid	154	274	272	
195		C	A	B	A	light yellow solid	51-53	387	385	
196		A	A	A	A	white solid	93-95	256	254	
197		B	A	B	A	white solid	65-66	262	260	
198		E	E	E	E	Pale yellow solid		441		
199		B	A	D	A			368	366	
200		D	D	D	C	yellow solid	181-186	421	419	
201		D	D	D	D	white solid	161-162	401	399	
202		E	E	E	E	Pale yellow solid		380		
203		D	B	D	D	white solid	159-161	--	303	

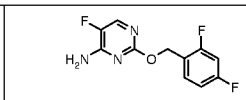
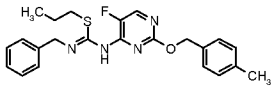
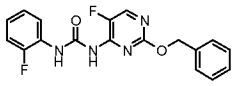
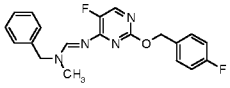
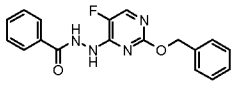
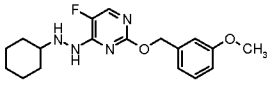
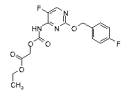
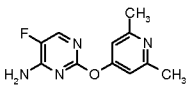
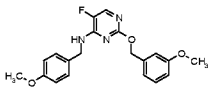
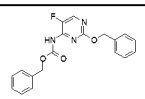
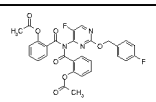
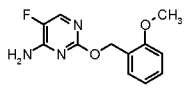
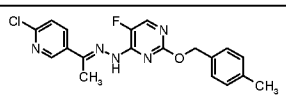
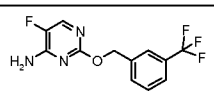
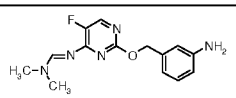
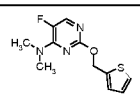
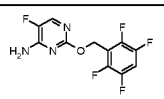
204		E	E	E	E	Pale yellow solid		368		
205		D	B	D	D	pale yellow oil		321	318	
206		E	E	E	E	Off white solid			352	
207		D	D	D	C	tan solid	142-147	298	296	
208		D	C	D	D	white solid	196-198	371	369	
209		A	A	A	A	white solid	84-85	275		
210		A	A	A	A	white solid	121-123	256	254	
211		A	A	A	A	off-white solid	173-174	326	324	
212		A	A	A	A	off-white solid	122-124	346	344	
213		A	A	A	A	White Solid	90-92	226		
214		D	D	D	D	WHITE SOLID	110-113	291		
215		E	E	E	E	Off white solid		248		
216		B	A	A	A	white solid	108-112	298	296	
217		E	E	E	E	Pale yellow liquid		376		
218		E	E	E	E	Pale yellow solid		473		
219		D	B	B	A	off-white solid	141-143	262	260	
220		A	A	A	A			372	370	

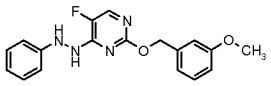
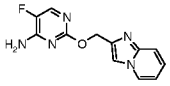
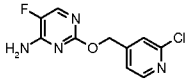
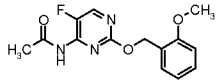
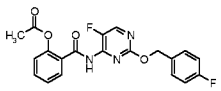
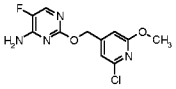
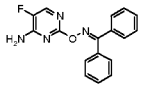
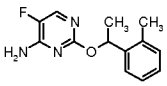
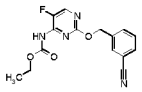
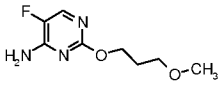
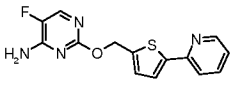
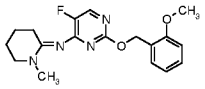
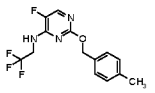
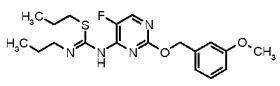
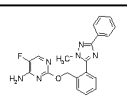
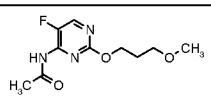
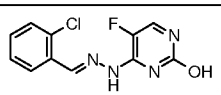
221		E	E	E	E	white solid	113-115	215		
222		E	E	E	E	Pale yellow viscous liquid			423	
223		A	A	A	A	white solid	132-134	236	234	
224		D	C	C	A	white solid	184	347	345	
225		E	E	E	E				306	
226		A	A	A	A	white glassy solid	68-77	370		
227		A	A	A	A	white solid	56-57	324	322	
228		B	A	C	A	light yellow solid		362	360	
229		E	E	E	E	Off white solid		322		
230		D	D	A	A	yellow solid	159-163	403	401	
231		D	D	D	D	white solid	193-194	375	373	
232		A	A	A	A	white solid	105-107	252	250	
233		A	A	B	A	white solid	114-115			
234		A	A	A	A	pale yellow solid		357		
235		B	A	A	A	viscous yellow oil		345	342	
236		A	A	A	A	white solid	111-113	238		
237		D	D	D	D	white solid	62-65	240	238	

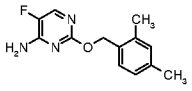
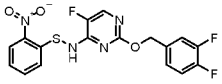
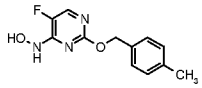
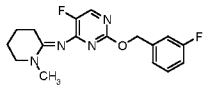
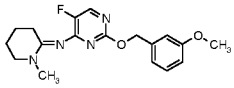
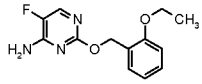
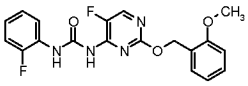
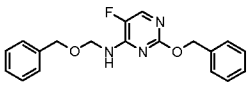
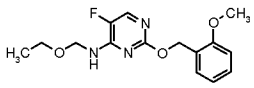
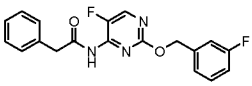
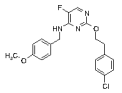
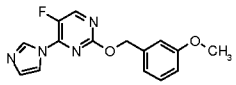
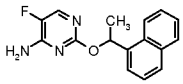
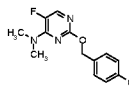
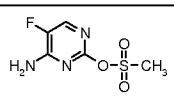
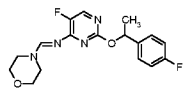
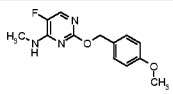
238		D	C	D	B	clear colorless oil		515	513	
239		B	A	A	A	white solid	165-166	403	401	
240		D	D	D	C	white solid	86-87	268	266	
241		A	B	A	A	white solid	164-165	365		
242		E	E	E	E	Pale yellow solid		320		
243		E	E	E	E	Pale yellow solid		429		
244		D	A	D	A	pale yellow solid	138-142	332	329	
245		B	A	B	A	white solid	145-148	254	252	
246		E	E	D	D	white solid	157-158	254	252	
247		A	A	A	A	off white solid	94-95	295		
248		A	A	D	A	OFF WHITE SOLID	102-104	304		
249		C	B	C	A	off white solid	92-93	358	356	
250		E	E	E	E	white solid	117-118	254	252	
251		A	A	A	A	beige solid	120-122	300		
252		D	D	C	C	white solid	132-135			
253		B	A	C	A	yellow oil		263	261	
254		E	E	E	E	Gummy liquid		268		

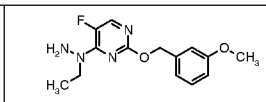
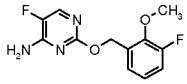
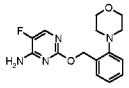
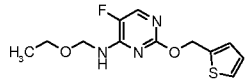
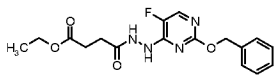
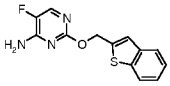
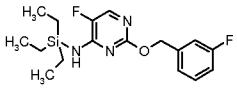
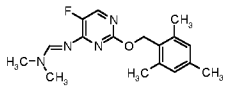
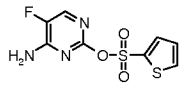
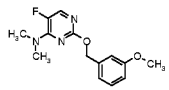
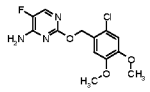
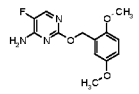
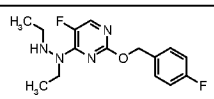
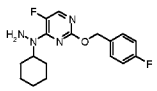
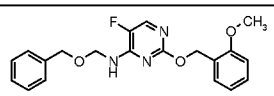
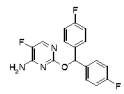
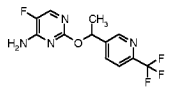
255		E	E	E	E	Off white solid		200		
256		D	C	D	D	white solid	83-84	184	182	
257		B	A	B	A	white soid	90-91	296	294	
258		C	B	B	A	off white solid	80-82	236	233	
259		A	A	B	A	white solid	103-105	310		
260		A	A	A	A	off white slid	95 (dec)	357		
261		B	A	B	A	pale amber oil		340		
262		A	A	B	A	white solid	101-105			
263		E	E	E	E	Off white solid		270 M+Na		
264		A	A	B	A	white solid	131-133	356		
265		E	E	E	E	Yellow solid			344	
266		D	A	A	A	white solid	137-138	391	389	
267		D	D	D	D	white solid	104-105	172	170	
268		C	B	D	C	white solid	126-127		247	
269		D	D	D	D	pale green solid	91-94	265	237	
270		D	D	D	D	white solid	111-112		239	
271		B	A	A	A	white solid	119	306	304	

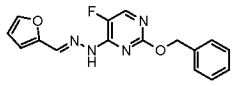
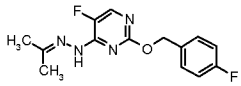
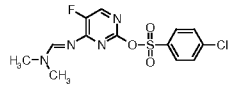
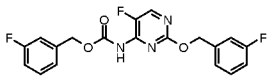
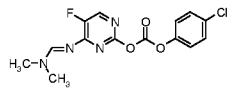
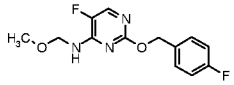
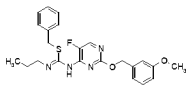
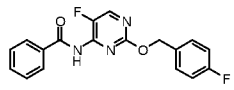
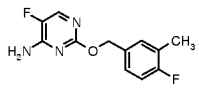
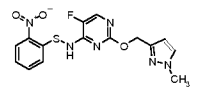
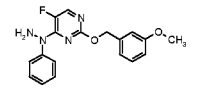
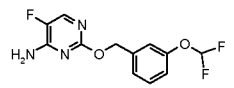
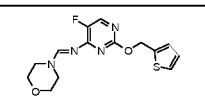
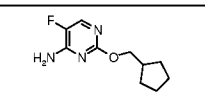
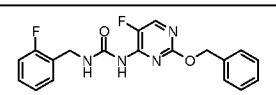
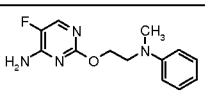
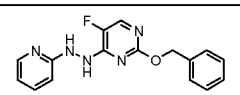
272		A	A	A	A	clear yellow oil		349		
273		A	A	B	A			340	338	
274		A	A	A	A	off white solid	84-86	319		
275		A	A	A	A	beige solid	136	227		
276		A	A	A	A			322	320	
277		E	E	E	E				290	
278		E	E	E	E	Off white solid		411		
279		A	A	B	A	YELLOW GUMMY SOLID		316		
280		A	A	A	A			340	338	
281		E	E	E	E	Pale yellow solid		427		
282		C	B	D	C	dark brown solid	158-163	312	309	
283		D	C	B	A	yellow solid	166-176	441	439	
284		D	D	D	D	white solid	196-198	236	234	
285		C	C	B	A	pale brown solid	118-120	331	329	
286		B	A	A	A	off-white solid	121-123	248	246	
287		A	A	A	A	white solid	115-116	363	361	
288		D	D	D	D	white solid	188-190	401	399	

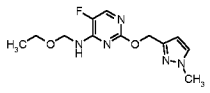
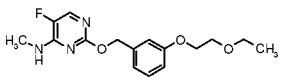
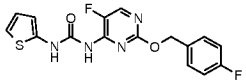
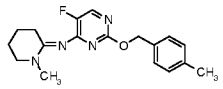
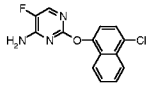
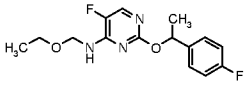
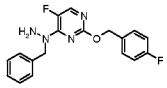
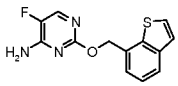
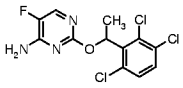
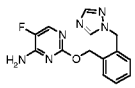
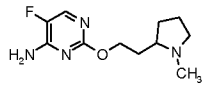
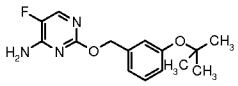
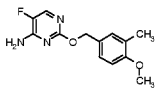
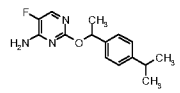
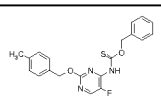
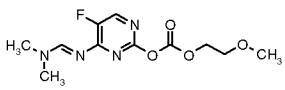
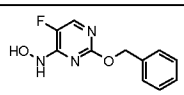
289		A	A	A	A	white solid	128		254	
290		E	E	E	E	Pale yellow solid		425		
291		D	C	D	D	off-white solid	198-200	357	355	
292		A	A	A	A	colorless oil		369		
293		D	D	D	D	white solid	200-202	340	337	
294		D	A	D	A	yellow oil		347		
295		A	A	A	A				366	
296		D	C	D	D	white solid		235	233	
297		E	E	E	E	Pale yellow liquid			368	
298		A	A	A	A			354	352	
299		E	E	E	E	off white solid	83-88	562		
300		A	A	A	A	white solid	106-107	250	248	
301		B	A	C	C	tan solid	136-139	386	384	
302		A	A	A	A	grey solid	105-107		286	
303		B	A	C	A	thick oil		290		
304		E	E	E	E	Yellow liquid		276 [M+Na]		
305		E	E	E	E	white solid		292	290	

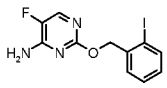
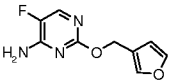
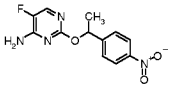
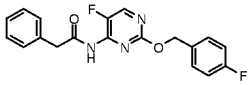
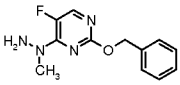
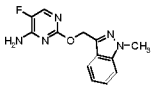
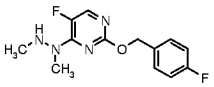
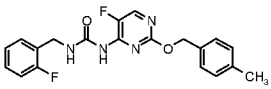
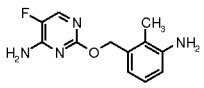
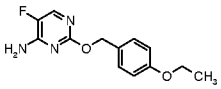
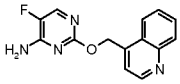
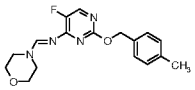
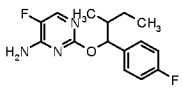
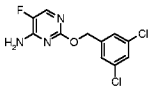
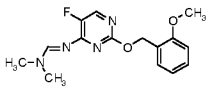
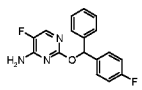
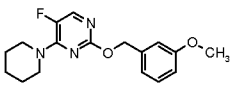
306		C	C	D	A	brown solid	108-112	341	339	
307		A	A	A	A	white solid	161-163	261	258	
308		A	A	A	A	yellow solid	182-183	256		
309		A	A	A	A	white solid		292	290	
310		E	E	E	E	colorless oil		400	398	
311		A	A	A	A	white solid	160-161	286		
312		A	A	A	A	white solid	196-200	309	307	
313		A	A	A	A	white solid	99-102		246	
314		A	A	A	A			317	315	
315		A	A	B	A	white solid	64-65	202	200	
316		A	A	A	A	yellow solid	138-140	303		
317		C	A	B	A	pale amber oil		345		
318		E	E	E	E				314	
319		E	E	E	E	Pale yellow viscous liquid		393		
320		C	C	D	D	yellow solid	209		377	
321		A	A	A	A	LIGHT YELLOW SOLID	112-114	244		
322		D	D	D	D	yellow solid	235-237	267	265	

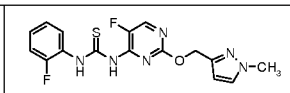
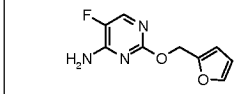
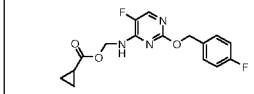
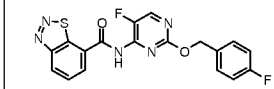
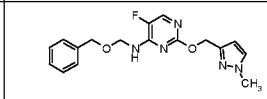
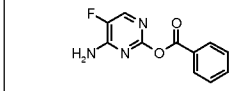
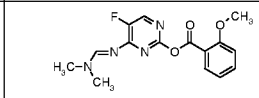
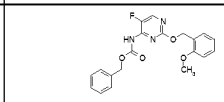
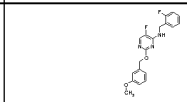
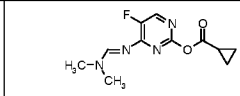
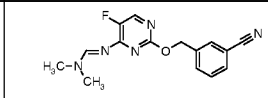
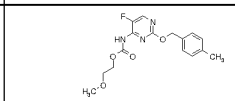
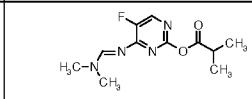
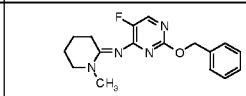
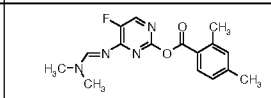
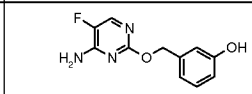
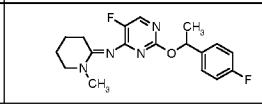
323		A	A	A	A	white solid	153	248	246	
324		D	C	A	A	yellow solid	185-189	409	407	
325		A	A	A	A	off white solid	138-141	250	248	
326		B	A	A	A	pale amber oil		333		
327		B	A	B	A	pale amber oil		345		
328		A	A	A	A	off-white solid	116-117	264	262	
329		D	D	D	D	white solid	187-188	387	385	
330		D	C	D	A	white solid	75-77	340	338	
331		A	A	A	A	clear colorless oil		308	306	
332		B	C	A	A	yellow-white solid	121-123	356	354	
333		E	E	E	E	Gummy liquid		388		
334		A	A	A	A	white solid	79-80	301		
335		A	A	A	A	orange oil			282	
336		E	E	E	E	Gummy liquid		262		
337		C	C	C	A	white solid	191-192	208	206	
338		A	A	A	A	white solid	102-103	349		
339		C	B	D	C	white solid	63-65	264	262	

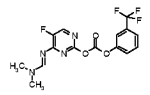
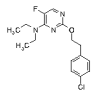
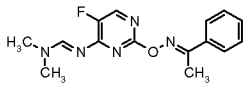
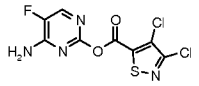
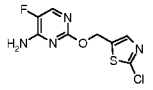
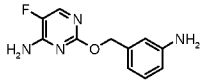
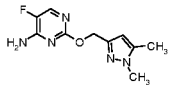
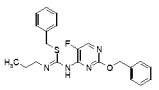
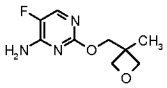
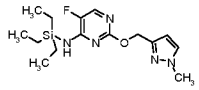
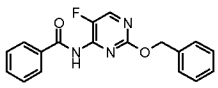
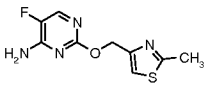
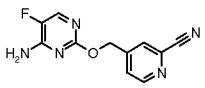
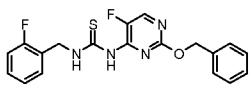
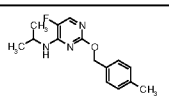
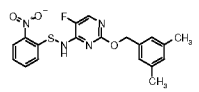
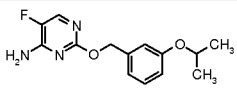
340		C	A	D	A	yellow oil		294	291	
341		A	A	A	A	white solid	129	268	266	
342		A	A	A	A	off-white crystals	147-149	305	303	
343		A	A	C	A	white solid	55-57	284	282	
344		D	C	C	C	off white solid	117-121	363	361	
345		A	A	A	A	white solid	154-156	276		
346		A	A	A	A	clear oil		352	350	
347		A	A	A	A	white solid	134-135	317		
348		A	A	A	A	white solid	128-130			
349		E	E	E	E	Pale yellow liquid		278		
350		A	A	A	A	white solid	117	314	312	
351		A	A	A	A	white solid	151	280	278	
352		D	D	D	D	colorless liquid		310	307	
353		D	D	D	D	white solid	68-72	335	333	
354		C	A	B	A	clear pale yellow oil		370	368	
355		A	A	A	A	white solid	150-152		330	
356		C	B	C	B	orange oil			301	

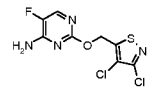
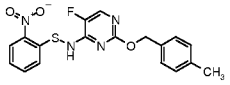
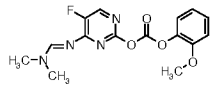
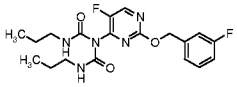
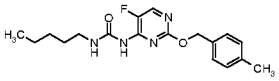
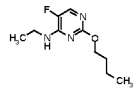
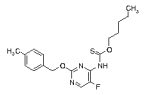
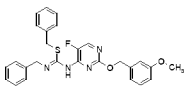
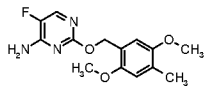
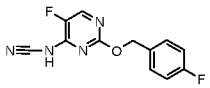
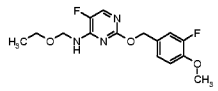
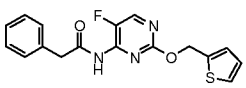
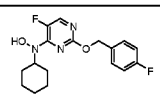
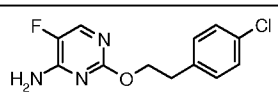
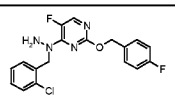
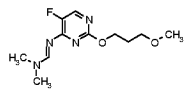
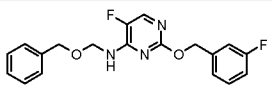
357		D	B	C	C	off white solid	173-177	313	311	
358		C	A	D	B	brown solid	120-123	293	291	
359		A	C	A	A	white solid	172-174	360		
360		A	A	A	A	white solid	105-106	390	388	
361		A	A	B	A	white solid	150-153	339		
362		B	A	B	A	white solid	115-116	282	280	
363		E	E	E	E	Pale yellow viscous liquid		441		
364		A	A	A	A	white solid	114-115	342	340	
365		A	A	A	A	tacky yellow glass		252		
366		B	A	A	A	yellow solid	186-192	377	375	
367		D	D	D	D	off white solid	94-97.5	341		
368		A	A	A	A	tan solid	95-96	286	284	
369		A	A	A	A	white solid	138-139	323		
370		D	D	D	D	white solid	93-94	212	210	
371		D	D	D	D	white solid	168-169	371	369	
372		E	E	C	A	white solid	138-139	263	261	
373		C	B	D	D	brown solid	44-50	313	310	

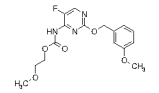
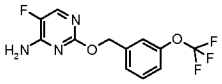
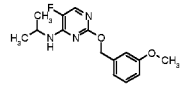
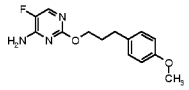
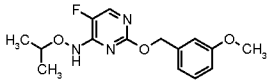
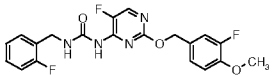
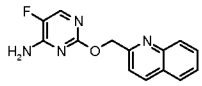
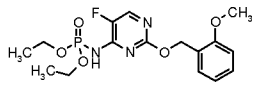
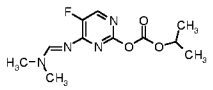
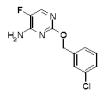
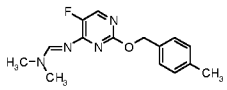
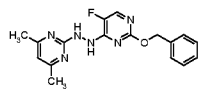
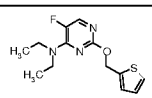
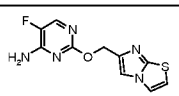
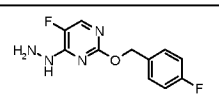
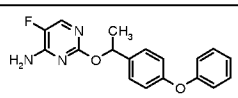
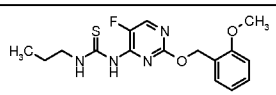
374		A	A	B	A	clear pale yellow oil		282	280	
375		C	A	D	D	yellow oil		322	320	
376		D	C	D	D	lavender powder	214-216	363	361	
377		B	A	A	A	pale amber oil		329		
378		A	A	B	A	white solid	177-179	290	288	
379		B	A	A	A	white solid	84-85	310	308	
380		D	A	A	A	off white solid	73-76	343		
381		A	A	A	A	light yellow solid	173-175	276	274	
382		D	A	A	A	white solid	149-152		336	
383		C	D	D	D	yellow solid	118-120	--	299	
384		C	A	B	A	dark oil		241	239	
385		A	A	A	A	ivory solid	104-105	292	290	
386		A	A	A	A	white solid	124	264	262	
387		A	A	A	A	orange oil			274	
388		E	E	E	E	Pale yellow solid		384		
389		A	A	A	A	light yellow solid	88.5-89.5	308.8 (Na+)		
390		A	A	A	A	off white solid	96-100	236	234	

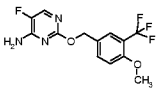
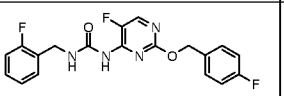
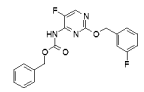
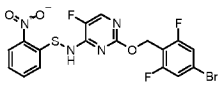
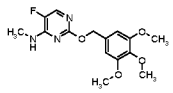
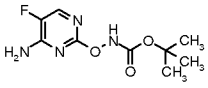
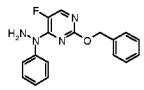
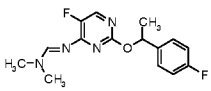
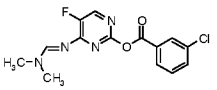
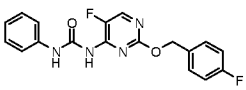
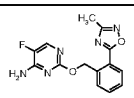
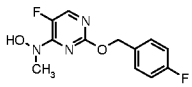
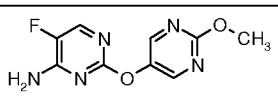
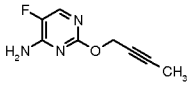
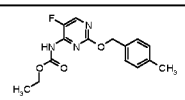
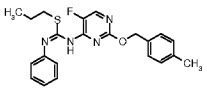
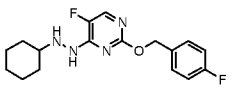
391		C	A	B	A	off-white solid	132-135	346	344	
392		A	A	A	A	off-white solid		210		
393		C	A	C	A	clear oil			277	
394		A	A	A	A	white solid	177-179	356	354	
395		C	B	D	D	yellow oil		249	247	
396		A	A	A	A	off-white solid	181-183	274	272	
397		D	D	D	D	colorless oil		282	279	
398		D	C	D	D	white solid	176-178	385	383	
399		A	A	B	A	white solid	174	249	247	
400		A	A	A	A	off-white solid	154-156	264	262	
401		A	A	A	A	off-white solid		271		
402		A	A	A	A	white solid	121-122	331		
403		C	A	A	A	white solid	93-94		292	
404		A	A	A	A	white solid		289	287	
405		A	A	A	A	clear pale yellow oil		305		
406		A	A	A	A	white solid	134-138		312	
407		D	D	D	D	yellow oil		318		

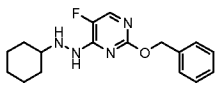
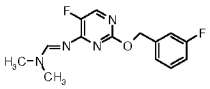
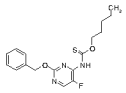
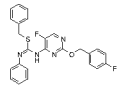
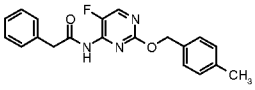
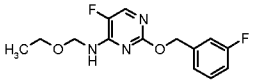
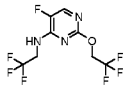
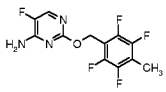
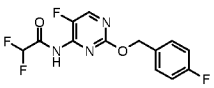
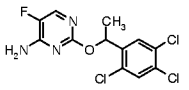
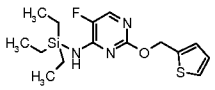
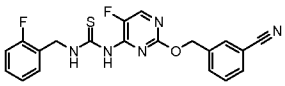
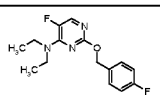
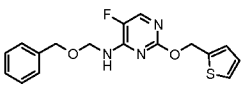
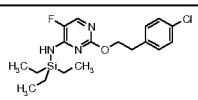
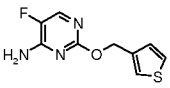
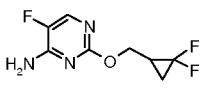
408		D	A	D	A	yellow solid	144-145	377	375	
409		A	A	A	A	tan solid		210		
410		B	A	B	A	white solid	114-115	336		
411		C	C	A	A	white solid	138-142	400	398	
412		D	B	D	A	colorless oil		344	342	
413		A	A	A	A	white solid	245-247	234	232	
414		E	E	E	E	white solid	125 (dec)	319		
415		A	A	B	A			384	382	
416		D	C	D	D			358		
417		A	A	A	A	white solid	105-115 (dec)	253		
418		A	A	A	A	brown oil		300		
419		A	A	A	A			336	334	
420		A	A	A	A	white solid	93-94	255		
421		A	A	A	A	pale amber oil		315		
422		A	A	A	A	white solid	111-112	317		
423		D	D	D	D	white solid		236	234	
424		B	A	B	A	pale amber solid	93-100	347		

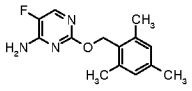
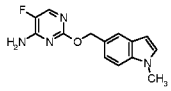
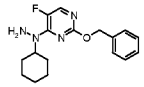
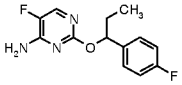
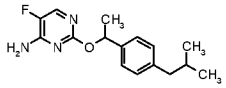
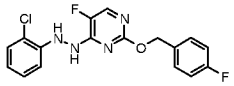
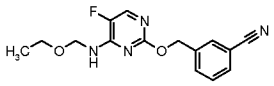
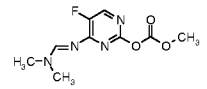
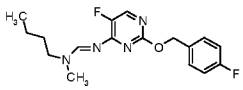
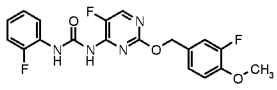
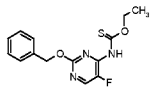
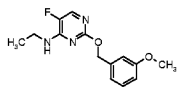
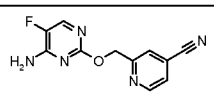
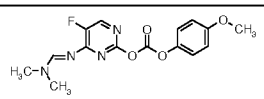
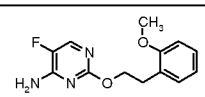
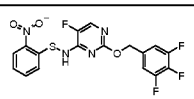
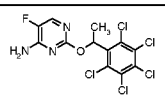
425		A	A	A	A	white solid	95-99	372		
426		E	E	E	E	Colourless liquid		324		
427		A	A	A	A	yellow white solid	125-126	302		
428		C	A	B	B	light yellow solid		309	307	
429		A	A	A	A	beige solid	168-169	261	259	
430		A	A	A	A	dark brown solid	128-130	235	233	
431		A	A	A	A	clear yellow oil		238		
432		E	E	E	E	Pale yellow solid		411		
433		D	D	D	D	yellow solid		214	212	
434		A	A	A	A	clear oil		338		
435		B	A	A	A	white solid	115-117	324	322	
436		A	A	A	A	white solid	115	241		
437		D	B	D	B	brown solid	182-183	246	244	
438		D	D	B	A	white solid	162-164	387	385	
439		E	E	E	E	Yellow solid		298 [M+Na]		
440		C	D	D	D	yellow solid	172-179	401	399	
441		A	A	A	A	light yellow solid	61-62	278	276	

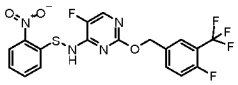
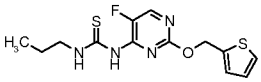
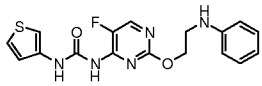
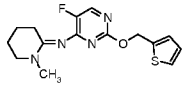
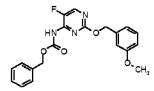
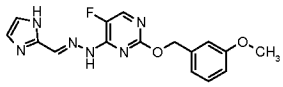
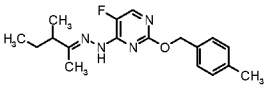
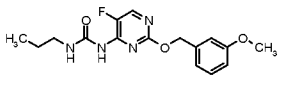
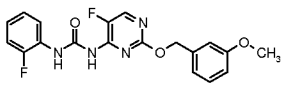
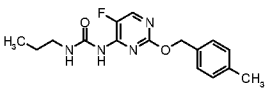
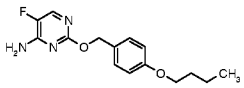
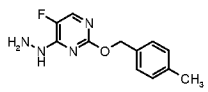
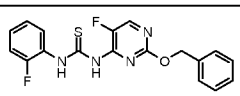
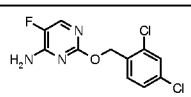
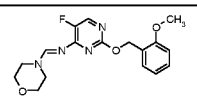
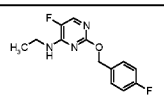
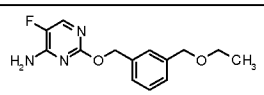
442		A	A	A	A	fluffy off-white solid	195-196	297	293	
443		C	C	A	A	yellow solid	173-177	387	385	
444		A	A	A	A	white solid	121-123	336		
445		A	A	B	A	brown oil		408	406	
446		E	E	E	E	white solid	152-153	347	345	
447		E	E	E	E	Pale yellow liquid		214		
448		E	E	E	E	Pale yellow solid		364		
449		E	E	E	E	Off white solid		489		
450		A	B	A	A	white solid	155	294	292	
451		D	D	D	D	white solid	158-160	263	261	
452		A	A	A	A	white solid	108-109	326	324	
453		B	A	A	A	light yellow glass		344	342	
454		C	D	D	A	off white solid	153.5-157.9	337	334	
455		C	A	B	A	white solid	101-103	268	266	
456		D	A	B	A	yellow oil		377		
457		B	A	B	A	LIGHT YELLOW SOLID	53-55	257		
458		D	D	D	B	white tacky solid		358	356	

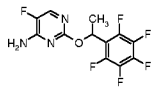
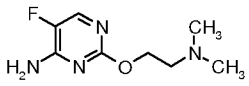
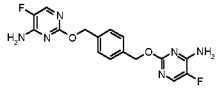
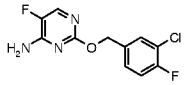
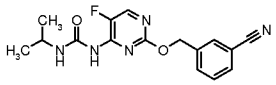
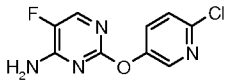
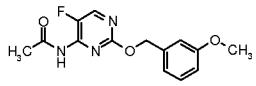
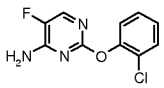
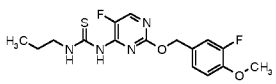
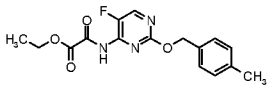
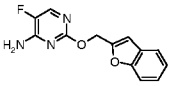
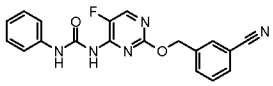
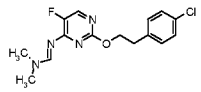
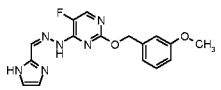
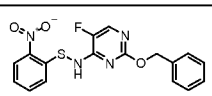
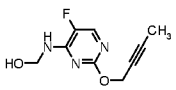
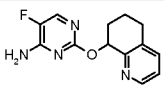
459		A	A	B	A			352	350	
460		A	A	A	A	white solid		304	302	
461		E	E	E	E	Gummy liquid			290	
462		B	C	B	A	white solid	143-144	278	276	
463		C	B	D	B	colorless oil		308	306	
464		D	C	D	D	off-white solid	171-174	419	417	
465		A	A	A	A	tan solid	155-157	271	269	
466		D	D	D	D	light yellow glass		386	384	
467		A	A	A	A	white solid	120-121	292.8 (Na+)		
468		A	A	A	A	white powder	143-145	254		
469		A	A	A	A	white solid	98-99	288		
470		C	C	D	D	pale pink solid	154.4-157.2	342	340	
471		E	E	E	E	Gummy liquid		282		
472		A	A	A	A	yellow solid	58-61	266	264	
473		C	A	C	A	fluffy white solid	123-124	253	251	
474		A	A	A	A	clear oil			324	
475		B	A	B	A	white solid	170-171	349	351	

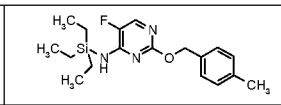
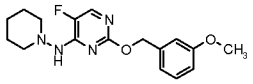
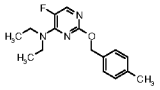
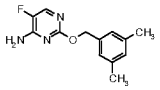
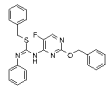
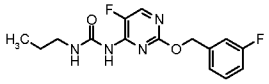
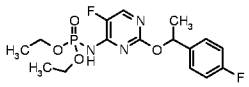
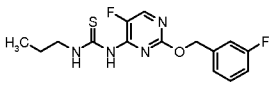
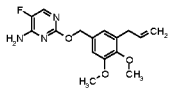
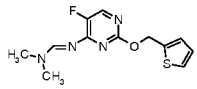
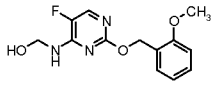
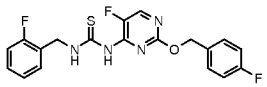
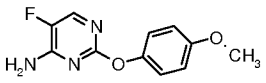
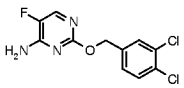
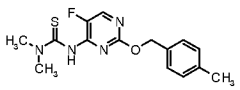
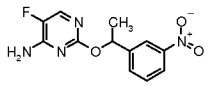
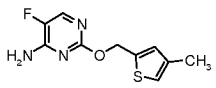
476		A	A	A	A	white solid	123-125	318	316	
477		D	B	D	D	white solid	189-191	389	387	
478		A	A	B	A			372	370	
479		B	B	A	A	yellow solid	143-150	488		
480		D	D	D	D	pale yellow solid	150-154	324	322	
481		A	A	A	A	white solid	169-174 (dec)			
482		D	C	D	D	off white solid	111-115	312	309	
483		A	A	A	A	clear yellow oil		307		
484		A	A	A	A	yellow oil		323		
485		D	D	D	D	white solid	206-207	357	355	
486		C	C	D	D	ivory solid	188-189	302	300	
487		D	A	D	A	white solid	153.8-157.1	268	266	
488		D	D	D	D	white solid	191-192	238	236	
489		A	A	D	B	white solid	122-123	182	180	
490		A	A	A	A			306	304	
491		E	E	E	E	Pale yellow solid		411		
492		D	C	D	C	pale brown solid	139-143	335	333	

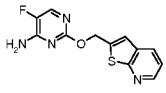
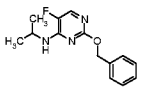
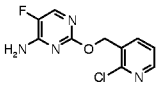
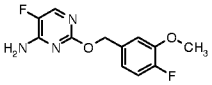
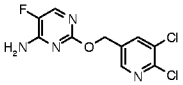
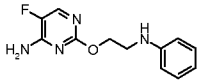
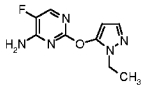
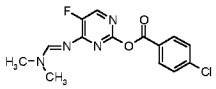
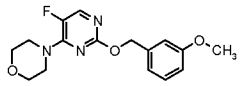
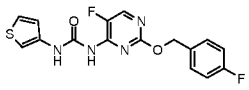
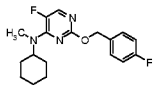
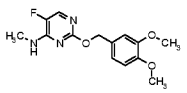
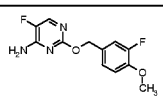
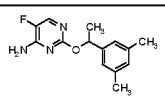
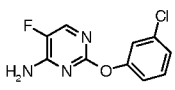
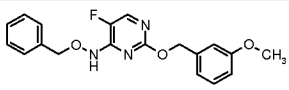
493		D	D	D	C	pale yellow solid	95-98	318	315	
494		A	A	A	A	off white solid	77-78	293		
495		E	E	E	E	Yellow solid		350		
496		E	E	E	E	Pale yellow solid		463		
497		D	C	B	A	white solid	123-124	352	350	
498		A	A	A	A	white solid	56-58	296	294	
499		E	E	E	E				292	
500		A	A	A	A	white solid	147-150	306	304	
501		A	A	A	A	viscous semisolid		316	314	
502		D	D	D	D	white solid	130-134		336	
503		A	A	A	A	clear oil		341	339	
504		D	D	D	B	off-white solid	165-166	412	410	
505		E	E	E	E	Brown liquid		294		
506		D	D	C	A	white solid	95-97	346	344	
507		D	A	B	A	YELLOW GUMMY SOLID		382		
508		A	A	A	A	tan solid		226		
509		C	D	D	D	tan solid	72-77	220	218	

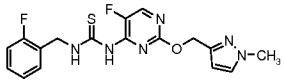
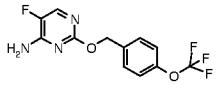
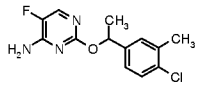
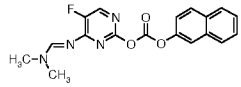
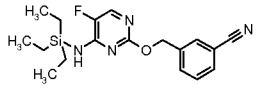
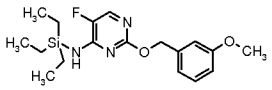
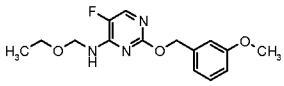
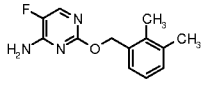
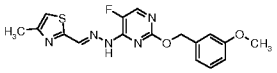
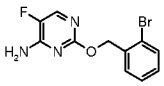
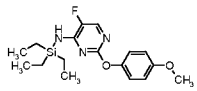
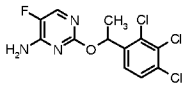
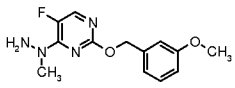
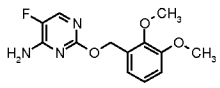
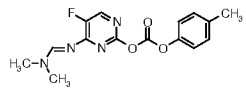
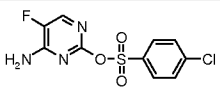
510		B	A	B	A	white solid	150	262	260	
511		C	C	B	B	yellow oil			271	
512		D	D	D	B	off white solid	63-67	318		
513		A	A	A	A	sticky solid			264	
514		A	A	A	A	yellow oil			288	
515		D	D	D	A	brown solid	123-129	363	361	
516		A	A	A	A	clear pale yellow oil		303	301	
517		A	A	A	A	white solid	125-127	243		
518		A	A	A	A	tan oil		335		
519		D	D	D	D	white solid	208-211	405	403	
520		E	E	E	E	Pale yellow solid		308		
521		E	E	E	E	Pale yellow solid		278		
522		D	D	D	C	rust solid	188-189	246	244	
523		A	A	A	A	white solid	127-130	356.8 (Na+)		
524		D	B	D	B	white solid	100-101	264	262	
525		A	A	A	A	yellow solid	154-160	427	425	
526		D	D	D	B	yellow solid	216-218		404	

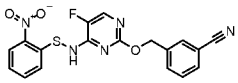
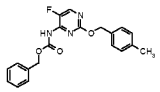
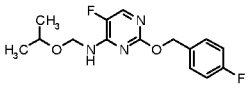
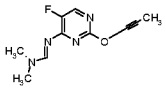
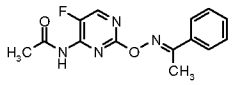
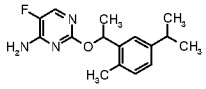
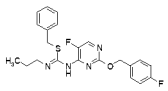
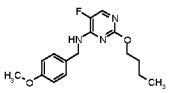
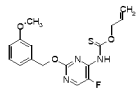
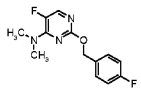
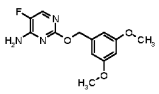
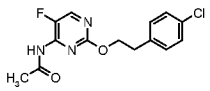
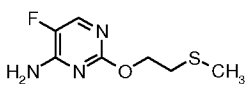
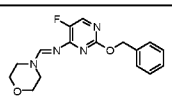
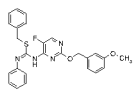
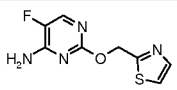
527		D	D	B	A	yellow solid	178-182	459	457	
528		D	B	A	A	tan solid	121-124	327	325	
529		D	D	D	D	OFF WHITE SOLID	188-190			
530		B	A	A	A	pale amber oil		321		
531		A	A	A	A			384	382	
532		D	C	C	B	off white solid	157-162	343	341	
533		D	C	B	B	white solid	120-123	331	329	
534		D	C	D	C	white solid	147-148	335	333	
535		D	D	D	D	white solid	182-183	387	385	
536		C	C	D	D	white solid	171-172	319	317	
537		A	A	A	A	off-white solid	112-113	292	290	
538		B	A	C	B	pale biege solid	103-107	250	247	
539		D	D	A	A	white solid	142-144	373	371	
540		A	A	A	A	white solid	185	289	287	
541		A	A	A	A	white solid	99-100	347		
542		E	E	E	E	Off white solid		266		
543		A	A	A	A	colorless oil			276	

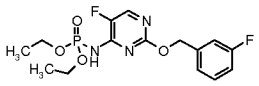
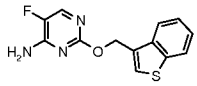
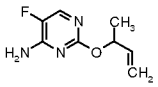
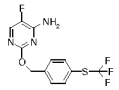
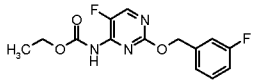
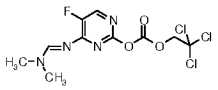
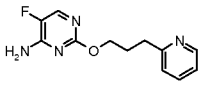
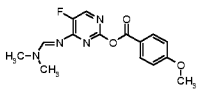
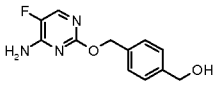
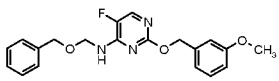
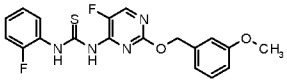
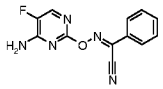
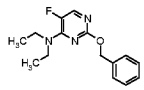
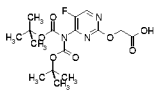
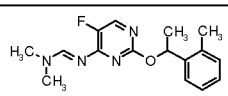
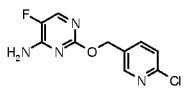
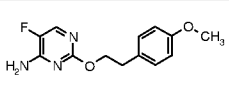
544		D	D	D	C	white solid	134-140		322	
545		D	B	D	C	white solid	134-135		199	
546		B	D	B	B	white solid	235-238		360	
547		A	A	A	A	white solid	130-132	273	271	
548		D	D	D	D	white solid	196-198	330	328	
549		D	D	C	D	white solid	187-188	241	239	
550		A	A	A	A	white solid	105-106	292	290	
551		E	E	D	C	white solid	155-156	240	238	
552		D	A	D	A	off-white solid	148-149	369	367	
553		A	A	A	A	clear oil		334	332	
554		C	A	C	A	white solid	123-124	260	258	
555		D	D	D	D	white solid	203-205 (dec)	364	362	
556		D	A	C	A	WHITE SOLID	100-103	323		
557		D	D	C	D	white solid	208-210	343	341	
558		C	C	A	A	yellow solid	167-171	373	371	
559		A	A	B	A	PALE YELLOW SOLID		212		
560		D	A	D	C	yellow solid		261	259	

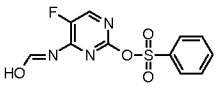
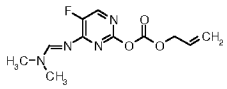
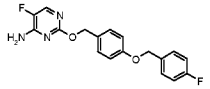
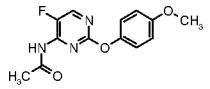
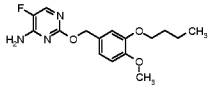
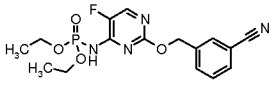
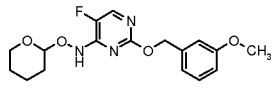
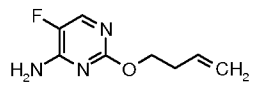
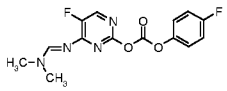
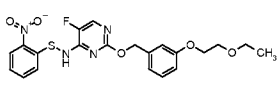
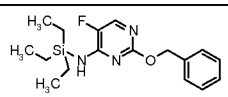
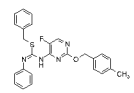
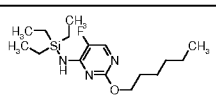
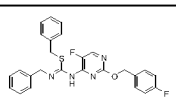
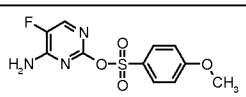
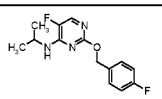
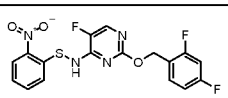
561		A	A	A	A	clear oil		349		
562		D	C	D	D	yellow oil		333	331	
563		E	E	E	E	Colourless liquid		290		
564		C	A	B	A	white solid	109	248	246	
565		E	E	E	E	White solid		445		
566		D	D	D	D	white solid	158-159	323	321	
567		C	A	C	B	clear yellow oil		388	386	
568		A	A	B	A	off-white solid	125-126	339	337	
569		B	A	A	A	white solid	90	320	318	
570		A	A	A	A	off white solid	101-102	281		
571		A	A	A	A	white solid	132-133	280	278	
572		C	B	C	A	off-white solid	178-179	405	403	
573		D	D	C	B	white solid	201-202	236	234	
574		A	A	A	A	white solid	131	289	287	
575		E	E	E	E	yellow oil		321		
576		C	A	C	A	white solid	117-122		277	
577		A	A	A	A	off-white solid	86-88	240		

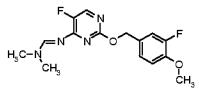
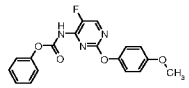
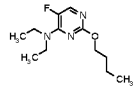
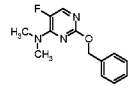
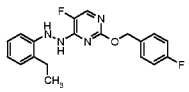
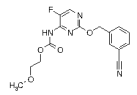
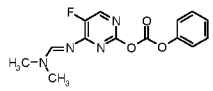
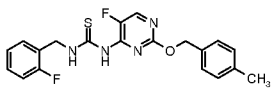
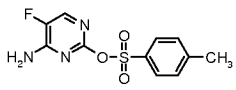
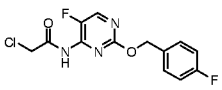
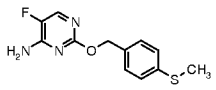
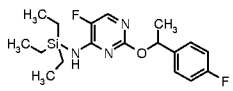
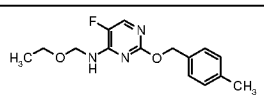
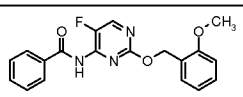
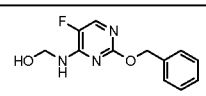
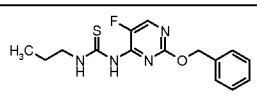
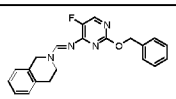
578		A	A	A	A	pale yellow solid	140-142	277		
579		E	E	E	E	Pale yellow solid		262		
580		D	B	B	A	white solid	185-187	256		
581		A	A	A	A	white solid	120	268	266	
582		A	A	A	A	off-white solid	162	290	288	
583		A	A	D	A	white solid	108-109	249	247	
584		D	A	D	A	off white solid	153-154	224	222	
585		A	A	A	A	white solid	125 (dec)	323		
586		D	D	D	D	colorless oil		320		
587		C	A	D	D	white solid	200-201	363	361	
588		D	D	D	D	white solid	86.3-89.8	335		
589		D	D	D	D	white solid	>200	294	292	
590		A	A	A	A	white solid	154	268	266	
591		E	E	E	E	Off white solid		282		
592		A	A	A	A	yellow oil			260	
593		E	E	D	B	white solid	134-135	240	238	
594		D	C	D	B	white solid	104.4-107	356	354	

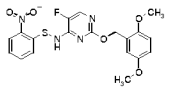
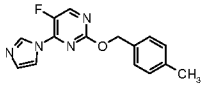
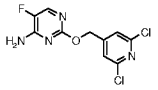
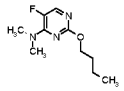
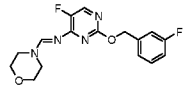
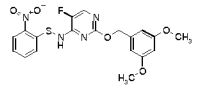
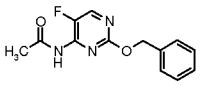
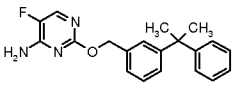
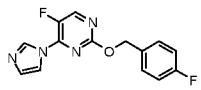
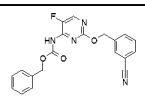
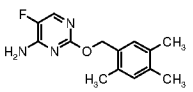
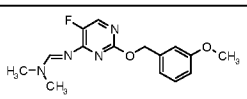
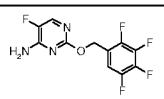
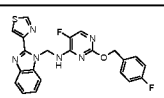
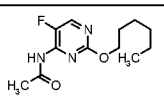
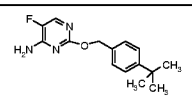
595		D	D	C	A	off-white solid	160-161	391	389	
596		A	A	A	A	off-white solid	105-107	305	302	
597		A	A	A	A	clear oil			280	
598		A	A	B	A	white solid	156-160	356		
599		A	A	B	A	clear oil		359	357	
600		A	A	A	A	clear oil		365		
601		A	A	A	A	white solid	53-54	308	306	
602		D	D	D	B	white solid	144		247	
603		D	D	C	A	off white solid	173-176	374	372	
604		A	A	A	A	off-white solid	106-108	####	####	
605		D	A	B	A	WHITE SOLID	64-67	350		
606		E	E	E	E			316		
607		D	C	D	D	white solid	112-113		334	
608		B	A	B	A	dark red oil		279	262	
609		A	A	A	A	white solid	112	280	278	
610		C	B	A	A	white solid	157-159	319		
611		A	A	A	A	white solid	143-145			

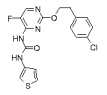
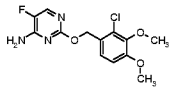
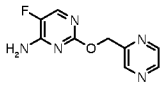
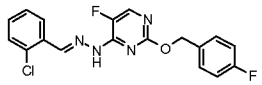
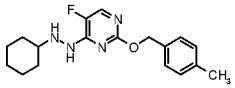
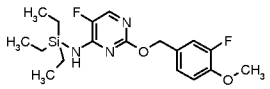
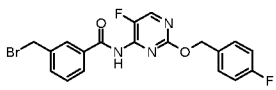
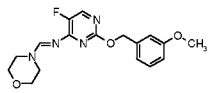
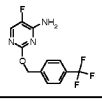
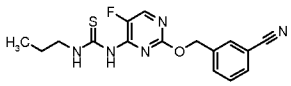
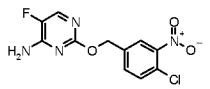
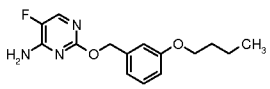
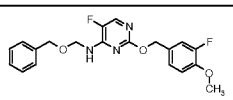
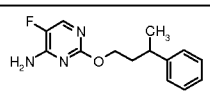
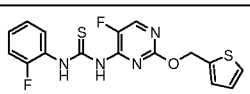
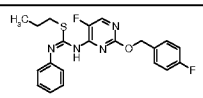
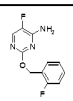
612		A	A	A	A	yellow solid	165-172	398	396	
613		A	A	A	A			368	366	
614		A	A	A	A	white solid	75-76	310	308	
615		A	A	C	A	YELLOW SOLID	58-60	237		
616		A	A	A	A	white solid	149-151		287	
617		A	A	A	A	clear oil			288	
618		E	E	E	E	Off white solid		429		
619		E	E	E	E	Gummy liquid		306		
620		E	E	E	E	Pale yellow solid		350		
621		E	E	E	E	Off white solid		266		
622		E	E	E	E	Pale yellow liquid		296		
623		B	A	A	A	white solid	112	280	278	
624		B	A	B	A	LIGHT BROWN SOLID	128-130	310		
625		D	C	D	C	white solid	114-115		202	
626		A	A	A	A	white solid	130-131	317		
627		E	E	E	E	Pale yellow solid		475		
628		B	A	C	A	beige solid	101-103	227		

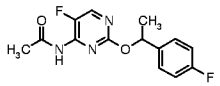
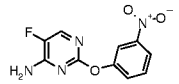
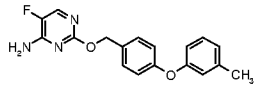
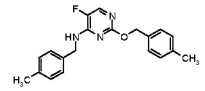
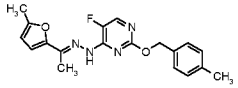
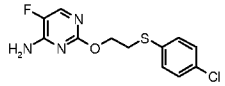
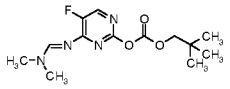
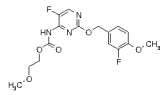
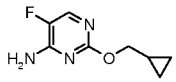
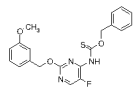
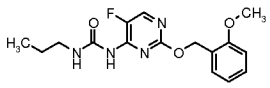
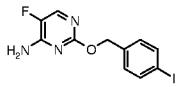
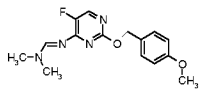
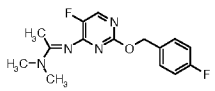
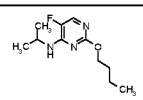
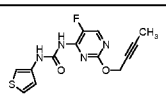
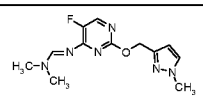
629		D	B	D	B	light yellow solid		374	372	
630		A	A	A	A	white solid	167-169	276		
631		D	D	D	D	clear yellow oil		184	182	
632		A	A	A	A	white solid	128-131	320	318	
633		A	A	A	A	white solid			308	
634		A	A	A	A	white solid	130-133	359		
635		D	A	C	A	white solid	117-118		247	
636		A	A	A	A	white solid	132-135	319		
637		A	A	A	A	white solid	158-160		249	
638		D	B	B	A	white solid	77-78	370	368	
639		B	A	A	A	white solid	136-137	403	401	
640		A	A	A	A	yellow white solid	218-220	258		
641		E	E	E	E	Pale yellow liquid		276		
642		E	E	E	E	white foam	61-65	410 (M+Na)		
643		A	A	A	A	pasty off-white solid				
644		A	A	A	A	white solid	164-166	255		
645		D	B	C	A	white solid	117-118	264	262	

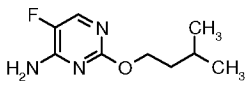
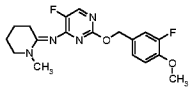
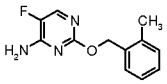
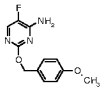
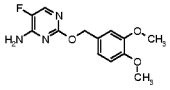
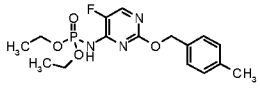
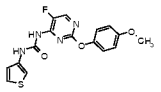
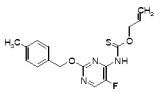
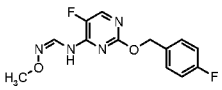
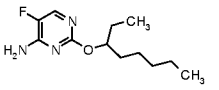
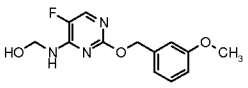
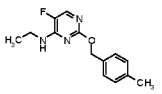
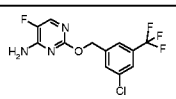
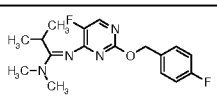
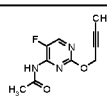
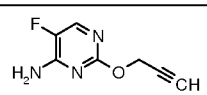
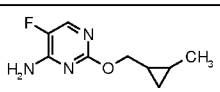
646		A	A	B	A	white solid	185-187	298	296	
647		A	A	A	A	white solid	89-90	290.8 (Na+)		
648		A	A	A	A	white solid	132	344	342	
649		D	A	D	C	LIGHT YELLOW SOLID	130-132	278		
650		A	A	A	A	yellow solid	108	322	320	
651		D	B	D	D	white solid		381	379	
652		D	A	D	B	yellow oil		350	348	
653		C	A	D	D	white solid	58-59	184		
654		A	A	A	A	white solid	118-121	324		
655		B	C	B	A	yellow solid	144-146	461	459	
656		A	A	A	A	clear oil		334		
657		E	E	E	E	Off white solid		459		
658		D	B	D	B	YELLOW GUMMY SOLID				
659		E	E	E	E	Pale yellow solid		477		
660		C	D	A	A	white solid	160-161			
661		E	E	E	E	Off white solid		280		
662		C	C	D	A	yellow solid	176	409	407	

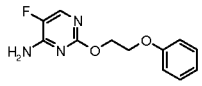
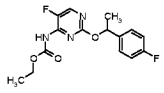
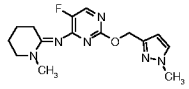
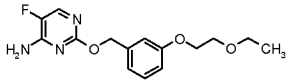
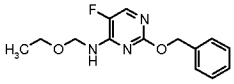
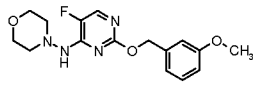
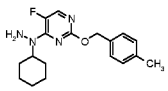
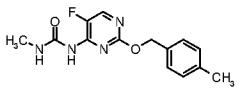
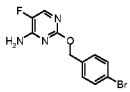
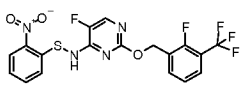
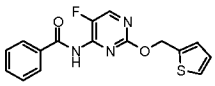
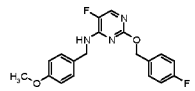
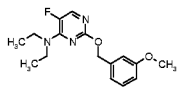
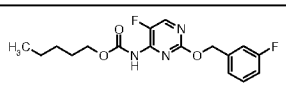
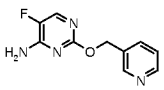
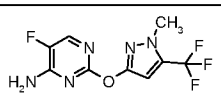
663		A	A	A	A	yellow solid	123-124	323		
664		D	D	D	C	OFF WHITE SOLID	125-127	356		
665		E	E	E	E	Colourless liquid		242		
666		E	E	E	E	Yellow solid		248		
667		D	A	D	A	brown solid	108-111	357	355	
668		A	A	C	A			347	345	
669		A	A	A	A	white solid	135-136	305		
670		B	A	B	A	off-white solid	188-190	401	399	
671		A	A	A	A	white solid	153-154			
672		A	A	A	A	off-white solid	127-129	314		
673		A	A	A	A	off-white solid	94-95	266	264	
674		A	A	A	A	clear oil		366	364	
675		A	A	A	A	light tan waxy solid		292	290	
676		D	D	C	A	yellow oil		354	352	
677		A	A	A	A	white solid	113-114	250	248	
678		C	A	D	A	off-white crystals	128-129	321	319	
679		A	A	A	A	off white solid	98-99	363		

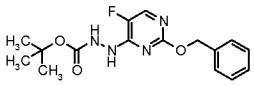
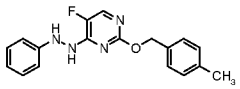
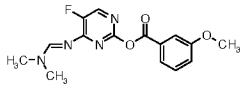
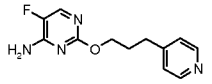
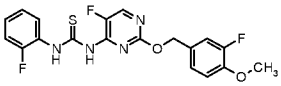
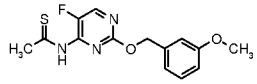
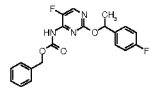
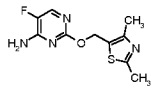
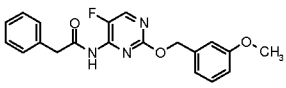
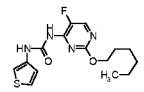
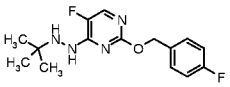
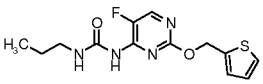
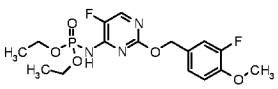
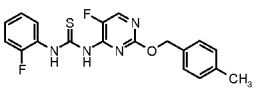
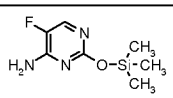
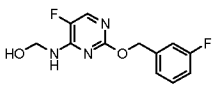
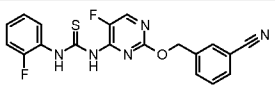
680		C	C	D	D	yellow solid	175-182	433	431	
681		A	A	A	A	white solid	86-88	285		
682		A	A	A	A	off-white solid	153-155	290		
683		E	E	E	E	Colourless liquid		236 [M+Na]		
684		A	A	A	A	white solid	94-95	335		
685		D	D	D	A	yellow solid	175-183	433	431	
686		E	E	E	E	white solid	160-161	262	260	
687		D	D	C	A	yellow solid	122	338	336	
688		A	A	A	A	white solid	93-95	289		
689		A	A	A	A	white solid	126-128	254	252	
690		A	A	B	A			379	377	
691		B	A	B	A	yellow solid	162	262	260	
692		A	A	A	A	clear yellow oil		305		
693		A	A	A	A	white solid	127-130	292	290	
694		D	C	D	C	white solid	181-183	451	449	
695		D	C	D	A	WHITE SOLID	100-102	256		
696		B	A	A	A	off-white solid	98-102	276	274	

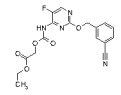
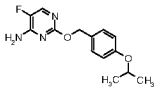
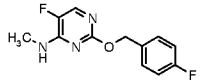
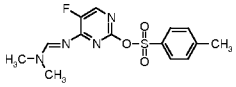
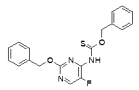
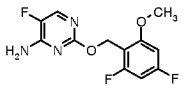
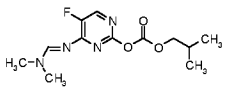
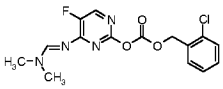
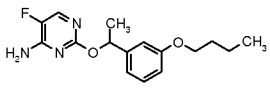
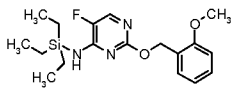
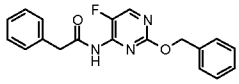
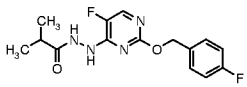
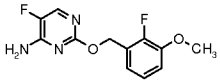
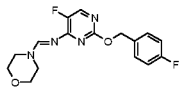
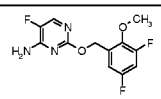
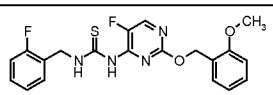
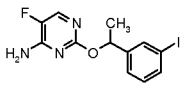
697		C	C	D	D	LIGHT YELLOW SOLID		393		
698		A	A	A	A	white solid	117	314	312	
699		B	A	A	A	tannish solid		222		
700		C	A	D	B	tan solid	185-187	375	373	
701		D	A	D	A	pale yellow solid	138-142	332	329	
702		A	A	A	A	clear oil		382	380	
703		D	D	D	C	white solid	116-117	435	433	
704		A	A	A	A	white solid	76-77	347		
705		B	A	A	A	white solid	117-119	288	286	
706		D	B	D	A	light yellow solid	163-165	346	344	
707		A	A	A	A	orange solid	156	299	297	
708		A	A	A	A	white solid	89-90	292	290	
709		D	B	D	A	clear colorless oil		388	386	
710		B	A	B	A	colorless oil		262	260	
711		C	A	B	A	white solid	138-139	379	377	
712		E	E	E	E	Off white solid		415		
713		B	A	A	A	brown solid	95-98	238		

714		A	A	A	A	yellow oil		294	292	
715		D	D	C	B	white solid	198-201	251	249	
716		A	A	A	A	yellow solid	93	326	324	
717		A	A	B	A			338		
718		C	C	C	A	pale yellow solid	135-139	356	353	
719		E	E	D	B	white solid	103-104	300	298	
720		A	A	A	A	white solid	115	299		
721		E	E	E	E			370	368	
722		D	C	D	D	light yellow solid	58-59	184	182	
723		E	E	E	E	Pale yellow solid		400		
724		D	D	D	C	white solid	170-171	335	333	
725		A	A	A	A	yellow solid	146-147	346	344	
726		A	A	A	A	white solid	109-110	305		
727		A	A	A	A	clear yellow oil		307	305	
728		E	E	E	E	Brown liquid		228		
729		B	B	B	C	light yellow solid	178-180	307		
730		A	A	A	A	clear yellow oil		279		

731		D	D	D	D	white solid	84-85	200	198	
732		B	A	A	A	pale amber oil		362		
733		A	A	A	A	white solid	96-98	234	232	
734		A	A	A	A	White Solid	110-111	250	248	
735		A	A	A	A	white solid			278	
736		D	D	D	D	white solid		370	368	
737		D	D	D	D	YELLOW SOLID		361		
738		E	E	E	E	Pale yellow solid		334		
739		A	A	A	A	white solid	87-88	295	293	
740		E	E	D	D	yellow oil		242	240	
741		A	A	C	A	clear colorless oil		280	278	
742		E	E	E	E	Pale yellow solid		284 [M+Na]		
743		A	A	A	A	yellow solid	93		320	
744		A	A	A	A	tan oil		335		
745		A	A	A	A	WHITE SOLID	158-160	224		
746		D	A	D	D	orange solid	106-108	168	166	
747		B	A	D	A	tan oil		--	196	

748		E	E	D	D	white solid	112-113	250	248	
749		A	A	A	A			324	322	
750		C	B	C	A			328		
751		C	A	B	A	pale amber oil		319		
752		A	A	A	A	colorless oil		308	306	
753		A	A	A	A	clear pale yellow oil		278	276	
754		D	C	D	D	colorless oil		336	333	
755		D	D	C	C	pale yellow oil		331		
756		C	D	D	D	white solid	199-200	348	346	
757		A	A	A	A	light yellow needles	127-129	299	297	
758		C	B	C	A	yellow solid	163-170	459	457	
759		C	A	B	A	yellow oil		330	328	
760		E	E	E	E	Off white solid			356	
761		E	E	E	E	Brown liquid		306		
762		A	A	A	A	white solid	61-62	352	350	
763		A	A	A	A	off-white solid		221		
764		D	D	D	D	white solid	145-146	278	276	

765		D	D	D	C	white solid	44-49	335	333	
766		D	C	D	B	dark brown solid	132-140	325	323	
767		A	A	A	A	white solid	110 (dec)	319		
768		D	C	D	C	white solid	183-184	249	247	
769		D	A	B	A	off-white solid	150-152	421	419	
770		A	A	A	A	yellow oil			306	
771		A	A	A	A			386	384	
772		A	A	A	A	yellow solid	180-181	255		
773		D	D	C	A	white solid	132-134	368	366	
774		D	D	D	D	LIGHT YELLOW SOLID		339		
775		D	D	D	D	white solid	77-80	310	307	
776		D	D	D	D	white solid	157-158	311	309	
777		D	C	D	D	white solid		404	402	
778		A	A	A	A	white solid	146-147	387	385	
779		A	A	A	A	white solid	118-120			201
780		A	A	A	A	white solid	107-108	268	266	
781		D	C	D	B	light yellow solid	160-162	398	396	

782		C	A	D	C			375	373	
783		A	A	A	A	off-white solid	51-54	278	276	
784		D	D	D	D	white solid	112-115		250	
785		A	A	A	A	white solid	163-164	340		
786		E	E	E	E	Pale yellow semi solid		370		
787		A	A	A	A	white solid	171	286	284	
788		A	A	A	A	white solid	59-60	285		
789		A	A	A	A	white solid	134-141	353		
790		A	A	A	A	clear oil			304	
791		E	E	E	E	clear oil		365		
792		C	B	A	A	white solid	123-125	338	336	
793		D	D	D	D	off white solid	158-166	323	321	
794		A	A	A	A	white solid	108		266	
795		A	A	A	A	white solid	124-125	335		
796		A	A	A	A	white solid	149	286	284	
797		C	A	B	A	off-white solid	167-168	417	415	
798		A	A	A	A	clear oil			358	

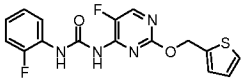
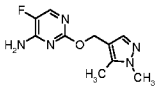
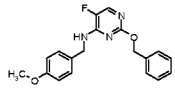
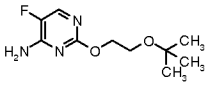
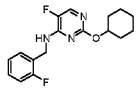
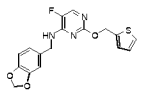
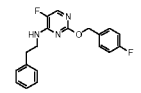
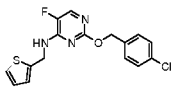
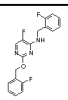
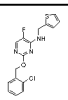
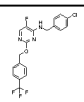
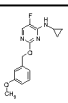
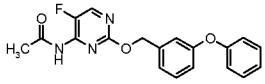
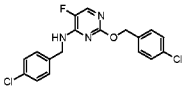
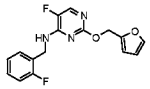
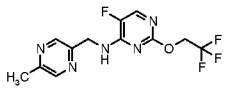
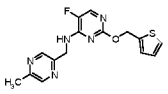
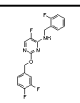
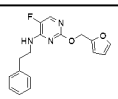
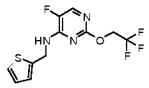
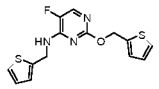
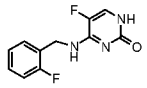
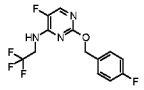
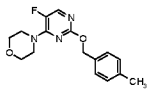
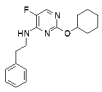
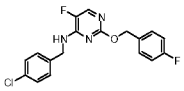
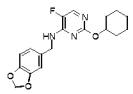
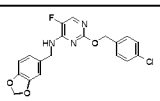
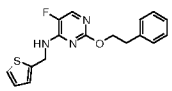
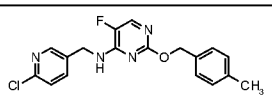
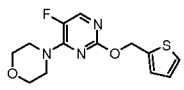
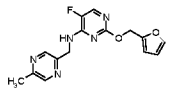
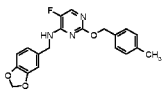
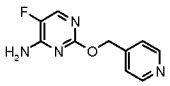
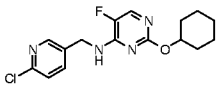
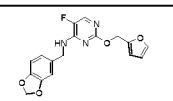
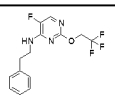
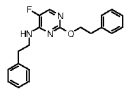
799		D	D	D	D	white solid	200-202	363	361	
800		A	A	A	A	tan solid		238		
801		E	E	E	E	Off white solid			338	
802		D	D	D	D	white solid	98-99	230	228	

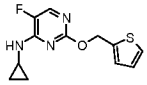
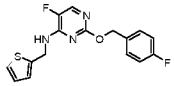
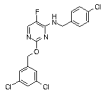
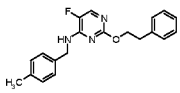
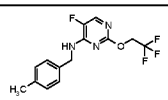
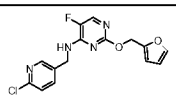
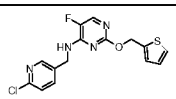
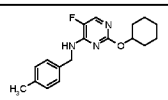
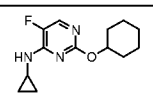
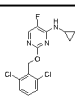
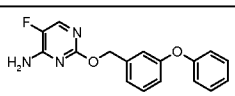
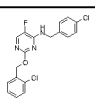
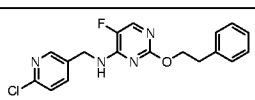
TABLE II: 1 DP Activity of Compounds on SEPTTR at 50 and 200 ppm

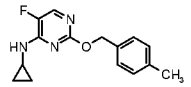
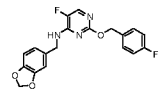
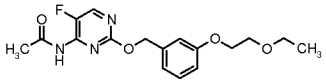
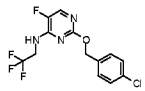
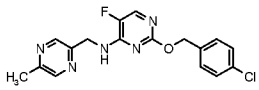
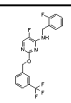
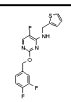
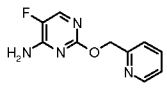
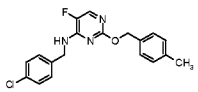
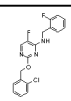
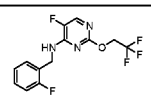
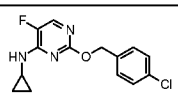
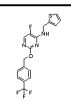
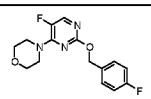
Cmpd	Structure	SEPTTR 1DP 50 ppm	SEPTTR 1DP 200 ppm	Phys. App.	MP	Mass Spec. (ES+)	Mass Spec. (ES-)	GCMS
803		D	B			320		
804		C	B			360		
805		B	A			342		
806		E	A			384		
807		E	A			294		
808		A	A			350		
809		B	A			346		
810		E	A			350		
811		A	A			412		
812		E	A			290		

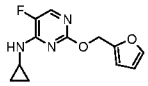
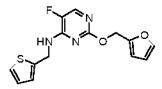
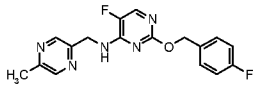
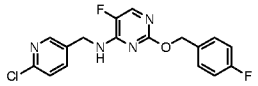
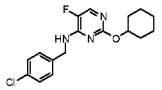
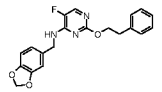
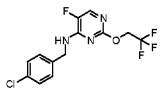
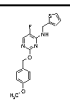
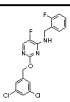
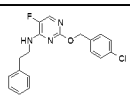
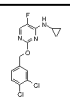
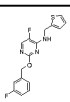
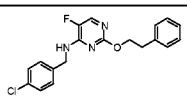
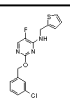
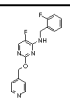
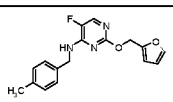
813		A	A			412		
814		E	A			384		
815		A	A	white solid	115-118	354	352	
816		A	A			378		
817		C	A			318		
818		D	D			317		
819		E	A	off white solid		328		
820		C	A			362		
821		E	A			290		
822		C	A			332		
823		E	A			290		
824		A	A			346		
825		B	A			364		
826		E	A			328		
827		D	C			314		
828		D	D			304		
829		C	A			428		

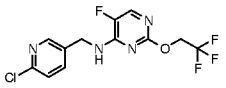
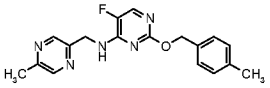
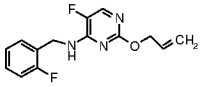
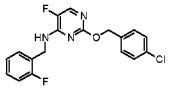
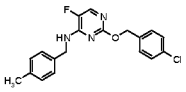
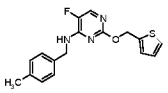
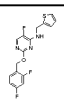
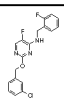
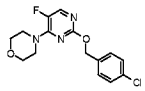
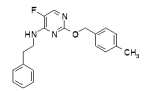
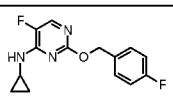
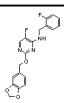
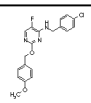
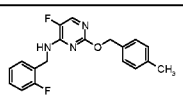
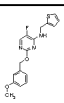
830		D	D			308		
831		B	A			322		
832		D	D	white solid	167-169	238	236	
833		C	B				318	
834		E	A			296		
835		E	A			384		
836		B	A			304		
837		D	D			316		
838		E	A			384		
839		E	A			360		
840		B	A			362		
841		B	A			346		
842		A	A			388		
843		C	A			330		
844		A	A				357	
845		A	A			296		
846		D	C	white solid	108-110	226	224	

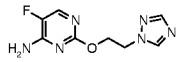
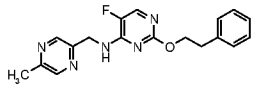
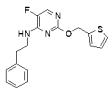
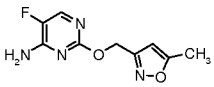
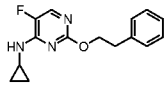
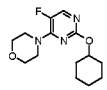
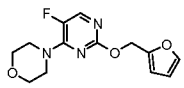
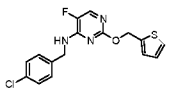
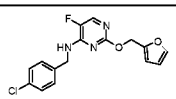
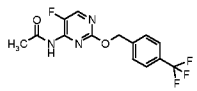
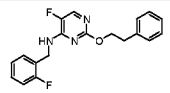
847		A	E	white solid	155-157	288	286	
848		D	D	white solid		212	210	
849		A	A			316		
850		D	B	yellow-white solid	189-191	144		
851		A	A			380		
852		B	A			278		
853		D	D	white solid	112-114	158		
854		B	A			368		
855		E	A			344		
856		E	A	off-white solid		221		
857		B	A			397		
858		D	C				335	
859		A	A			344		
860		E	A			400		
861		D	C			316		
862		B	A			338		
863		A	A			398		

864		D	C	white solid	115-117	212	210	
865		C	A			358		
866		D	A			266		
867		A	A			334		
868		B	A			414		
869		E	A			346		
870		E	A			330		
871		D	C			338		
872		C	B			316		
873		D	D			335		
874		D	D			351		
875		D	A			316		
876		D	D			249		
877		E	A			330		
878		A	A	yellow gummy solid		312	310	
879		A	A			380		
880		D	C			359		

881		A	A			274		
882		A	A			372		
883		A	A			398		
884		A	A	orange oil		350	348	
885		C	B				334	
886		A	A			360		
887		E	A			294		
888		D	B			329		
889		A	A			397		
890		E	A			352		
891		A	A	yellowish solid		221		
892		B	A			358		
893		A	A			362		
894		D	D			320		
895		A	A			294		
896		E	A			384		
897		D	B			308		

898		D	D			250		
899		C	A			306		
900		B	A			344		
901		B	A			363		
902		E	A			317		
903		D	A			336		
904		D	C			368		
905		C	B			336		
906		E	A			346		
907		B	A			398		
908		A	A			358		
909		E	A			328		
910		E	A			334		
911		D	D			358		
912		E	A			350		
913		A	A			329		
914		D	A			314		

915		D	D			337		
916		A	A			340		
917		D	B	yellow-white solid	54-56	278	276	
918		A	A			362		
919		E	A			304		
920		A	A			359		
921		A	A			364		
922		B	C			330		
923		E	A			352		
924		A	A			362		
925		D	D			324		
926		A	A			338		
927		B	A			278		
928		A	A			372		
929		B	A			374		
930		D	A			342		
931		E	A			346		

932		A	A	white solid	49-51	170	168	
933		C	B	white solid	145-149		223	
934		D	C			340		
935		C	A			345		
936		A	A	white solid	88-91	234	232	
937		A	A			330		
938		E	A			296		
939		D	A	off-white solid		225		
940		D	D			274		
941		D	D			282		
942		A	A			414		
943		B	A			398		
944		D	D			280		
945		A	A			350		
946		B	A			334		
947		A	A	white solid	144-146	330	328	
948		D	D			342		

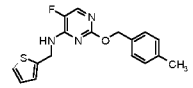
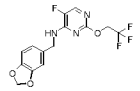
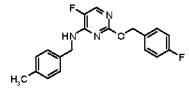
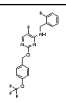
949		B	A			330		
950		D	D			346		
951		B	A			342		
952		E	C			261		
953		C	A			412		

TABLE III: 1 DP Activity of Compounds on CERCBE, VENTIN, and MYCOFI

Cmpd #	CERCBE 1DP 25 ppm	CERCBE 1DP 75 ppm	VENTIN 1DP 25 ppm	VENTIN 1DP 75 ppm	MYCOFI 1DP 50 ppm	MYCOFI 1DP 200 ppm
1	C	C	A	A	C	B
3	E	E	D	A	E	E
4	A	A	A	A	E	E
5	E	E	A	A	E	E
7	B	B	A	A	E	E
9	D	D	A	C	E	E
10	D	D	B	A	E	E
11	D	D	A	A	E	E
14	D	D	A	A	E	E
15	E	E	A	A	E	E
20	E	E	B	A	E	E
23	D	B	B	A	E	E
24	D	D	C	A	E	E
35	E	E	A	A	E	E
36	B	B	B	A	E	E
46	E	E	A	A	E	E

61	D	D	A	B	E	E
68	B	B	B	A	E	E
69	D	C	B	A	E	E
79	D	C	C	C	E	E
121	D	D	A	C	E	E
122	C	C	A	A	E	E
125	C	C	C	A	E	E
135	C	C	B	B	E	E
137	D	D	D	A	E	E
141	D	D	D	C	E	E
155	D	D	C	D	E	E
158	D	D	B	B	E	E
163	D	D	D	C	E	E
164	D	D	C	B	E	E
169	D	D	B	C	E	E
180	D	C	C	D	E	E
187	D	C	B	C	E	E
189	C	D	B	B	E	E
190	C	C	C	C	E	E
207	D	D	D	C	E	E
209	E	E	B	A	E	E
211	D	D	C	B	E	E
214	B	B	A	A	E	E
221	C	B	D	C	E	E
226	D	C	C	A	E	E
233	D	D	D	B	E	E
236	E	E	A	A	E	E
248	D	D	D	B	E	E
251	D	B	A	A	E	E
260	A	B	A	A	E	E
270	C	C	D	C	E	E

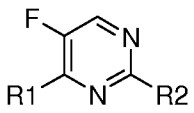
271	C	C	C	B	E	E
288	D	C	B	C	E	E
311	C	C	C	C	E	E
313	E	E	C	B	E	E
316	B	A	A	A	E	E
335	C	A	A	A	E	E
337	B	A	B	A	E	E
341	D	D	C	D	E	E
342	C	A	A	A	E	E
343	A	A	A	B	E	E
345	E	E	B	A	E	E
347	E	E	A	C	E	E
352	D	D	D	C	E	E
353	C	C	C	A	E	E
356	B	D	B	C	E	E
370	C	C	C	C	E	E
373	D	D	D	C	E	E
384	D	D	B	D	E	E
410	C	C	C	B	E	E
411	C	C	B	B	E	E
418	D	D	B	B	E	E
436	B	C	A	A	E	E
452	D	D	D	C	E	E
469	E	E	B	A	E	E
481	C	A	A	A	E	E
483	D	D	C	A	E	E
488	D	D	C	C	E	E
510	E	E	A	A	E	E
524	D	D	B	B	E	E
538	D	D	C	B	E	E
554	D	B	A	A	E	E

560	D	C	D	A	E	E
569	C	A	A	A	E	E
570	D	C	C	A	E	E
582	B	B	A	A	E	E
584	C	C	C	C	E	E
593	C	B	A	A	E	E
626	D	D	C	A	E	E
630	D	D	B	A	E	E
631	D	D	D	C	E	E
635	C	C	C	A	E	E
649	D	D	C	C	E	E
651	C	C	D	D	E	E
687	D	D	C	B	E	E
694	C	C	C	B	E	E
707	B	C	B	B	E	E
710	D	D	C	C	E	E
719	D	C	B	B	E	E
720	D	B	B	A	E	E
730	C	C	B	B	E	E
732	C	A	C	A	E	E
734	E	E	A	A	E	E
739	D	D	C	B	E	E
741	D	D	B	A	E	E
764	C	D	C	C	E	E
800	A	A	A	A	E	E
804	D	D	D	D	E	E
845	D	D	C	C	E	E
849	C	C	A	B	E	E
858	C	C	C	D	E	E
860	D	C	C	B	E	E
894	D	D	D	C	E	E

933	C	C	D	C	E	E
941	D	D	B	C	E	E
952	D	D	D	D	E	E

WHAT IS CLAIMED IS:

1. A compound of formula I



I

wherein R^1 is $-N(R^3)R^4$;

R^2 is $-OR^{21}$;

R^3 is:

H;

C_1-C_6 alkyl optionally substituted with 1- to 3 R^5;

C_2-C_6 alkenyl optionally substituted with 1-3 R^5;

a 5- or 6- membered heteroaromatic ring selected from the group consisting of furanyl, pyridinyl, pyridinyl-N-oxide, pyrimidinyl, pyridazinyl, pyrazinyl, thiazolyl, triazinyl, thiadiazolyl, oxazolyl, isoxazolyl, triazolyl, each heteroaromatic ring being optionally substituted with 1-3 R^{30};

imidazole fused with an aromatic or heteroaromatic ring selected from the group consisting of benzene, oxazole, isoxazole, furan, thiazole, pyrimidine, pyridine, pyrrole, pyrazine, thiophene, each aromatic or heteroaromatic ring being optionally substituted with 1 to 3 R^{30};

benzo[1,3]dioxolyl;

3H-isobenzofuran-1-onyl;

cyano;

C_3-C_6 alkynyl optionally substituted with 1-3 R^5;

$-C(=O)R^6$;

$-C(=O)OCH_2C(=O)R^8$;

$-C(=S)R^6$;

$-C(=S)NHR^8$;

-C(=O)N(R^8) R^{10};

-OR^7;

-P(O)(OR^{15})$_2$;

-$S(O)_2R^8$;

-SR^8;

-$Si(R^8)_3$;

-$N(R^9)R^{10}$;

-$N=C(R^{15})R^{16}$;

-$(CHR^{22})_mR^{37}$;

-$(CHR^{24})OR^{29}$; or

-$C(=NR^{16})SR^{16}$;

wherein m is an integer from 1-3;

R^4 is:

H;

C_1-C_6 alkyl, optionally substituted with 1-3 R^5;

-$C(=O)R^6$; or

-C(=O)N(R^8) R^{10};

alternatively R^3 and R^4 may be taken together to form:

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

$=C(R^{12})N(R^{13})R^{14}$;

$=C(R^{13})(R^{14})$;

$=C(R^{15})OR^{15}$;

$=S(R^{34})_2$; or

$=NR^{35}$;

R^5 is independently halogen, C_1-C_6 alkyl, C_1-C_4 haloalkyl, C_1-C_4 alkoxy, C_1-C_4 haloalkoxy, C_1-C_4 alkylthio, C_1-C_4 haloalkylthio, amino, C_1-C_3 alkylamino, C_2-C_6 alkoxycarbonyl, C_2-C_6 alkylcarbonyl, C_2-C_6 alkylaminocarbonyl, -OH, N-methyl piperazine or C_3-C_6 trialkylsilyl;

R^6 is independently H, C_1-C_6 alkyl, C_1-C_5 haloalkyl, C_1-C_5 alkoxy, C_1-C_5 haloalkoxy C_2-C_6 alkoxycarbonyl, C_1-C_4 alkoxyalkoxy, C_2-C_6 alkylaminocarbonyl; 1-benzo[1,2,3]thiadiazol-7-yl, thiazolyl, benzyl, phenyl, phenoxy, or benzyloxy wherein the thiazolyl, benzyl, phenyl, phenoxy, or benzyloxy may be optionally substituted with 1-3 R^{20}, a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^7 is H, C_1-C_6 alkyl, C_2-C_6 alkenyl, C_1-C_5 haloalkyl, benzyl which may be optionally substituted with 1-5 R^{20}, $CHR^{18}C(O)OR^{19}$, or a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^8 is independently C_1-C_6 alkyl, C_1-C_6 haloalkyl, amino, C_1-C_6 alkylamino, C_2-C_6 dialkylamino, phenyl optionally substituted with 1-3 R^{30}, or a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^9 is H, C_1-C_6 alkyl C_1-C_6 haloalkyl, $-C(=O)R^{17}$, or phenyl optionally substituted with 1-3 R^{20},

R^{10} is H or C_1-C_6 alkyl, C_1-C_6 haloalkyl, or phenyl optionally substituted with 1-3 R^{20};

R^{11} is independently halogen, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_1- C_6 alkylthio, C_1-C_6 haloalkylthio, amino, C_1-C_6 alkylamino, C_2-C_6 dialkylamino, C_2-C_6 alkoxycarbonyl, or C_2-C_6 alkylcarbonyl;

R^{12} is H or C_1-C_4 alkyl;

R^{13} and R^{14} are independently H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, C_2-C_6, alkylcarbonyl, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20};

alternatively R^{13} and R^{14} may be taken together to form:

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, or 3,4-dihydro-1H-isoquinolin-2-yl;

alternatively R^{12} and R^{13} may be taken together to form:

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^{15} is H or C_1-C_6 alkyl;

R^{16} is H, C_1-C_6 alkyl, or phenyl optionally substituted with 1-3 R^{20};

alternatively R^{15} and R^{16} may be taken together as $-(CH_2)_4-$ or $-(CH_2)_5-$;

R^{17} is H, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 alkoxy, phenyl, phenoxy, or benzyloxy wherein each ring may be optionally substituted with 1-3 R^{20};

R^{18} is H, C_1-C_6 alkyl, or C_1-C_6 haloalkyl;

R^{19} is H, C_1-C_6 alkyl, C_1-C_6 haloalkyl, or benzyl;

R^{20} is independently halogen, cyano, nitro, amino, C_1-C_6 alkoxyalkoxy, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 hydroxyalkyl, C_2-C_6 alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, C_2-C_6 alkenyl, C_2-C_6 haloalkenyl, C_3-C_6 alkynyl, C_3-C_6 haloalkynyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_2-C_6 alkenyloxy, C_2-C_6 haloalkenyloxy, C_3-C_6 alkynyloxy, C_3-C_6 haloalkynyloxy, C_1-C_6 alkylthio, C_1-C_6 haloalkylthio, C_1-C_6 alkylsulfonyl, C_1-C_6 haloalkylsulfonyl, C_2-C_6 alkenylthio, C_2-C_6 haloalkenylthio, C_2-C_6 haloalkenylsulfonyl, C_3-C_6 alkynylthio, C_3-C_6 alkynylsulfonyl, C_3-C_6 haloalkynylsulfonyl, C_1-C_6 alkylamino, C_2-C_8 dialkylamino, C_3-C_8 dialkylaminocarbonyl, C_2-C_6 alkoxycarbonyl, C_2-C_6 alkylcarbonyl, C_3-C_6 trialkylsilyl, 2-[(E)-methoxyimino]-N-methyl-acetamidyl, phenyl, benzyl, benzyloxy, phenoxy,or a 5- or 6- membered heteroaromatic ring wherein each phenyl, benzyl, benzyloxy, phenoxy, or 5- or 6- membered heteroaromatic ring may be optionally substituted with 1-3 substitutents independently selected from R^{31};

R^{21} is:

H;

C_1-C_{14} alkyl;

C_1-C_6 haloalkyl;

C_2-C_4 alkenyl;

C_2-C_4 haloalkenyl;

C_3-C_4 alkynyl;

C_3-C_4 haloalkynyl;

phenyl, naphthyl, or tetrahydroquinolinyl each optionally substituted with 1-3 R^{20};

$-(CHR^{22})_mR^{23}$;

$-(CHR^{24})_mC(O)OR^{25}$;

$-(CHR^{24})_mC(O)R^{26}$;

$-(CHR^{24})_mC(O)N(R^{27})R^{28}$;

$-(CHR^{24})_mOR^{29}$;

$-(CHR^{24})_mSR^{29}$

$-(CHR^{24})_mN(R^{27})R^{28}$;

$-C(=O)R^{32}$;

$-N=C(R^{32})(R^{36})$;

$-NR^{25}C(=O)OR^{25}$

$-Si(R^8)_3$;

$-SO_2R^{33}$;

C_2-C_6 alkoxy carbonyl;

C_2-C_6 alkylaminocarbonyl;

C_2-C_6 alkylcarbonyl;

sugars selected from the group consisting of beta-D-glucose-tetraacetate, rhamnose, fructose, and pentose; or

a 5- or 6- membered heteroaromatic ring selected from the group consisting of furanyl, pyridinyl, pyridinyl-N-oxide, pyrimidinyl, pyridazinyl, pyrazinyl, pyrazolyl, thiazolyl, triazinyl, thiadiazolyl, oxazolyl, triazolyl or isoxazolyl wherein each 5- or 6- member heteroaromatic ring may be optionally substituted with 1-5 R^{20};

R^{22} is independently:

H;

halogen;

cyano;

nitro;

C_1-C_6 alkyl;

C_1-C_6 haloalkyl;

phenyl or benzyl optionally substituted with 1-3 R^{20};

C_1-C_6 hydroxyalkyl;

C_2-C_6 alkoxylalkyl;

C_3-C_6 haloalkynyl;

C_2-C_6 alkenyl;

C_2-C_6 haloalkenyl;

C_3-C_6 alkynyl;

C_1-C_6 alkoxy;

C_1-C_6 haloalkoxy;

C_1-C_6 alkylthio;

C_1-C_6 alkylamino;

C_2-C_8 dialkylamino;

C_3-C_6 cycloalkylamino;

C_4-C_6 (alkyl)cycloalkylamino;

C_2-C_6 alkylcarbonyl;

C_2-C_6 alkoxycarbonyl;

C_2-C_6 alkylaminocarbonyl;

C_3-C_8 dialkylaminocarbonyl;

C_3-C_6 trialkylsilyl;

ring-fused heteroaromatic rings selected from the group consisting of benzothiophenyl, quinolinyl, isoquinolinyl, thieno[2,3-b]pyridyl, 1-methyl-1H-thieno[2,3-c]pyrazolyl, and benzoimidazolyl, wherein each of the rings may be further substituted with 1-3 R^{20}; or

a 5- or 6- membered heteroaromatic ring selected from the group consisting of furanyl, pyridinyl, pyridinyl-N-oxide, pyrimidinyl, pyridazinyl, pyrazinyl, thiazolyl, triazinyl, thiadiazolyl, oxazolyl, isoxazolyl, triazolyl and thienyl;

R^{23} is:

H;

halogen;

C_1-C_6 alkyl;

C_1-C_6 haloalkyl;

C_2-C_6 dialkylamino;

phenyl optionally substituted with 1-5 R^{20};

ring-fused heteroaromatic rings selected from the group consisting of benzothiophenyl, quinolinyl, isoquinolinyl, thieno[2,3-b]pyridyl, 1-methyl-1H-thieno[2,3-c]pyrazolyl, benzofuranyl and benzoimidazolyl, 2,3-dihydro-benzofuran-2-yl, 4-methyl-4H-thieno[3,2-b]pyrrol-5-yl, 1-methyl-1H-indol-5-yl, imidazo[1,2-a]pyridin-2-yl, imidazo[2,1-b]thiazol-6-yl, benzothiazol-2-yl, benzo[b]thiophen-7-yl, and 1-methyl-1H-indazol-3-yl, wherein each of the rings may be further substituted with 1-3 R^{20};

naphthyl;

benzo[1,3]dioxolyl;

pyrrolidinonyl;

oxetanyl;

C_1-C_6 alkylthio optionally substituted with 1-5 R^{20};

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}; or

a 5- or 6- membered heteroaromatic ring selected from the group consisting of furanyl, pyridinyl, pyridinyl-N-oxide, pyrimidinyl, pyridazinyl, pyrazinyl, pyrazolyl, thiazolyl, triazinyl, thiadiazolyl, oxazolyl, isoxazolyl, triazolyl, imidazolyl, thiophene-2-yl and thiophen-3-yl wherein each heteroaromatic ring may be optionally substituted with 1-3 R^{20};

R^{24} is H, C_1-C_6 alkyl, C_1-C_6 alkoxy, benzyl, or phenyl wherein each of the benzyl or phenyl may be optionally substituted with 1-3 R^{20};

R^{25} is H, C_1-C_6 alkyl, phenyl or benzyl optionally substituted with 1-3 R^{20};

R^{26} is:

H;

C_1-C_6 alkyl;

C_1-C_6 alkoxy;

phenyl optionally substituted with 1-3 R^{20}; or

a 5- or 6 membered heteroaromatic ring selected from the group consisting of furanyl, pyridinyl, pyridinyl-N-oxide, pyrimidinyl, pyridazinyl, pyrazinyl, thiazolyl, triazinyl, thiadiazolyl, oxazolyl, triazolyl and isoxazolyl;

R^{27} and R^{28} are independently:

H;

C_1-C_6 alkyl;

benzyl or phenyl wherein each of the benzyl or phenyl may be optionally substituted with 1-3 R^{20};or

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^{29} is:

H;

C_1-C_6 alkyl;

C_1-C_6 haloalkyl;

C_1-C_6 alkoxyalkyl;

C_2-C_6 alkylcarbonyl;

benzyl or phenyl wherein each of the benzyl or phenyl may be optionally substituted with 1-3 R^{20}; or

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^{30} is independently halogen, cyano, nitro, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 hydroxyalkyl, C_2-C_6 alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, C_2-C_6 alkenyl, C_2-C_6 haloalkenyl, C_3-C_6 alkynyl, C_3-C_6 haloalkynyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_2-C_6 alkenyloxy, C_2-C_6 haloalkenyloxy, C_3-C_6 alkynyloxy, C_3-C_6 haloalkynyloxy, C_1-C_6 alkylthio, C_1-C_6 alkylsulfonyl, C_1-C_6 haloalkylsulfonyl, C_2-C_6 alkenylthio, C_2-C_6 haloalkenylthio, C_2-C_6 haloalkenylsulfonyl, C_3-C_6 alkynylthio, C_3-C_6 alkynylsulfonyl, C_3-C_6 haloalkynylsulfonyl, C_1-C_6 alkylamino, C_2-C_8 dialkylamino, C_3-C_8 dialkylaminocarbonyl, C_3-C_6 trialkylsilyl, thiazolyl, phenyl, pyrimidinyl, or pyridyl, wherein the thiazolyl, phenyl, pyridyl, or pyrimidinyl may be optionally substituted with 1-3 R^{20};

R^{31} is independently halogen, cyano, nitro, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 hydroxyalkyl, C_2-C_6 alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, C_2-C_6 alkenyl, C_2-C_6 haloalkenyl, C_3-C_6 alkynyl, C_3-C_6 haloalkynyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_2-C_6 alkenyloxy, C_2-C_6 haloalkenyloxy, C_3-C_6 alkynyloxy, C_3-C_6 haloalkynyloxy, C_1-C_6 alkylthio, C_1-C_6 alkylsulfonyl, C_1-C_6 haloalkylsulfonyl, C_2-C_6 alkenylthio, C_2-C_6 haloalkenylthio, C_2-C_6 haloalkenylsulfonyl, C_3-C_6 alkynylthio, C_3-C_6 alkynylsulfonyl, C_3-C_6 haloalkynylsulfonyl, C_1-C_6 alkylamino, C_2-C_8 dialkylamino, C_3-C_8 dialkylaminocarbonyl, or C_3-C_6 trialkylsilyl;

R^{32} is independently:

C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 hydroxyalkyl, C_2-C_6 alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, C_2-C_6 alkenyl, C_2-C_6 haloalkenyl, C_3-C_6 alkynyl, C_3-C_6 haloalkynyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_2-C_6 alkenyloxy, C_2-C_6 haloalkenyloxy, C_3-C_6 alkynyloxy, C_3-C_6 haloalkynyloxy, C_1-C_6 alkylthio, C_1-C_6

alkylsulfonyl, C_1-C_6 haloalkylsulfonyl, C_2-C_6 alkenylthio, C_2-C_6 haloalkenylthio, C_2-C_6 haloalkenylsulfonyl, C_3-C_6 alkynylthio, C_3-C_6 alkynylsulfonyl, C_3-C_6 haloalkynylsulfonyl, C_1-C_6 alkylamino, C_2-C_8 dialkylamino, C_3-C_8 dialkylaminocarbonyl, C_3-C_6 trialkylsilyl;

phenyl wherein the phenyl ring may be optionally substituted with 1-3 R^{20}; or

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^{33} is independently:

C_1-C_6 alkyl, C_1-C_6 haloalkyl, phenyl or thienyl optionally substituted with 1-3 R^{20}; or

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^{34} is:

C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_2-C_6 alkoxyalkyl, C_1-C_6 alkylamino; or

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^{35} is:

C_1-C_6 alkyl, C_2-C_6 alkylcarbonyl; or

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11};

R^{36} is H, cyano, C_1-C_6 alkyl, C_1-C_6 alkoxy, benzyl, or phenyl wherein each of the benzyl or phenyl may be optionally substituted with 1-3 R^{20};

alternatively R^{32} and R^{36} may be taken together to form:

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}; and

R^{37} is independently:

H, halogen, or phenyl optionally substituted with 1-5 R^{20};

C_1-C_6 alkyl, C_1-C_6 haloalkyl, hydroxyl, C_1-C_6 alkoxy, or C_1-C_6 haloalkoxy; or

a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}.

2. The compound of the formula I wherein R^3 is C_1-C_6 alkyl, -C(=O)R^6, -$(CHR^{22})_mR^{37}$,-$(CHR^{24})OR^{29}$, -OR^7, -C(=S)NHR^8, -$Si(R^8)_3$, -C(=O)$OCH_2C(=O)R^8$, R^4 is H, R^6 is C_1-C_6 alkyl, C_1-C_6 alkyl, C_1-C_5 haloalkyl, C_1-C_5 alkoxy, C_2-C_6 alkoxycarbonyl, phenyl, benzyl, C_1-C_4 alkoxyalkoxy, thiazolyl wherein the thiazole may be optionally substituted with 1-3 R^{20}, R^7 is H, C_1-C_6 alkyl, R^8 is C_1-C_6 alkyl, C_1-C_6 haloalkyl, or phenyl optionally substituted with 1-3 R^{30}, R^{24} is H, C_1-C_6 alkyl, R^{29} is H, C_1-C_6 alkyl, C_1-C_6 alkoxyalkyl, R^{30} is halogen, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, phenyl wherein each phenyl may be optionally substituted with 1-3 R^{20}, R^{20} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, R^{37} is halogen, phenyl optionally substituted with 1-5 R^{20}, C_1-C_6 alkyl, C_1-C_6 haloalkyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{21} is (-$CHR^{22})_mR^{23}$, m is 1, R^{22} is H, R^{23} is a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}. R^{11} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy.

3. The compound of the formula I wherein R^3 is C_1-C_6 alkyl, -C(=O)R^6, -$(CHR^{22})_mR^{37}$,-$(CHR^{24})OR^{29}$, -OR^7, -C(=S)NHR^8, -$Si(R^8)_3$, -C(=O)$OCH_2C(=O)R^8$, R^4 is H, R^6 is C_1-C_6 alkyl, C_1-C_6 alkyl, C_1-C_5 haloalkyl, C_1-C_5 alkoxy, C_2-C_6 alkoxycarbonyl, phenyl, benzyl, C_1-C_4 alkoxyalkoxy, thiazolyl wherein the thiazole may be optionally substituted with 1-3 R^{20}, R^7 is H, C_1-C_6 alkyl, R^8 is C_1-C_6 alkyl, C_1-C_6 haloalkyl, or phenyl optionally substituted with 1-3 R^{30}, R^{24} is H, C_1-C_6 alkyl, R^{29} is H, C_1-C_6 alkyl,

C_1-C_6 alkoxyalkyl, R^{30} is halogen, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, phenyl wherein each phenyl may be optionally substituted with 1-3 R^{20}, R^{20} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, R^{37} is halogen, phenyl optionally substituted with 1-5 R^{20}, C_1-C_6 alkyl, C_1-C_6 haloalkyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{11} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, C_1-C_4 alkyl, phenyl, R^{23} is a ring-fused heteroaromatic rings selected from the group consisting of benzothiophenyl, quinolinyl, isoquinolinyl, thieno[2,3-b]pyridyl, 1-methyl-1H-thieno[2,3-c]pyrazolyl, benzofuranyl and benzoimidazolyl, 2,3-dihydro-benzofuran-2-yl, 4-methyl-4H-thieno[3,2-b]pyrrol-5-yl, 1-methyl-1H-indol-5-yl, imidazo[1,2-a]pyridin-2-yl, imidazo[2,1-b]thiazol-6-yl, benzothiazol-2-yl, benzo[b]thiophen-7-yl, 1-methyl-1H-indazol-3-yl, wherein each of the rings may be further substituted with 1-3 R^{20}.

4. The compound of the formula I wherein R^3 is C_1-C_6 alkyl, $-C(=O)R^6$, $-(CHR^{22})_mR^{37}$,$-(CHR^{24})OR^{29}$, $-OR^7$, $-C(=S)NHR^8$, $-Si(R^8)_3$, $-C(=O)OCH_2C(=O)R^8$, R^4 is H, R^6 is C_1-C_6 alkyl, C_1-C_6 alkyl, C_1-C_5 haloalkyl, C_1-C_5 alkoxy, C_2-C_6 alkoxycarbonyl, phenyl, benzyl, C_1-C_4 alkoxyalkoxy, thiazolyl wherein the thiazole may be optionally substituted with 1-3 R^{20}, R^7 is H, C_1-C_6 alkyl, R^8 is C_1-C_6 alkyl, C_1-C_6 haloalkyl, or phenyl optionally substituted with 1-3 R^{30}, R^{24} is H, C_1-C_6 alkyl, R^{29} is H, C_1-C_6 alkyl, C_1-C_6 alkoxyalkyl, C_2-C_6 alkylcarbonyl, R^{30} is halogen, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, phenyl wherein each phenyl may be optionally substituted with 1-3 R^{20}, R^{37} is halogen, phenyl optionally substituted with 1-5 R^{20}, C_1-C_6 alkyl, C_1-C_6 haloalkyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{11} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, R^{23} is naphthlyl, benzo[1,3]dioxolyl, phenyl optionally substituted with 1-5 R^{20}, R^{20} is halogen, cyano, nitro, amino, C_1-C_6 alkoxyalkoxy, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 hydroxyalkyl, C_2-C_6 alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, C_2-C_6 alkenyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_1-C_6 alkylthio, C_1-C_6 haloalkylthio, C_1-C_6 alkylsulfonyl, C_1-C_6 alkylamino, benzyloxy,

phenoxy, wherein each benzyloxy, phenoxy, may be optionally substituted with 1-3 substitutents independently selected from R^{31}, R^{31} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy.

5. The compound of the formula I wherein R^3 is C_1-C_6 alkyl, -C(=O)R^6, -$(CHR^{22})_mR^{37}$,-$(CHR^{24})OR^{29}$, -OR^7, -C(=S)NHR^8, -$Si(R^8)_3$, -$C(=O)OCH_2C(=O)R^8$, R^4 is H, R^6 is C_1-C_6 alkyl, C_1-C_6 alkyl, C_1-C_5 haloalkyl, C_1-C_5 alkoxy, C_2-C_6 alkoxycarbonyl, phenyl, benzyl, C_1-C_4 alkoxyalkoxy, thiazolyl wherein the thiazole may be optionally substituted with 1-3 R^{20}, R^7 is H, C_1-C_6 alkyl, R^8 is C_1-C_6 alkyl, C_1-C_6 haloalkyl, or phenyl optionally substituted with 1-3 R^{30}, R^{24} is H, C_1-C_6 alkyl, R^{29} is H, C_1-C_6 alkyl, C_1-C_6 alkoxyalkyl, C_2-C_6 alkylcarbonyl, R^{30} is halogen, nitro C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, phenyl wherein each phenyl may be optionally substituted with 1-3 R^{20}, R^{20} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_1-C_6 alkoxyalkoxy, C_1-C_6 haloalkyl, C_1-C_6 hydroxyalkyl, C_2-C_6 alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, hydroxyl, C_1-C_6 alkylamino, C_2-C_8 dialkylamino, phenyl wherein each phenyl may be optionally substituted with 1-5 R^{31}, 5- or 6-membered heteroaromatic ring wherein each heteroaromatic ring may be optionally substituted with 1-3 R^{31}, R^{31} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, R^{37} is halogen, phenyl optionally substituted with 1-5 R^{20}, C_1-C_6 alkyl, C_1-C_6 haloalkyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{11} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, R^{21} is (-$CHR^{22})_mR^{23}$, m is 1, R^{22} is -CH_3, -CH_2CH_3, -$CH_2CH_2CH_3$, benzyl, 4-fluoro-phenyl, R^{23} is phenyl, 4-fluoro-phenyl, p-tolyl.

6. The compound of the formula I wherein R^3 is C_1-C_6 alkyl, -C(=O)R^6, -$(CHR^{22})_mR^{37}$,-$(CHR^{24})OR^{29}$, -OR^7, -C(=S)NHR^8, -$Si(R^8)_3$, -$C(=O)OCH_2C(=O)R^8$, R^4 is H, R^6 is C_1-C_6 alkyl, C_1-C_5 haloalkyl, C_1-C_5 alkoxy, C_2-C_6 alkoxycarbonyl, phenyl, benzyl, C_1-C_4 alkoxyalkoxy, thiazolyl wherein the thiazole may be optionally substituted with 1-3 R^{20}, R^7 is H, C_1-C_6 alkyl, R^8 is C_1-C_6 alkyl, C_1-C_6 haloalkyl, or phenyl optionally substituted with 1-3 R^{30}, R^{24} is H, C_1-C_6 alkyl, R^{29} is H, C_1-C_6 alkyl, C_1-C_6 alkoxyalkyl, C_2-C_6 alkylcarbonyl, R^{30} is halogen, nitro C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, phenyl wherein each phenyl may be optionally substituted

with 1-3 R^{20}, R^{20} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_1-C_6 alkoxyalkoxy, C_1-C_6 hydroxyalkyl, C_2-C_6 alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, hydroxyl, C_1-C_6 haloalkoxy, C_1-C_6 alkylamino, C_2-C_8 dialkylamino, phenyl wherein each phenyl may be optionally substituted with 1-5 R^{31}, 5- or 6- membered heteroaromatic ring wherein each heteroaromatic ring may be optionally substituted with 1-3 R^{31}, R^{31} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, R^{37} is halogen, phenyl optionally substituted with 1-5 R^{20}, C_1-C_6 alkyl, C_1-C_6 haloalkyl, hydroxyl, C_1-C_6 alkoxy, a 5- or 6-membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{11} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, C_1-C_6 alkyl, R^{23} is phenyl, p-tolyl, 4-fluoro-phenyl, 4-methoxy-phenyl, 3-methoxy-phenyl, thiophen-2-yl, thiophen-3-yl, 3-fluoro-phenyl, 3-bromo-phenyl, benzothiophen-2-yl, 2,4,6-trimethyl-phenyl, 1-ethyl-2-methoxy-phenyl, 3-benzonitrile, 3-fluoro-4-methoxy-phenyl.

7. The compound of the formula I wherein R^3 is C_1-C_6 alkyl, $-C(=O)R^6$, $-(CHR^{22})_mR^{37}$,$-(CHR^{24})OR^{29}$, $-OR^7$, $-C(=S)NHR^8$, R^4 is H, R^{21} is $-C(=O)R^{32}$, $-N=C(R^{32})(R^{36})$, $-SO_2R^{33}$, $-NR^{25}C(=O)OR^{25}$, C_2-C_6 alkoxy carbonyl; C_2-C_6 alkylaminocarbonyl; C_2-C_6 alkylcarbonyl, R^6 is C_1-C_6 alkyl, C_1-C_5 haloalkyl, C_1-C_5 alkoxy, C_2-C_6 alkoxycarbonyl, phenyl, benzyl, C_1-C_4 alkoxyalkoxy, thiazolyl wherein the thiazole may be optionally substituted with 1-3 R^{20}, R^7 is H, C_1-C_6 alkyl, R^8 is C_1-C_6 alkyl, C_1-C_6 haloalkyl, or phenyl optionally substituted with 1-3 R^{30}, R^{24} is H, C_1-C_6 alkyl, R^{29} is H, C_1-C_6 alkyl, C_1-C_6 alkoxyalkyl, C_2-C_6 alkylcarbonyl, R^{30} is halogen, nitro, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, phenyl wherein each phenyl may be optionally substituted with 1-3 R^{20}, R^{25} is H, C_1-C_6 alkyl, R^{33} is C_1-C_6 alkyl, C_1-C_6 haloalkyl, phenyl or thienyl optionally substituted with 1-3 R^{20}, R^{32} is C_1-C_6 alkyl, C_1-C_6 haloalkyl, alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, R^{36} is H, cyano, C_1-C_6 alkyl, C_1-C_6 alkoxy, benzyl, or phenyl wherein each of the benzyl or phenyl may be optionally substituted with 1-3 R^{20}, R^{20} is halogen, C_1-C_6 alkoxyalkoxy, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 hydroxyalkyl, C_2-C_6 alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_1-C_6 alkylamino, C_2-C_8 dialkylamino, phenyl wherein each phenyl may be optionally substituted with 1-5 R^{31}, 5- or 6- membered heteroaromatic ring wherein each heteroaromatic ring may be optionally substituted with

1-3 R^{31}, R^{31} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, R^{37} is halogen, phenyl optionally substituted with 1-5 R^{20}, C_1-C_6 alkyl, C_1-C_6 haloalkyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{11} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy.

8. The compound of the formula I wherein R^3 is C_1-C_6 alkyl, -C(=O)R^6, -C(=O)N(R^8)R^{10}, R^4 is C_1-C_6 alkyl, -C(=O)R^6, -C(=O)N(R^8)R^{10}, R^6 is C_1-C_6 alkyl, C_1-C_5 haloalkyl, C_1-C_5 alkoxy, C_2-C_6 alkoxycarbonyl, phenyl, benzyl, C_1-C_4 alkoxyalkoxy, thiazolyl wherein the thiazole may be optionally substituted with 1-3 R^{20}, R^8 is C_1-C_6 alkyl, C_1-C_6 haloalkyl, or phenyl optionally substituted with 1-3 R^{30}, R^{10} is H, C_1-C_6 alkyl, phenyl optionally substituted with 1-3 R^{20}, R^{21} is -C(=O)R^{32}, -N=C(R^{32})(R^{36}), -SO_2R^{33}, NR^{25}C(=O)OR^{25}, C_2-C_6 alkoxy carbonyl; C_2-C_6 alkylaminocarbonyl; C_2-C_6 alkylcarbonyl, R^{30} is halogen, nitro C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, phenyl wherein each phenyl may be optionally substituted with 1-3 R^{20}, R^{25} is H, C_1-C_6 alkyl, R^{33} is C_1-C_6 alkyl, C_1-C_6 haloalkyl, phenyl or thienyl optionally substituted with 1-3 R^{20}, R^{32} is C_1-C_6 alkyl, C_1-C_6 haloalkyl, alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, R^{36} is H, cyano, C_1-C_6 alkyl, C_1-C_6 alkoxy, benzyl, or phenyl wherein each of the benzyl or phenyl may be optionally substituted with 1-3 R^{20}, R^{20} is halogen, C_1-C_6 alkoxyalkoxy, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 hydroxyalkyl, C_2-C_6 alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_1-C_6 alkylamino, C_2-C_8 dialkylamino, phenyl wherein each phenyl may be optionally substituted with 1-5 R^{31}, 5- or 6- membered heteroaromatic ring wherein each heteroaromatic ring may be optionally substituted with 1-3 R^{31}, R^{31} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy.

9. The compound of the formula I wherein R^3 is C_1-C_6 alkyl, -C(=O)R^6, -C(=O)N(R^8)R^{10}, R^4 is C_1-C_6 alkyl, -C(=O)R^6, -C(=O)N(R^8)R^{10}, R^6 is C_1-C_6 alkyl, C_1-C_5 haloalkyl, C_1-C_5 alkoxy, C_2-C_6 alkoxycarbonyl, phenyl, benzyl, C_1-C_4 alkoxyalkoxy, thiazolyl wherein the thiazole may be optionally substituted with 1-3 R^{20}, R^8 is C_1-C_6 alkyl, C_1-C_6 haloalkyl, or phenyl optionally substituted with 1-3 R^{30}, R^{30} is halogen, nitro, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, phenyl wherein each

phenyl may be optionally substituted with 1-3 R^{20}, R^{10} is H, C_1-C_6 alkyl, phenyl optionally substituted with 1-3 R^{20}, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, R^{23} is phenyl optionally substituted with 1-5 R^{20}.

10. The compound of the formula I wherein R^3 is C_1-C_6 alkyl, $-C(=O)R^6$, $-C(=O)N(R^8)R^{10}$, R^4 is C_1-C_6 alkyl, $-C(=O)R^6$, $-C(=O)N(R^8)R^{10}$, R^6 is C_1-C_6 alkyl, C_1-C_5 haloalkyl, C_1-C_5 alkoxy, C_2-C_6 alkoxycarbonyl, phenyl, benzyl, C_1-C_4 alkoxyalkoxy, thiazolyl wherein the thiazole may be optionally substituted with 1-3 R^{20}, R^8 is C_1-C_6 alkyl, C_1-C_6 haloalkyl, or phenyl optionally substituted with 1-3 R^{30}, R^{10} is H, C_1-C_6 alkyl, phenyl optionally substituted with 1-3 R^{20}, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is $-CH_3$, $-CH_2CH_3$, $-CH_2CH_2CH_3$, benzyl, 4-fluoro-phenyl, R^{23} is phenyl, 4-fluoro-phenyl, p-tolyl, R^{20} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy.

11. The compound of the formula I wherein R^3 is C_1-C_6 alkyl, $-C(=O)R^6$, $-C(=O)N(R^8)R^{10}$, R^4 is C_1-C_6 alkyl, $-C(=O)R^6$, $-C(=O)N(R^8)R^{10}$, R^6 is C_1-C_6 alkyl, C_1-C_5 haloalkyl, C_1-C_5 alkoxy, C_2-C_6 alkoxycarbonyl, phenyl, benzyl, C_1-C_4 alkoxyalkoxy, thiazolyl wherein the thiazole may be optionally substituted with 1-3 R^{20}, R^8 is C_1-C_6 alkyl, C_1-C_6 haloalkyl, or phenyl optionally substituted with 1-3 R^{30}, R^{10} is H, C_1-C_6 alkyl, phenyl optionally substituted with 1-3 R^{20}, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, R^{23} is phenyl, p-tolyl, 4-fluoro-phenyl, 4-methoxy-phenyl, 3-methoxy-phenyl, thiophen-2-yl, thiophen-3-yl, 3-fluoro-phenyl, 3-bromo-phenyl, benzothiophen-2-yl, 2,4,6-trimethyl-phenyl, 1-ethyl-2-methoxy-phenyl, 3-benzonitrile, 3-fluoro-4-methoxy-phenyl.

12. The compound of the formula I wherein R^3 and R^4 may be taken together to form: a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, R^{23} is phenyl optionally substituted with 1-5 R^{20}.

13. The compound of the formula I wherein wherein R^3 and R^4 may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{11} is halogen, C_1-C_6 alkyl, R^{21} is $-C(=O)R^{32}$, $-N=C(R^{32})(R^{36})$, $-SO_2R^{33}$, $NR^{25}C(=O)OR^{25}$, C_2-C_6 alkoxy carbonyl; C_2-C_6 alkylaminocarbonyl; C_2-C_6 alkylcarbonyl, R^{25} is H, C_1-C_6 alkyl, R^{33} is C_1-C_6 alkyl, C_1-

C_6 haloalkyl, phenyl or thienyl optionally substituted with 1-3 R^{20}, R^{32} is C_1-C_6 alkyl, C_1-C_6 haloalkyl, alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, C_2-C_6 alkenyl, R^{36} is H, cyano, C_1-C_6 alkyl, C_1-C_6 alkoxy, benzyl, or phenyl wherein each of the benzyl or phenyl may be optionally substituted with 1-3 R^{20}, R^{20} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy.

14. The compound of the formula I wherein R^3 and R^4 may be taken together to form: a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{11} is halogen, C_1-C_6 alkyl, R^{21} is (-CHR^{22})$_m$$R^{23}$, m is 1, R^{22} is -CH_3, -CH_2CH_3, -$CH_2CH_2CH_3$, benzyl, 4-fluoro-phenyl, R^{23} is phenyl, 4-fluoro-phenyl, p-tolyl.

15. The compound of the formula I wherein wherein R^3 and R^4 may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{11} is halogen, C_1-C_6 alkyl, R^{21} is (-CHR^{22})$_m$$R^{23}$, m is 1, R^{22} is H, R^{23} is phenyl, p-tolyl, 4-fluoro-phenyl, 4-methoxy-phenyl, 3-methoxy-phenyl, thiophen-2-yl, thiophen-3-yl, 3-fluoro-phenyl, 3-bromo-phenyl, benzothiophen-2-yl, 2,4,6-trimethyl-phenyl, 1-ethyl-2-methoxy-phenyl, 3-benzonitrile, 3-fluoro-4-methoxy-phenyl.

16. The compound of the formula I wherein R^3 and R^4 may be taken together to form, =$C(R^{12})N(R^{13})R^{14}$, R^{12} is H, C_1-C_4 alkyl, R^{13} is H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20}, R^{14} is H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20}, alternatively R^{13} and R^{14} may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, alternatively R^{12} and R^{13} may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{11} is halogen, C_1-C_6 alkyl, R^{21} is -$C(=O)R^{32}$, -$N=C(R^{32})(R^{36})$, -SO_2R^{33}, $NR^{25}C(=O)OR^{25}$, C_1-C_6 alkyl, C_1-C_6 alkoxy, R^{25} is H, C_1-C_6 alkyl, R^{32} is C_1-C_6 alkyl, phenyl wherein the phenyl may be optionally substituted with 1-3 R^{20}. R^{33} is C_1-C_6 alkyl, phenyl or thienyl optionally substituted with 1-3 R^{20}, R^{36} is cyano, C_1-C_6 alkyl,

phenyl wherein the phenyl may be optionally substituted with 1-3 R^{20}, and R^{20} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy.

17. The compound of the formula I wherein R^3 and R^4 may be taken together to form, $=C(R^{12})N(R^{13})R^{14}$, R^{12} is H, C_1-C_4 alkyl, R^{13} is H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20}, R^{14} is H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20}, alternatively R^{13} and R^{14} may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, alternatively R^{12} and R^{13} may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{11} is halogen, C_1-C_6 alkyl, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, C_1-C_4 alkyl, phenyl, R^{23} is a ring-fused heteroaromatic rings selected from the group consisting of benzothiophenyl, quinolinyl, isoquinolinyl, thieno[2,3-b]pyridyl, 1-methyl-1H-thieno[2,3-c]pyrazolyl, benzofuranyl and benzoimidazolyl, 2,3-dihydro-benzofuran-2-yl, 4-methyl-4H-thieno[3,2-b]pyrrol-5-yl, 1-methyl-1H-indol-5-yl, imidazo[1,2-a]pyridin-2-yl, imidazo[2,1-b]thiazol-6-yl, benzothiazol-2-yl, benzo[b]thiophen-7-yl, 1-methyl-1H-indazol-3-yl, wherein each of the rings may be further substituted with 1-3 R^{20}, R^{20} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy.

18. The compound of the formula I wherein R^3 and R^4 may be taken together to form, $=C(R^{12})N(R^{13})R^{14}$, R^{12} is H, C_1-C_4 alkyl, R^{13} is H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20}, R^{14} is H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20}, alternatively R^{13} and R^{14} may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, alternatively R^{12} and R^{13} may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{11} is halogen, C_1-C_6 alkyl, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, R^{23} is a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms

wherein each ring may be optionally substituted with 1-3 R^{11}, R^{20} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy.

19. The compound of the formula I wherein R^3 and R^4 may be taken together to form, $=C(R^{12})N(R^{13})R^{14}$, R^{12} is H or C_1-C_4 alkyl, R^{13} is H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20}, R^{14} is H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20}, alternatively R^{13} and R^{14} may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, alternatively R^{12} and R^{13} may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{11} is halogen, C_1-C_6 alkyl, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, R^{23} is a 5- or 6- membered heteroaromatic ring selected from the group consisting of furanyl, pyridinyl, pyridinyl-N-oxide, pyrimidinyl, pyridazinyl, pyrazinyl, pyrazolyl, thiazolyl, triazinyl, thiadiazolyl, oxazolyl, isoxazolyl, triazolyl, imidazolyl, thiophene-2-yl and thiophen-3-yl, 1-methyl-1H-pyrazol-3-yl, wherein each heteroaromatic ring may be optionally substituted with 1-3 R^{20}, R^{20} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy.

20. The compound of the formula I wherein R^3 and R^4 may be taken together to form, $=C(R^{12})N(R^{13})R^{14}$, R^{12} is H or C_1-C_4 alkyl, R^{13} is H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20}, R^{14} is H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20}, alternatively R^{13} and R^{14} may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, alternatively R^{12} and R^{13} may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{11} is halogen, C_1-C_6 alkyl, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, R^{23} is phenyl optionally substituted with 1-5 R^{20}, R^{20} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy.

21. The compound of the formula I wherein R^3 and R^4 may be taken together to form, $=C(R^{12})N(R^{13})R^{14}$, R^{12} is H or C_1-C_4 alkyl, R^{13} is H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20}, R^{14} is H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20}, alternatively R^{13} and R^{14} may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, alternatively R^{12} and R^{13} may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{11} is halogen, C_1-C_6 alkyl, R^{20} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is $-CH_3$, $-CH_2CH_3$, $-CH_2CH_2CH_3$, benzyl, 4-fluoro-phenyl, R^{23} is phenyl, 4-fluoro-phenyl, p-tolyl.

22. The compound of the formula I wherein R^3 and R^4 may be taken together to form, $=C(R^{12})N(R^{13})R^{14}$, R^{12} is H or C_1-C_4 alkyl, R^{13} is H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20}, R^{14} is H, cyano, -OH, C_1-C_4 alkyl, C_1-C_6 alkoxy, phenyl, or benzyl wherein the phenyl or benzyl may be optionally substituted with 1-3 R^{20}, alternatively R^{13} and R^{14} may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, alternatively R^{12} and R^{13} may be taken together to form a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}, R^{11} is halogen, C_1-C_6 alkyl, R^{20} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, R^{23} is phenyl, p-tolyl, 4-fluoro-phenyl, 4-methoxy-phenyl, 3-methoxy-phenyl, thiophen-2-yl, thiophen-3-yl, 3-fluoro-phenyl, 3-bromo-phenyl, benzothiophen-2-yl, 2,4,6-trimethyl-phenyl, 1-ethyl-2-methoxy-phenyl, 3-benzonitrile, 3-fluoro-4-methoxy-phenyl.

23. The compound of the formula I wherein R^3 is H; R^4 is H, R^{21} is $-C(=O)R^{32}$, $-N=C(R^{32})(R^{36})$, $-SO_2R^{33}$, $NR^{25}C(=O)OR^{25}$, C_1-C_6 alkyl, C_1-C_6 alkoxy, R^{25} is H, C_1-C_6 alkyl, R^{32} is C_1-C_6 alkyl, phenyl wherein the phenyl may be optionally substituted with 1-3 R^{20}. R^{33} is C_1-C_6 alkyl, phenyl or thienyl optionally substituted with 1-3 R^{20}, R^{36} is

cyano, C_1-C_6 alkyl, phenyl wherein the phenyl may be optionally substituted with 1-3 R^{20}, and R^{20} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy.

24. The compound of the formula I wherein R^3 is H; R^4 is H, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, C_1-C_4 alkyl, phenyl, R^{23} is a ring-fused heteroaromatic rings selected from the group consisting of benzothiophenyl, quinolinyl, isoquinolinyl, thieno[2,3-b]pyridyl, 1-methyl-1H-thieno[2,3-c]pyrazolyl, benzofuranyl and benzoimidazolyl, 2,3-dihydro-benzofuran-2-yl, 4-methyl-4H-thieno[3,2-b]pyrrol-5-yl, 1-methyl-1H-indol-5-yl, imidazo[1,2-a]pyridin-2-yl, imidazo[2,1-b]thiazol-6-yl, benzothiazol-2-yl, benzo[b]thiophen-7-yl, 1-methyl-1H-indazol-3-yl, wherein each of the rings may be further substituted with 1-3 R^{20}, R^{20} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy.

25. The compound of the formula I wherein R^3 is H; R^4 is H, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, R^{23} is a 5- or 6- membered saturated or unsaturated ring containing 1-3 heteroatoms wherein each ring may be optionally substituted with 1-3 R^{11}.

26. The compound of the formula I wherein R^3 is H; R^4 is H, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, R^{23} is a 5- or 6- membered heteroaromatic ring selected from the group consisting of furanyl, pyridinyl, pyridinyl-N-oxide, pyrimidinyl, pyridazinyl, pyrazinyl, pyrazolyl, thiazolyl, triazinyl, thiadiazolyl, oxazolyl, isoxazolyl, triazolyl, imidazolyl, thiophene-2-yl and thiophen-3-yl, 1-methyl-1H-pyrazol-3-yl, wherein each heteroaromatic ring may be optionally substituted with 1-3 R^{20}, R^{20} is halogen, nitro, C_1-C_6 alkyl, C_1-C_6 alkoxy.

27. The compound of the formula I wherein R^3 is H; R^4 is H, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is C_1-C_6 alkyl, phenyl optionally substituted with 1-5 R^{20}, R^{23} is, naphthyl, phenyl optionally substituted with 1-5 R^{20}, R^{20} is halogen, nitro, C_1-C_6 alkyl, C_1-C_6 alkoxy, phenoxy, phenyl wherein each phenoxy, phenyl may be optionally substituted with 1-3 substitutents independently selected from R^{31}, R^{31} is halogen, C_1-C_6 alkyl, C_1-C_6 haloalkyl, benzyl, pyridyl.

28. The compound of the formula I wherein R^3 is H; R^4 is H, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, R^{23} is naphthlyl, benzo[1,3]dioxolyl, phenyl optionally substituted with 1-5

R^{20}, R^{20} is halogen, cyano, nitro, amino, C_1-C_6 alkoxyalkoxy, C_1-C_6 alkyl, C_1-C_6 haloalkyl, C_1-C_6 hydroxyalkyl, C_2-C_6 alkoxyalkyl, C_2-C_6 haloalkoxyalkyl, C_2-C_6 alkenyl, hydroxyl, C_1-C_6 alkoxy, C_1-C_6 haloalkoxy, C_1-C_6 alkylthio, C_1-C_6 haloalkylthio, C_1-C_6 alkylsulfonyl, C_1-C_6 alkylamino, benzyloxy, phenoxy, wherein each benzyloxy, phenoxy, may be optionally substituted with 1-3 substitutents independently selected from R^{31}, R^{31} is halogen, C_1-C_6 alkyl, C_1-C_6 alkoxy.

29. The compound of the formula I wherein R^3 is H; R^4 is H, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is $-CH_3$, $-CH_2CH_3$, $-CH_2CH_2CH_3$, benzyl, 4-fluoro-phenyl, R^{23} is phenyl, 4-fluoro-phenyl, p-tolyl.

30. The compound of the formula I wherein R^3 is H; R^4 is H, R^{21} is $(-CHR^{22})_mR^{23}$, m is 1, R^{22} is H, R^{23} is phenyl, p-tolyl, 4-fluoro-phenyl, 4-methoxy-phenyl, 3-methoxy-phenyl, thiophen-2-yl, thiophen-3-yl, 3-fluoro-phenyl, 3-bromo-phenyl, benzothiophen-2-yl, 2,4,6-trimethyl-phenyl, 1-ethyl-2-methoxy-phenyl, 3-benzonitrile, 3-fluoro-4-methoxy-phenyl.

31. A composition for the control of a fungal pathogen including the compound of Claim 1 and a phytologically acceptable carrier material.

32. The composition of claim 31 wherein the fungal pathogen is one Apple Scab (*Venturia inaequalis*), Speckled Leaf Blotch of Wheat (*Septoria tritici*), Leaf spot of sugarbeets (*Cercospora beticola*), Leaf Spot of peanut (*Cercospora arachidicola*), and Black Sigatoka (*Mycosphaerella fijiensis*).

33. A method for the control and prevention of fungal attack on a plant, the method including the steps of:

applying a fungicidally effective amount of at least one of the compounds of Claim 1 to at least one of the plant, an area adjacent to the plant, soil adapted to support growth of the plant, a root of the plant, foliage of the plant, and a seed adapted to produce at least one of the plant and another plant.