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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 September 2014 (25.09.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/149208 A1

(51) International Patent Classification:
C07D 473/40 (2006.01) *A01P 7/04* (2006.01)
A01N 43/48 (2006.01)

(21) International Application Number:
PCT/US2014/014719

(22) International Filing Date:
4 February 2014 (04.02.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/798,680 15 March 2013 (15.03.2013) US

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(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, BN, BR, BW, BY, BZ, CA, CH, CL, 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, IR, IS, JP, KE, KG, 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, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, 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, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, 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, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

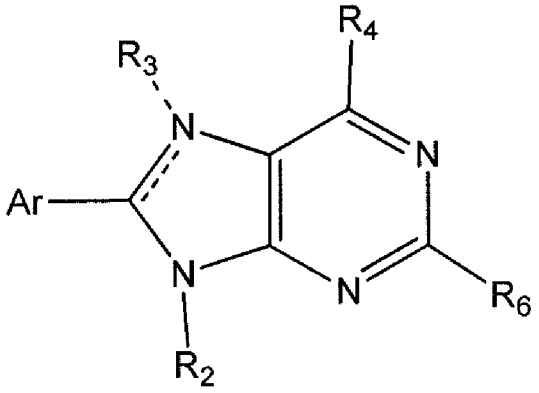
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

— *with international search report (Art. 21(3))*

— *with amended claims and statement (Art. 19(1))*

(54) Title: PURINE-BASED PESTICIDAL COMPOSITIONS AND RELATED METHODS



I

(57) Abstract: Pesticidal composition comprising a purine compound of general formula I, or any agriculturally acceptable salt thereof, wherein Ar, R2, R3, R4 and R6 are as described herein. Disclosed also is the pesticidal composition, comprising a purine compound of general formula I or any agriculturally acceptable salt thereof. Further disclosed are the methods of preparing such pesticidal compositions and the method of controlling insects using such pesticidal compositions. I

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PURINE-BASED PESTICIDAL COMPOSITIONS AND RELATED METHODS

PRIORITY CLAIM

This application claims the benefit of the filing date of United States Provisional Patent Application Serial Number 61/798,680, filed March 15, 2013, for "PURINE-BASED PESTICIDAL COMPOSITIONS AND RELATED METHODS."

TECHNICAL FIELD

Various aspects and embodiments relate generally to pesticidal compositions and to methods of preparing and using such pesticidal compositions. Particular aspects and embodiments generally relate to purine-based pesticidal compositions and to the methods of producing and using such pesticidal compositions.

BACKGROUND

Controlling insect populations is essential to modern agriculture, food storage, and hygiene. There are more than ten thousand species of insects that cause losses in agriculture. The world-wide agricultural losses amount to billions of U.S. dollars each year. Accordingly, there exists a continuous need for new pesticides and for methods of producing and using such pesticides.

DISCLOSURE

Embodiments of the present disclosure include purine-based compounds and pesticidal compositions comprising such purine-based compound.

Embodiments of the present disclosure further include methods of producing purine-based compounds.

Further embodiments of the present disclosure include methods of controlling pests that comprise applying a purine-based pesticidal composition near a population of pests.

MODE(S) FOR CARRYING OUT THE INVENTION

As used herein, the term "alkyl" refers to an acyclic, saturated, branched or unbranched, substituent consisting of carbon and hydrogen, for example, methyl, ethyl, propyl, isopropyl,

1-butyl, 2-butyl, isobutyl, tert-butyl, pentyl, 2-methylbutyl, 1,1-dimethylpropyl, hexyl, heptyl, octyl, nonyl, and decyl.

As used herein the term "cycloalkyl" means a monocyclic or polycyclic, saturated substituent consisting of carbon and hydrogen, such as, for example, cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, cyclodecyl, norbornyl, bicycle[2.2.2]octyl, and decahydronapthyl.

As used herein, the term "alkenyl" means and includes a straight, branched, or cyclic hydrocarbon containing at least one carbon–carbon double bond. Examples may include, but are not limited to, ethenyl, propenyl, butenyl, pentenyl, hexenyl, heptenyl, octenyl, nonenyl, or decenyl.

As used herein the term "cycloalkenyl" means a cyclic hydrocarbon containing at least one carbon–carbon double bond, such as, for example, cyclopentenyl, cyclohexenyl, cycloheptenyl, cyclooctenyl, and cyclodecenyl.

As used herein, the term "alkynyl" means and includes a straight, branched, or cyclic hydrocarbon containing at least one carbon–carbon triple bond. Examples may include, but are not limited to, ethynyl, propargyl, butynyl, pentynyl, hexynyl, heptynyl, octynyl, nonynyl, or decynyl.

As used herein, the term "aryl" means and includes an aromatic ring compound with or without any substitution, such as, for example, phenyl and naphthyl.

As used herein, the term "alkoxy" means and includes an alkyl or a cycloalkyl group containing at least one carbon–oxygen single bond. Non-limiting examples may include methoxy, ethoxy, propoxy, butoxy, cyclopropxy, cyclobutoxy, or cyclopentoxy.

As used herein, the term "alkylthio" means and includes an alkyl group containing at least one carbon–sulfur single bond.

As used herein, the term "haloalkylthio" means and includes an alkyl group containing at least one carbon–sulfur single bond and halogen atom.

As used herein, the terms "halo" and "halogen" mean and include fluorine, chlorine, bromine, or iodine.

As used herein, the terms "haloalkyl" and "haloalkoxy," respectively, mean and include an alkyl group and an alkoxy group substituted with at least one halogen atom or halothio group.

As used herein, the term "heteroatom" means and includes sulfur (S), oxygen (O) or nitrogen (N) atom.

As used herein, the term "heteroaryl" means and includes an aromatic moiety containing at least one sulfur (S), oxygen (O), or nitrogen (N) atom in the aromatic ring. Non-limiting examples may include furyl, pyridyl, pyrimidyl, thienyl, isothiazolyl, imidazolyl, tetrazolyl, pyrazinyl, benzofuranyl, benzothiophenyl, quinolyl, isoquinolyl, benzothienyl, isobenzofuryl, pyrazolyl, indolyl, isoindolyl, benzimidazolyl, purinyl, carbozolyl, oxazolyl, thiazolyl, isothiazolyl, 1,2,4-thiadiazolyl, isooxazolyl, pyrrolyl, pyrazolyl, quinazolinyl, pyridazinyl, pyrazinyl, cinnolinyl, phthalazinyl, quinoxalinyl, xanthinyl, hypoxanthinyl, pteridinyl, 5-azacytidinyl, 5-azauracilyl, triazolopyridinyl, imidazolopyridinyl, pyrrolopyrimidinyl, or pyrazolopyrimidinyl.

As used herein, the term "heteroalkyl" means and includes an alkyl moiety as defined herein containing at least one sulfur (S), oxygen (O), or nitrogen (N) atom.

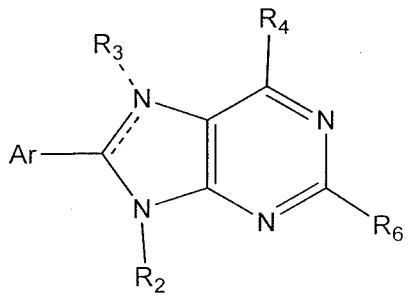
As used herein, the term "cyano" means and includes a functional group containing a carbon–nitrogen triple bond.

As used herein, the term "nitro" means and includes a functional group containing a nitrogen atom joined to two oxygen atoms.

As used herein the term, "pesticidally effective amount" means and includes an amount of active material that causes an adverse effect to the at least one insect, wherein the adverse effect may include deviations from natural development, killing, regulation, or the like.

As used herein, the term "control" or grammatical variations thereof means and includes regulating the number of living insects or regulating the number of viable eggs of the pests.

The pesticidal composition may comprise a purine compound having general formula **I**, or any agriculturally acceptable salt thereof:



I

wherein

Ar may be any aryl or heteroaryl moiety including, but not limited to, phenyl, pyridyl, pyrimidinyl, pyridazinyl, pyrazinyl, triazinyl, pyrazolo, imidazolo, thiophenyl, furyl, or any other heteroaromatic ring system. Ar may be substituted or unsubstituted. Ar may be

substituted at any open position with hydrogen, halogen, alkyl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, or combinations thereof; and the alkyl, alkenyl, or alkynyl group may be substituted with one or more heteroatoms such as N, O, Si, or SO_n (n = 0, 1, 2) at any position. Additionally, Ar may be substituted with alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, unsubstituted amines, substituted amines, unsubstituted aryloxy, substituted aryloxy, or combinations thereof;

R_2, R_3, R_4 and R_6 each may independently be selected from:

(a) hydrogen, halogen, haloalkyl, alkoxy, haloalkoxy, alkylthio, haloalkylthio or halothio;

(b) C1-C8 alkyl, C2-C8 alkenyl or C2-C8 alkynyl;

(c) O–C1-C8 alkyl, O-C2-C8 alkenyl or O-C2-C8 alkynyl;

(d) C1-C8 alkyl, C2-C8 alkenyl or C2-C8 alkynyl moiety substituted with one or more heteroatoms such as N, O, Si, or SO_n (n = 0, 1, 2) at any position;

(e) amine, alkoxyamine, or cyano amine;

(f) C(O)R′, C(O)OR′ or C(O)NR′ where R′ may be alkyl optionally substituted with one or more heteroatoms such as N, O, Si, or SO_n (n = 0,1 , 2) at any position, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide or substituted amine group, unsubstituted aryloxy and substituted aryloxy;

(g) SO_n (n = 0, 1, 2) substituted with C1-C8 alkyl that may include one or more heteroatoms such as N, O, Si or SO_n (n = 0, 1, 2) at any position, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide or substituted amine group, unsubstituted aryloxy and substituted aryloxy;

(h) aryl or heteroaryl substituted with any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide or substituted amine group, unsubstituted aryloxy, substituted aryloxy; and the alkyl, alkenyl, or alkynyl group may be substituted with one or more heteroatoms such as N, O, Si, or SO_n (n = 0, 1, 2) at any position; or

(i) an amino moiety substituted with hydrogen, C1-C8 alkyl, C3-C8 cycloalkyl, C2-C8 alkenyl or C2-C8 alkynyl moiety that may be substituted with one or more heteroatoms, such as N, O, Si, or SO_n (n = 0, 1, 2) at any position, halogen, alkoxy, haloalkyl, or haloalkoxy; C(O)R′, C(O)OR′ or C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety which may be substituted with at least one heteroatom such as N, O, Si, or SO_n (n = 0,1 , 2) at any position, halogen, alkoxy, haloalkyl, or haloalkoxy or R′ may be an aryl or heteroaryl with at least one substituent being any combination of hydrogen, C1-C8 alkyl, C2-C8 alkenyl or C2-C8 alkynyl moiety that may be substituted with one or more heteroatoms, such as N, O, Si, or SO_n (n = 0, 1, 2) at any position, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide or substituted amine group, unsubstituted aryloxy and substituted aryloxy;

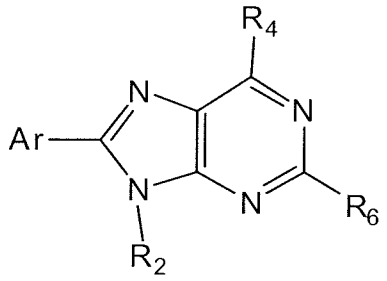
In one embodiment, the pesticidal composition may comprise a purine compound of formula **I** or any agriculturally acceptable salt thereof, wherein:

Ar, R_2 and R_3 each may be selected from the groups as described above,

R_4 may be selected from the group consisting of C1-C8 alkyl substituted with at least two halogen atoms, C3-C8 cycloalkyl substituted with at least two halogen atoms, O–(C1-C8) alkyl that may be substituted with at least two halogen atoms, O–(C3-C8) cycloalkyl that may be substituted with at least one halogen atom, phenyl substituted with at least one of halogen, haloalkyl and haloalkoxy, and heteroaryl substituted with at least one of halogen, haloalkyl and haloalkoxy, and

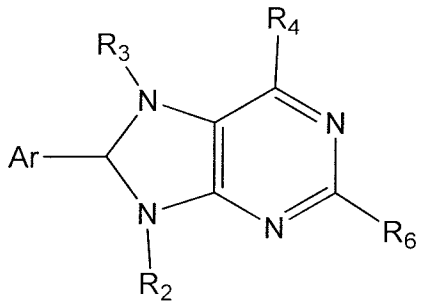
R_6 may be selected from the group consisting of C1-C8 alkyl, C1-C8 alkyl substituted with at least two halogen atoms, C3-C8 cycloalkyl, C3-C8 cycloalkyl substituted with at least two halogen atoms , O–(C1-C8) alkyl , O–(C1-C8) alkyl that may be substituted with two halogen atoms, O–(C3-C8) cycloalkyl , O–(C3-C8) cycloalkyl that may be substituted with at least one halogen atom, phenyl substituted with at least one of halogen, haloalkyl and haloalkoxy, heteroaryl substituted with at least one of halogen, haloalkyl and haloalkoxy, O–phenyl substituted with at least one of halogen, haloalkyl and haloalkoxy, O–heteroaryl substituted with at least one of halogen, haloalkyl and haloalkoxy, S–(C1-C8)alkyl, S–(C1-C8)alkyl substituted with at least one halogen atom, S–phenyl substituted with at least one of halogen, haloalkyl and haloalkoxy, S–heteroaryl substituted with at least one of halogen, haloalkyl and haloalkoxy.

In one embodiment, the pesticidal composition may comprise a purine compound having general formula **II** or any agriculturally acceptable salt thereof, wherein Ar, R_2, R_4 and R_6 are as described above.



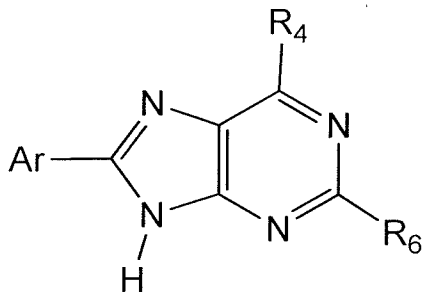
II

In another embodiment, the pesticidal composition may comprise a purine compound having general formula **III** or any agriculturally acceptable salt thereof, wherein Ar, R_2, R_3, R_4 and R_6 are as described above.



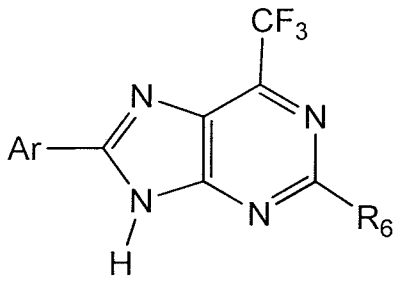
III

In a particular embodiment, the pesticidal composition may comprise a purine compound having general formula **II-1** or any agriculturally acceptable salt thereof, wherein Ar, R_4, and R_6 are as described above.



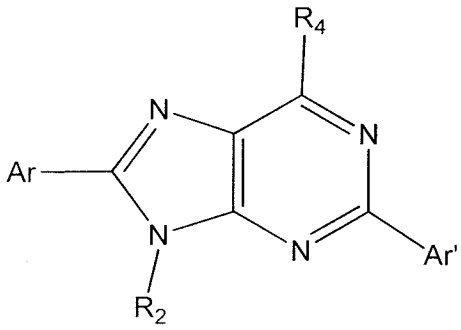
II-1

In another embodiment, the pesticidal composition may comprise a purine compound having general formula **II-2** or any agriculturally acceptable salt thereof, wherein Ar and R_6 are as described above.



II-2

In yet another embodiment, the pesticidal composition may comprise a purine compound having general formula **II-3** or any agriculturally acceptable salt thereof:



II-3

wherein

Ar and Ar′ each may be an aryl or heteroaryl group selected from the group consisting of furyl, phenyl, pyridyl, pyrimidinyl, pyridazinyl, pyrazinyl, triazinyl, pyrazolo, imidazolo, and

thiophenyl, and wherein the aryl group is substituted at any open position with at least one of hydrogen, halogen, alkyl, alkenyl, alkynyl, alkoxy, haloalkyl, haloalkoxy, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, amines, aryloxy, and combinations thereof, and

R_2 and R_4 each may independently be selected from the group consisting of:

(a) hydrogen, halogen, haloalkyl, alkoxy, haloalkoxy, alkylthio, haloalkylthio, halothio;

(b) C1-C8 alkyl, C2-C8 alkenyl, C2-C8 alkynyl;

(c) C1-C8 alkyl, C2-C8 alkenyl, C2-C8 alkynyl moiety substituted with at least one heteroatom;

(d) amine, cyano amine;

(e) C(O)R′, C(O)OR′, C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety substituted with at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of halogen, alkoxy, haloalkyl, haloalkoxy, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, and aryloxy;

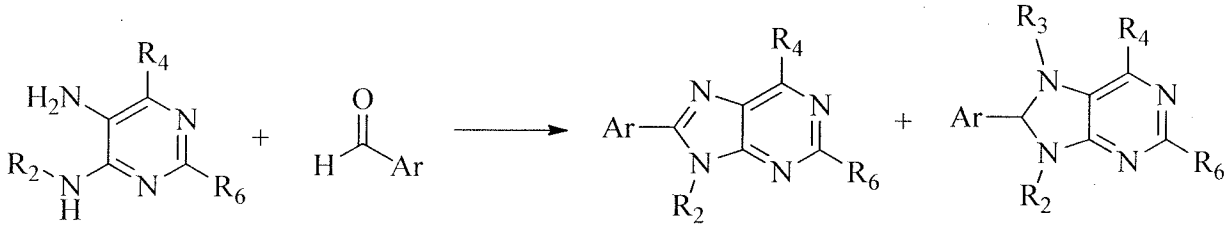
(f) SO_n (n = 0, 1, 2) substituted with C1-C8 alkyl group;

(g) aryl or heteroaryl substituted with any combination of halogen, alkoxy, haloalkyl, haloalkoxy, alkylthio, haloalkylthio, halothio, cyano, nitro or sulfone group; and

(h) amino moiety substituted with alkyl, C(O)R′, C(O)OR′ or C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety which may be substituted with at least one heteroatom such as N, O, Si, or SO_n (n = 0,1 , 2) at any position, halogen, alkoxy, haloalkyl, haloalkoxy, or an aryl or heteroaryl groups that is substituted with any combination of halogen, alkoxy, haloalkyl, haloalkoxy, alkylthio, haloalkylthio, halothio, cyano, nitro, and sulfone.

In some embodiments, the purine compounds of formula **II** and **III** may be produced by reacting 2-R_6-4-*N′,N′*- H,R_2-amine-6-R_4-pyrimidine-5-amine compound **XI** with an aldehyde compound **IV** as shown in **Scheme 1**.

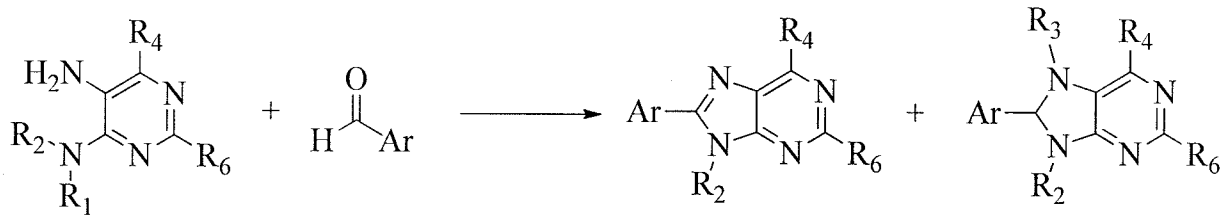
Scheme 1



XI **IV** **II** **III**

The method of **Scheme 1** may comprise reacting 2-R_6-4-*N',N'*- R_1,R_2-amine-6-R_4-pyrimidine-5-amine compound **XI** with an aldehyde compound **IV** in a dry polar aprotic solvent, such as DMF, at temperature from about 80°C to100°C to provide the purine compounds of formula **II** and **III**.

Scheme 2



XI **IV-1** **II-1** **III-1**

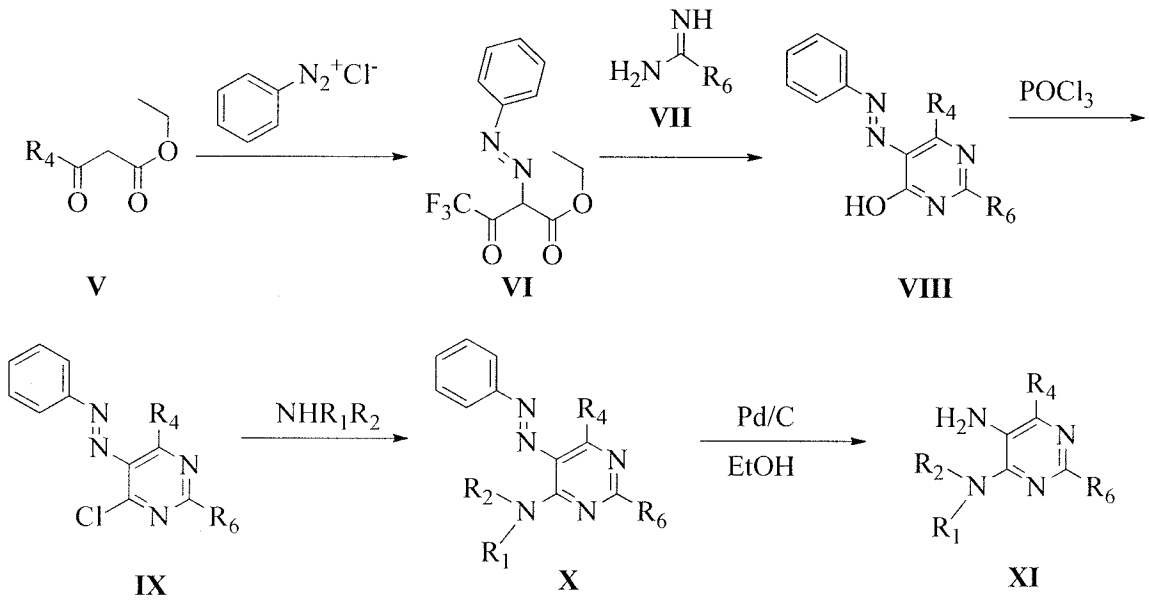
In some embodiments, the purine compounds of formula **II-1** and **III-1** may be produced by the method of **Scheme 2**, wherin R_4 may be a (C1-C8)alkyl substituted with at least two or more halogen atoms, (C3-C8)cycloalkyl substituted with at least two or more halogen atoms, substituted aryl or substituted hetroaryl, R_6 may be (C1-C8)alkyl with or without substitutent, (C3-C8)cycloalkyl with or without substitutent, substituted phenyl or substituted hetroaryl, O(C1-C8)alkyl substituted, O-phenyl substituted, O-heteroaryl substituted, S(C1-C8)alkyl substituted, S-phenyl substituted, S-heteroaryl substituted, N(C1-C8)alkyl, N-phenyl substituted, N-heteroaryl substituted, where the substituent of the aryl or heteroary may be at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy.

The purine compounds **II-1** and **III-1** may be produced from the reaction of 2-R_6-4-*N',N'*- R_1,R_2-amine-6-R_4-pyrimidine-5-amine compound **XI** with Ar-substituted aldehyde of formula **IV-1**, that is a substituted phenyl or substituted heteroaryl and iron (III) chloride ($FeCl_3$) adsorbed on silica gel, in a dry polar aprotic solvent, such as 1,4-dioxane, at temperatures between 80°C and 100°C for about 18 hours (h) to about 24 h. Additionally, the

isolated residue may or may not be treated with an oxididant, such as 4,5-dichloro-3,6-dioxocyclohexa-1,4-diene-1,2-dicarbonitrile (DDQ), to provide purine compounds **II-1** and **III-1**, wherin R_4 may be a (C1-C8)alkyl substituted with at least two or more halogen atoms, (C3-C8)cycloalkyl substituted with at least two or more halogen atoms, substituted aryl or substituted hetroaryl, R_6 may be (C1-C8)alkyl with or without substitutent, (C3-C8)cycloalkyl with or without substitutent, substituted phenyl or substituted hetroaryl, O(C1-C8)alkyl substituted, O-phenyl substituted, O-heteroaryl substituted, S(C1-C8)alkyl substituted, S-phenyl substituted, S-heteroaryl substituted, N(C1-C8)alkyl, N-phenyl substituted, N-heteroaryl substituted, where the substituent of the aryl or heteroary may be at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy.

In one embodiment, compound 2-R_6-4-*N'*,*N'*-R_1,R_2-amine-6-R_4-pyrimidine-5-amine **(XI)** may be produced as shown in **Scheme 3**. The phenyldiazonium salt may be prepared by reacting an aryl amine, such as aniline, in an acidic solvent such as concentrated hydrochloric acid (HCl) with an aqueous solution of sodium nitrite ($NaNO_2$) at a temperature from about -10°C to about 10°C.

Scheme 3

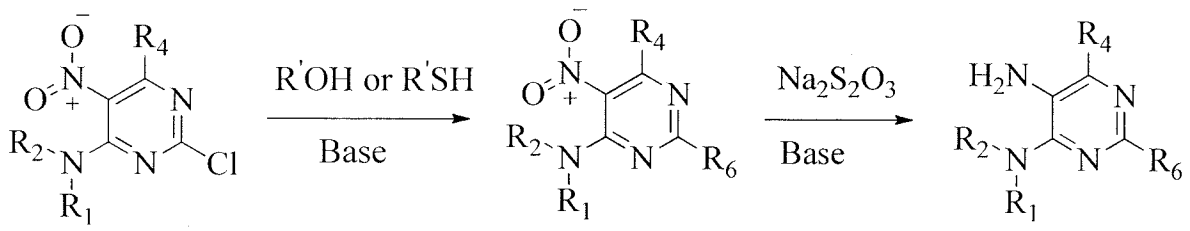


The method, as shown in **Scheme 3**, may include diazotizing compound R_4-substituted-β–diketoacetate (**V**) with phenyldiazonium salt in a basic solution, such as aqueous sodium acetate (NaOAc), at a temperature from about -10°C to about 10°C to provide the diazenyl-oxo-butanoates compound **VI**, then reacting compound **VI** with R^6-substituted

imidamide (**VII**) in the presence of base, such as sodium *n*-butoxide (NaO*n*Bu), in a polar protic solvent such as n-butanol to provide 2-R_6-5-(phenyldiazenyl)-6-R_4-pyrimidin-4-ol compound **VIII**. The hydroxy substituent group at the 4-position of the pyrimidinol compound **VIII** may be converted to the chloride group using a chlorinating reagent such as phosphorus oxychloride ($POCl_3$) in the presence of a base, such as *N,N*-diethylaniline, at a temperature from about 100°C to about 110°C to provide 2-R_6-4-chloro-5-(phenyldiazenyl)-6-R_4-pyrimidine compound **IX**. Upon reacting the pyrimidine compound **IX** with ammonia (*i.e.*, R_1 and R_2 are hydrogen atoms) in a polar protic solvent, such as methanol (MeOH), or with substituted amines wherein R_1 is hydrogen and R_2 is C1-C8 alkyl with or without halogens, or R_2 is an amine substituted with C1-C8 alkyl that is substituted and a protecting group such as BOC in a polar aprotic solvents, such as tetrahydrofuran (THF), at ambient temperature i.e. room temperature (RT, about 22 °C), 2-R_6-4-*N',N'*-R_1,R_2-amine-5-(phenyldiazenyl)-6-R_4-pyrimidine compound **X** may be obtained. Then, the pyrimidine compound **X** may be subjected to hydrogenation to produce 2-R_6-4-*N',N'*-R_1,R_2-amine-6-R_4-pyrimidine-5-amine compound **XI**. In some embodiments, the hydrogenation of pyrimidine compound **X** may be performed in a polar protic solvent, such as EtOH, under a hydrogen atmosphere (1 atmosphere) at an RT stirring for 24 h to provide 2-R_6-4-*N',N'*-R_1,R_2-amine-6-R_4-pyrimidine-5-amine compound **XI**, wherein R_4 may be a (C1-C8)alkyl substituted with at least two or more halogen atoms, (C3-C8)cycloalkyl substituted with at least two or more halogen atoms, substituted aryl or substituted hetroaryl, R_6 may be (C1-C8)alkyl with or without substitutent, (C3-C8)cycloalkyl with or without substitutent, substituted phenyl or substituted hetroaryl, O(C1-C8)alkyl substituted, O-phenyl substituted, O-heteroaryl substituted, S(C1-C8)alkyl substituted, S-phenyl substituted, S-heteroaryl substituted N(C1-C8)alkyl, N-phenyl substituted, N-heteroaryl substituted, where the substituent of the aryl or heteroary may be at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy.

In another embodiment, 2-R_6-4-*N',N'*-R_1,R_2-amine-6-R_4-pyrimidine-5-amine compound **XI** may be produced as shown in **Scheme 4.**

Scheme 4

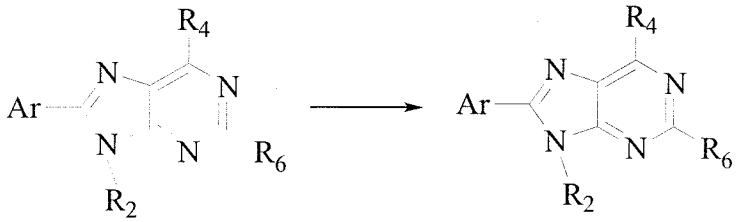


XII **XIII** **XI**

The method may comprise reacting 2-chloro-4-*N'*, *N'*-R_1,R_2-amine-5-nitro-6-R_4-pyrimidine compound **XII** with an alcohol (*e.g.*, MeOH) and a base (*e.g.*, pyridine), or with a thiol (*e.g.*, methanethiol) and a base (*e.g.*, sodium) in a polar aprotic solvent such as THF at an RT for 24 h to provide 2-R_6-4-*N'*,*N'*-R_1,R_2-amine-5-nitro-6-R_4-pyrimidine compound **XIII**, as described in Clark, J. et al. *J. Chem. Soc. (C),* **1971**, *12,* 2278–2282, wherein R_6 may be O–(C1-C8) alkyl substituted, O–phenyl substituted with halogen, alkyl, haloalkyl, alkoxy or haloalkoxy, O–heteroaryl substituted with halogen, alkyl, haloalkyl, alkoxy or haloalkoxy, S–(C1-C8)alkyl substituted, S–phenyl substituted with halogen, alkyl, haloalkyl, alkoxy or haloalkoxy, and S–heteroaryl substituted with halogen, alkyl, haloalkyl, alkoxy or haloalkoxy. Then, the nitro substituent group on compound **XIII** may be reduced with sodium hyposulfite ($Na_2S_2O_3$) and a base, such as an aqueous saturated sodium bicarbonate ($NaHCO_3$) solution, in a polar solvent such as acetone at an RT for about 20 minutes (min) to about 1 h to provide 2-R_6-4-*N'*,*N'*-R_1,R_2-amine-6-R_4-pyrimidine-5-amine compound **XI**.

In one embodiment, the purine compounds of formula **II-1** may be produced by reacting protected compound **II** with an acid to remove the protecting group, as shown in **Scheme 5.**

Scheme 5



II **II-1**

The method of **Scheme 5** may comprise reacting the protected compound **II** in a solvent, such as dichloromethane (CH_2Cl_2), with triethylsilane and trifluoroacetic acid (TFA) at a temperature of about 40°C for about four h.

The pesticidal composition comprising a purine compound of formula **I** may be used to control a wide variety of pests. As a non-limiting example, in one or more embodiments, the pesticidal composition comprising a purine compound of formula **I** may be used to control one or more members of at least one of Phylum Arthropoda, Phylum Nematoda, Subphylum Chelicerata, Subsphylum Myriapoda, Subphylum Hexapoda, Class Insecta, Class Arachnida,

and Class Symphyla. In at least some embodiments, the method of the present disclosure may be used to control one or more members of at least one of Class Insecta and Class Arachnida.

As a non-limiting example, in one or more embodiments, the method of the present disclosure may be used to control one or more members of at least one of Phylum Arthropoda, Phylum Nematoda, Subphylum Chelicerata, Subsphylum Myriapoda, Subphylum Hexapoda, Class Insecta, Class Arachnida, and Class Symphyla. In at least some embodiments, the method of the present disclosure may be used to control one or more members of at least one of Class Insecta and Class Arachnida.

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Coleoptera* (beetles) including, but not limited to, *Acanthoscelides spp.* (weevils), *Acanthoscelides obtectus* (common bean weevil), Agrilus *planipennis* (emerald ash borer), *Agriotes spp.* (wireworms), *Anoplophora glabripennis* (Asian longhorned beetle), *Anthonomus spp.* (weevils), *Anthonomus grandis* (boll weevil), *Aphidius spp., Apion spp.* (weevils), *Apogonia spp.* (grubs), *Ataenius spretulus* (Black Turfgrass Ataenius), *Atomaria linearis* (pygmy mangold beetle), *Aulacophore spp., Bothynoderes punctiventris* (beet root weevil), *Bruchus spp.* (weevils), *Bruchus pisorum* (pea weevil), *Cacoesia spp., Callosobruchus maculatus* (southern cow pea weevil), *Carpophilus hemipteras* (dried fruit beetle), *Cassida vittata, Cerosterna spp., Cerotoma spp.* (chrysomelids), *Cerotoma trifurcata* (bean leaf beetle), *Ceutorhynchus spp.* (weevils), *Ceutorhynchus assimilis* (cabbage seedpod weevil), *Ceutorhynchus napi* (cabbage curculio), *Chaetocnema spp.* (chrysomelids), *Colaspis spp.* (soil beetles), *Conoderus scalaris, Conoderus stigmosus, Conotrachelus nenuphar* (plum curculio), *Cotinus nitidis* (Green June beetle), *Crioceris asparagi* (asparagus beetle), *Cryptolestes ferrugineus* (rusty grain beetle), *Cryptolestes pusillus* (flat grain beetle), *Cryptolestes turcicus* (Turkish grain beetle), *Ctenicera spp.* (wireworms), *Curculio spp.* (weevils), *Cyclocephala spp.* (grubs), *Cylindrocpturus adspersus* (sunflower stem weevil), *Deporaus marginatus* (mango leaf-cutting weevil), *Dermestes lardarius* (larder beetle), *Dermestes maculates* (hide beetle), *Diabrotica spp.* (chrysomelids), *Epilachna varivestis* (Mexican bean beetle), *Faustinus cubae, Hylobius pales* (pales weevil), *Hypera spp.* (weevils), *Hypera postica* (alfalfa weevil), *Hyperdoes spp.* (Hyperodes weevil), *Hypothenemus hampei* (coffee berry beetle), *Ips spp.* (engravers), *Lasioderma serricorne* (cigarette beetle), *Leptinotarsa decemlineata* (Colorado potato beetle), *Liogenys fuscus, Liogenys suturalis, Lissorhoptrus oryzophilus* (rice water weevil), *Lyctus spp.* (wood beetles/powder post beetles), *Maecolaspis joliveti, Megascelis spp., Melanotus communis, Meligethes spp., Meligethes aeneus* (blossom beetle), *Melolontha*

melolontha (common European cockchafer), *Oberea brevis, Oberea linearis*, *Oryctes rhinoceros* (date palm beetle), *Oryzaephilus mercator* (merchant grain beetle), *Oryzaephilus surinamensis* (sawtoothed grain beetle), *Otiorhynchus spp.* (weevils), *Oulema melanopus* (cereal leaf beetle), *Oulema oryzae, Pantomorus spp.* (weevils), *Phyllophaga spp.* (May/June beetle), *Phyllophaga cuyabana* (chrysomelids), *Phynchites spp., Popillia japonica* (Japanese beetle), *Prostephanus truncates* (larger grain borer), *Rhizopertha dominica* (lesser grain borer), *Rhizotrogus spp.* (European chafer), *Rhynchophorus spp.* (weevils), *Scolytus spp.* (wood beetles), *Shenophorus spp.* (Billbug), *Sitona lineatus* (pea leaf weevil), *Sitophilus spp.* (grain weevils), *Sitophilus granaries* (granary weevil), *Sitophilus oryzae* (rice weevil), *Stegobium paniceum* (drugstore beetle), *Tribolium spp.* (flour beetles), *Tribolium castaneum* (red flour beetle), *Tribolium confusum* (confused flour beetle), *Trogoderma variabile* (warehouse beetle), and *Zabrus tenebioides*.

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Dermaptera* (earwigs).

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Dictyoptera* (cockroaches) including, but is not limited to, *Blattella germanica* (German cockroach), *Blatta orientalis* (oriental cockroach), *Parcoblatta pennylvanica*, *Periplaneta americana* (American cockroach), *Periplaneta australoasiae* (Australian cockroach), *Periplaneta brunnea* (brown cockroach), *Periplaneta fuliginosa* (smokybrown cockroach), *Pyncoselus suninamensis* (Surinam cockroach), and *Supella longipalpa* (brownbanded cockroach).

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Diptera* (true flies) including, but is not limited to, *Aedes spp.* (mosquitoes), *Agromyza frontella* (alfalfa blotch leafminer), *Agromyza spp.* (leaf miner flies), *Anastrepha spp.* (fruit flies), *Anastrepha suspensa* (Caribbean fruit fly), *Anopheles spp.* (mosquitoes), *Batrocera spp.* (fruit flies), *Bactrocera cucurbitae* (melon fly), *Bactrocera dorsalis* (oriental fruit fly), *Ceratitis spp.* (fruit flies), *Ceratitis capitata* (Mediterranea fruit fly), *Chrysops spp.* (deer flies), *Cochliomyia spp.* (screwworms), *Contarinia spp.* (Gall midges), *Culex spp.* (mosquitoes), *Dasineura spp.* (gall midges), *Dasineura brassicae* (cabbage gall midge), *Delia spp., Delia platura* (seedcorn maggot), *Drosophila spp.* (vinegar flies), *Fannia spp.* (filth flies), *Fannia canicularis* (little house fly), *Fannia scalaris* (latrine fly), *Gasterophilus intestinalis* (horse bot fly), *Gracillia perseae*, *Haematobia irritans* (horn fly), *Hylemyia spp.* (root maggots), *Hypoderma lineatum* (common cattle grub), *Liriomyza spp.* (leafminer flies),

Liriomyza brassica (serpentine leafminer), *Melophagus ovinus* (sheep ked), *Musca spp.* (muscid flies), *Musca autumnalis* (face fly), *Musca domestica* (house fly), *Oestrus ovis* (sheep bot fly), *Oscinella frit* (frit fly), Pego*myia betae* (beet leafminer), *Phorbia spp., Psila rosae* (carrot rust fly), *Rhagoletis cerasi* (cherry fruit fly), *Rhagoletis pomonella* (apple maggot), *Sitodiplosis mosellana* (orange wheat blossom midge), *Stomoxys calcitrans* (stable fly), *Tabanus spp.* (horse flies), and *Tipula spp.* (crane flies).

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Hemiptera* (true bugs) including, but is not limited to, *Acrosternum hilare* (green stink bug), *Blissus leucopterus* (chinch bug), *Calocoris norvegicus* (potato mirid), *Cimex hemipterus* (tropical bed bug), *Cimex lectularius* (bed bug), *Dagbertus fasciatus*, *Dichelops furcatus*, *Dysdercus suturellus* (cotton stainer), *Edessa meditabunda*, *Eurygaster maura* (cereal bug), *Euschistus heros*, *Euschistus servus* (brown stink bug), *Helopeltis antonii*, *Helopeltis theivora* (tea blight plantbug), *Lagynotomus spp.* (stink bugs), *Leptocorisa oratorius*, *Leptocorisa varicornis*, *Lygus spp.* (plant bugs), *Lygus hesperus* (western tarnished plant bug), *Maconellicoccus hirsutus*, *Neurocolpus longirostris*, *Nezara viridula* (southern green stink bug), *Phytocoris spp.* (plant bugs), *Phytocoris californicus*, *Phytocoris relativus*, *Piezodorus guildingi*, *Poecilocapsus lineatus* (fourlined plant bug), *Psallus vaccinicola*, *Pseudacysta perseae*, *Scaptocoris castanea*, and *Triatoma spp.* (bloodsucking conenose bugs/kissing bugs).

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Homoptera* (aphids, scales, whiteflies, leaflhoppers) including, but is not limited to, *Acrythosiphon pisum* (pea aphid), *Adelges spp.* (adelgids), *Aleurodes proletella* (cabbage whitefly), *Aleurodicus disperses*, *Aleurothrixus floccosus* (woolly whitefly), *Aluacaspis spp.*, *Amrasca bigutella bigutella*, *Aphrophora spp.* (leafhoppers), *Aonidiella aurantii* (California red scale), *Aphis spp.* (aphids), *Aphis gossypii* (cotton aphid), *Aphis pomi* (apple aphid), *Aulacorthum solani* (foxglove aphid), *Bemisia spp.* (whiteflies), *Bemisia argentifolii*, *Bemisia tabaci* (sweetpotato whitefly), *Brachycolus noxius* (Russian aphid), *Brachycorynella asparagi* (asparagus aphid), *Brevennia rehi*, *Brevicoryne brassicae* (cabbage aphid), *Ceroplastes spp.* (scales), *Ceroplastes rubens* (red wax scale), *Chionaspis spp.*(scales), *Chrysomphalus spp.* (scales), *Coccus spp.* (scales), *Dysaphis plantaginea* (rosy apple aphid), *Empoasca spp.* (leafhoppers), *Eriosoma lanigerum* (woolly apple aphid), *Icerya purchasi* (cottony cushion scale), *Idioscopus nitidulus* (mango leafhopper), *Laodelphax striatellus* (smaller brown planthopper), *Lepidosaphes spp.*, *Macrosiphum spp.*, *Macrosiphum euphorbiae* (potato aphid), *Macrosiphum granarium* (English grain aphid), *Macrosiphum rosae* (rose

aphid), *Macrosteles quadrilineatus* (aster leafhopper), *Mahanarva frimbiolata, Metopolophium dirhodum* (rose grain aphid), *Mictis longicornis, Myzus spp., Myzus persicae* (green peach aphid), *Nephotettix spp.* (leafhoppers), *Nephotettix cinctipes* (green leafhopper), *Nilaparvata lugens* (brown planthopper), *Parlatoria pergandii* (chaff scale), *Parlatoria ziziphi* (ebony scale), *Peregrinus maidis* (corn delphacid), *Philaenus spp.* (spittlebugs), *Phylloxera vitifoliae* (grape phylloxera), *Physokermes piceae* (spruce bud scale), *Planococcus spp.* (mealybugs), *Pseudococcus spp.* (mealybugs), *Pseudococcus brevipes* (pine apple mealybug), *Quadraspidiotus perniciosus* (San Jose scale), *Rhapalosiphum spp.* (aphids), *Rhapalosiphum maida* (corn leaf aphid), *Rhapalosiphum padi* (oat bird-cherry aphid), *Saissetia spp.* (scales), *Saissetia oleae* (black scale), *Schizaphis graminum* (greenbug), *Sitobion avenae* (English grain aphid), *Sogatella furcifera* (white-backed planthopper), *Therioaphis spp.* (aphids), *Toumeyella spp.* (scales), *Toxoptera spp.* (aphids), *Trialeurodes spp.* (whiteflies), *Trialeurodes vaporariorum* (greenhouse whitefly), *Trialeurodes abutiloneus* (bandedwing whitefly), *Unaspis spp.* (scales), *Unaspis yanonensis* (arrowhead scale), and *Zulia entreriana.* In at least some embodiments, the method of the present disclosure may be used to control *Myzus persicae.*

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Hymenoptera* (ants, wasps, and bees) including, but not limited to, *Acromyrrmex spp., Athalia rosae, Atta spp.* (leafcutting ants), *Camponotus spp.* (carpenter ants), *Diprion spp.* (sawflies), *Formica spp.* (ants), *Iridomyrmex humilis* (Argentine ant), *Monomorium ssp., Monomorium minumum* (little black ant), *Monomorium pharaonis* (Pharaoh ant), *Neodiprion spp.* (sawflies), *Pogonomyrmex spp.* (harvester ants), *Polistes spp.* (paper wasps), *Solenopsis spp.* (fire ants), *Tapoinoma sessile* (odorous house ant), *Tetranomorium spp.* (pavement ants), *Vespula spp.* (yellow jackets), and *Xylocopa spp.* (carpenter bees).

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Isoptera* (termites) including, but not limited to, *Coptotermes spp., Coptotermes curvignathus, Coptotermes frenchii, Coptotermes formosanus* (Formosan subterranean termite), *Cornitermes spp.* (nasute termites), *Cryptotermes spp.* (drywood termites), *Heterotermes spp.* (desert subterranean termites), *Heterotermes aureus, Kalotermes spp.* (drywood termites), *Incistitermes spp.* (drywood termites), *Macrotermes spp.* (fungus growing termites), *Marginitermes spp.* (drywood termites), *Microcerotermes spp.* (harvester termites), *Microtermes obesi, Procornitermes spp., Reticulitermes spp.* (subterranean termites), *Reticulitermes banyulensis, Reticulitermes grassei, Reticulitermes flavipes* (eastern subterranean termite), *Reticulitermes hageni, Reticulitermes hesperus* (western subterranean termite),

Reticulitermes santonensis, *Reticulitermes speratus*, *Reticulitermes tibialis*, *Reticulitermes virginicus*, *Schedorhinotermes spp.*, and *Zootermopsis spp.* (rotten-wood termites).

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Lepidoptera* (moths and butterflies) including, but not limited to, *Achoea janata*, *Adoxophyes spp.*, *Adoxophyes orana*, *Agrotis spp.* (cutworms), *Agrotis ipsilon* (black cutworm), *Alabama argillacea* (cotton leafworm), *Amorbia cuneana*, *Amyelosis transitella* (navel orangeworm), *Anacamptodes defectaria*, *Anarsia lineatella* (peach twig borer), *Anomis sabulifera* (jute looper), *Anticarsia gemmatalis* (velvetbean caterpillar), *Archips argyrospila* (fruittree leafroller), *Archips rosana* (rose leaf roller), *Argyrotaenia spp.* (tortricid moths), *Argyrotaenia citrana* (orange tortrix), *Autographa gamma*, *Bonagota cranaodes*, *Borbo cinnara* (rice leaf folder), *Bucculatrix thurberiella* (cotton leafperforator), *Caloptilia spp.* (leaf miners), *Capua reticulana*, *Carposina niponensis* (peach fruit moth), *Chilo spp.*, *Chlumetia transversa* (mango shoot borer), *Choristoneura rosaceana* (obliquebanded leafroller), *Chrysodeixis spp.*, *Cnaphalocerus medinalis* (grass leafroller), *Colias spp.*, *Conpomorpha cramerella*, *Cossus cossus* (carpenter moth), *Crambus spp.* (Sod webworms), *Cydiafunebrana* (plum fruit moth), *Cydia molesta* (oriental fruit moth), *Cydia nignicana* (pea moth), *Cydia pomonella* (codling moth), *Darna diducta*, *Diaphania spp.* (stem borers), *Diatraea spp.* (stalk borers), *Diatraea saccharalis* (sugarcane borer), *Diatraea graniosella* (southwester corn borer), *Earias spp.* (bollworms), *Earias insulata* (Egyptian bollworm), *Earias vitella* (rough northern bollworm), *Ecdytopopha aurantianum*, *Elasmopalpus lignosellus* (lesser cornstalk borer), *Epiphysias postruttana* (light brown apple moth), *Ephestia spp.* (flour moths), *Ephestia cautella* (almond moth), *Ephestia elutella* (tobbaco moth), *Ephestia kuehniella* (Mediterranean flour moth), *Epimeces spp.*, *Epinotia aporema*, *Erionota thrax* (banana skipper), *Eupoecilia ambiguella* (grape berry moth), *Euxoa auxiliaris* (army cutworm), *Feltia spp.* (cutworms), *Gortyna spp.* (stemborers), *Grapholita molesta* (oriental fruit moth), *Hedylepta indicata* (bean leaf webber), *Helicoverpa spp.* (noctuid moths), *Helicoverpa armigera* (cotton bollworm), *Helicoverpa zea* (bollworm/corn earworm), *Heliothis spp.* (noctuid moths), *Heliothis virescens* (tobacco budworm), *Hellula undalis* (cabbage webworm), *Indarbela spp.* (root borers), *Keiferia lycopersicella* (tomato pinworm), *Leucinodes orbonalis* (eggplant fruit borer), *Leucoptera malifoliella*, *Lithocollectis spp.*, *Lobesia botrana* (grape fruit moth), *Loxagrotis spp.* (noctuid moths), *Loxagrotis albicosta* (western bean cutworm), *Lymantria dispar* (gypsy moth), *Lyonetia clerkella* (apple leaf miner), *Mahasena corbetti* (oil palm bagworm), *Malacosoma spp.* (tent caterpillars), *Mamestra brassicae* (cabbage armyworm), *Maruca testulalis* (bean pod borer),

Metisa plana (bagworm), *Mythimna unipuncta* (true armyworm), *Neoleucinodes elegantalis* (small tomato borer), *Nymphula depunctalis* (rice caseworm), *Operophthera brumata* (winter moth), *Ostrinia nubilalis* (European corn borer), *Oxydia vesulia, Pandemis cerasana* (common currant tortrix), *Pandemis heparana* (brown apple tortrix), *Papilio demodocus, Pectinophora gossypiella* (pink bollworm), *Peridroma spp.* (cutworms), *Peridroma saucia* (variegated cutworm), *Perileucoptera coffeella* (white coffee leafminer), *Phthorimaea operculella* (potato tuber moth), *Phyllocnisitis citrella, Phyllonorycter spp.* (leafminers), *Pieris rapae* (imported cabbageworm), *Plathypena scabra, Plodia interpunctella* (Indian meal moth), *Plutella xylostella* (diamondback moth), *Polychrosis viteana* (grape berry moth), *Prays endocarpa, Prays oleae* (olive moth), *Pseudaletia spp.* (noctuid moths), *Pseudaletia unipunctata* (armyworm), *Pseudoplusia includens* (soybean looper), *Rachiplusia nu, Scirpophaga incertulas, Sesamia spp.* (stemborers), *Sesamia inferens* (pink rice stem borer), *Sesamia nonagrioides, Setora nitens, Sitotroga cerealella* (Angoumois grain moth), *Sparganothis pilleriana, Spodoptera spp.* (armyworms), *Spodoptera exigua* (beet armyworm), *Spodoptera fugiperda* (fall armyworm), *Spodoptera oridania* (southern armyworm), *Synanthedon spp.* (root borers), *Thecla basilides, Thermisia gemmatalis, Tineola bisselliella* (webbing clothes moth), *Trichoplusia ni* (cabbage looper), *Tuta absoluta, Yponomeuta spp., Zeuzera coffeae* (red branch borer), and *Zeuzera pyrina* (leopard moth). In at least some embodiments, the method of the present disclosure may be used to control *Spodoptera exigua*.

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Mallophaga* (chewing lice) including, but not limited to, *Bovicola ovis* (sheep biting louse), *Menacanthus stramineus* (chicken body louse), and *Menopon gallinea* (common hen house).

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Orthoptera* (grasshoppers, locusts, and crickets) including, but not limited to, *Anabrus simplex* (Mormon cricket), *Gryllotalpidae* (mole crickets), *Locusta migratoria, Melanoplus spp.* (grasshoppers), *Microcentrum retinerve* (angularwinged katydid), *Pterophylla spp.* (kaydids), *chistocerca gregaria*, *Scudderia furcata* (forktailed bush katydid), and *Valanga nigricorni*.

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Phthiraptera* (sucking lice) including, but not limited to, *Haematopinus spp.* (cattle and hog lice), *Linognathus ovillus* (sheep louse), *Pediculus humanus capitis* (human body louse), *Pediculus humanus humanus* (human body lice), and *Pthirus pubis* (crab louse).

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Siphonaptera* (fleas) including, but not limited to, *Ctenocephalides canis* (dog flea), *Ctenocephalides felis* (cat flea), and *Pulex irritans* (human flea).

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Thysanoptera* (thrips) including, but not limited to, *Frankliniella fusca* (tobacco thrips), *Frankliniella occidentalis* (western flower thrips), *Frankliniella shultzei, Frankliniella williamsi* (corn thrips), *Heliothrips haemorrhaidalis* (greenhouse thrips), *Riphiphorothrips cruentatus, Scirtothrips spp., Scirtothrips citri* (citrus thrips), *Scirtothrips dorsalis* (yellow tea thrips), *Taeniothrips rhopalantennalis, and Thrips spp.*

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Thysanura* (bristletails) including, but not limited to, *Lepisma spp.* (silverfish) and *Thermobia spp.* (firebrats).

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Acari* (mites and ticks) including, but not limited to, *Acarapsis woodi* (tracheal mite of honeybees), *Acarus spp.* (food mites), *Acarus siro* (grain mite), *Aceria mangiferae* (mango bud mite), *Aculops spp., Aculops lycopersici* (tomato russet mite), *Aculops pelekasi, Aculus pelekassi, Aculus schlechtendali* (apple rust mite), *Amblyomma americanum* (lone star tick), *Boophilus spp.* (ticks), *Brevipalpus obovatus* (privet mite), *Brevipalpus phoenicis* (red and black flat mite), *Demodex spp.* (mange mites), *Dermacentor spp.* (hard ticks), *Dermacentor variabilis* (american dog tick), *Dermatophagoides pteronyssinus* (house dust mite), *Eotetranycus spp., Eotetranychus carpini* (yellow spider mite), *Epitimerus spp., Eriophyes spp., Ixodes spp.* (ticks), *Metatetranycus spp., Notoedres cati, Oligonychus spp., Oligonychus coffee, Oligonychus ilicus* (southern red mite), *Panonychus spp., Panonychus citri* (citrus red mite), *Panonychus ulmi* (European red mite), *Phyllocoptruta oleivora* (citrus rust mite), *Polyphagotarsonemun latus* (broad mite), *Rhipicephalus sanguineus* (brown dog tick), *Rhizoglyphus spp.* (bulb mites), *Sarcoptes scabiei* (itch mite), *Tegolophus perseaflorae, Tetranychus spp., Tetranychus urticae* (twospotted spider mite), and *Varroa destructor* (honey bee mite).

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Nematoda* (nematodes) including, but not limited to, *Aphelenchoides* spp. (bud and leaf& pine wood nematodes), *Belonolaimus* spp. (sting nematodes), *Criconemella* spp. (ring nematodes), *Dirofilaria immitis* (dog heartwom), *Ditylenchusspp.* (stem and bulb nematodes), *Heterodera* spp. (cyst nematodes), *Heterodera zeae* (corn cyst nematode),

Hirschmanniella spp. (root nematodes), *Hoplolaimus* spp. (lance nematodes), *Meloidogyne* spp. (root knot nematodes), *Meloidogyne incognita* (root knot nematode), *Onchocerca volvulus* (hook-tail worm), *Pratylenchus* spp. (lesion nematodes), *Radopholus* spp. (burrowing nematodes), and *Rotylenchus reniformis* (kidney-shaped nematode).

In at least some embodiments, the method of the present disclosure may be used to control at least one insect in one or more of the Orders *Lepidoptera, Coleoptera, Homoptera, Hemiptera, Thysanoptera, Isoptera, Orthoptera, Diptera, Hymenoptera,* and *Siphonaptera*, and at least one mite in the Order *Acari*.

Example A: Bioassays on Beet Armyworm ("BAW") and Corn Earworm ("CEW") and Cabbage Looper ("CL")

BAW has few effective parasites, diseases, or predators to lower its population. BAW infests many weeds, trees, grasses, legumes, and field crops. In various places, it is of economic concern upon asparagus, cotton, corn, soybeans, tobacco, alfalfa, sugar beets, peppers, tomatoes, potatoes, onions, peas, sunflowers, and citrus, among other plants. CEW is known to attack corn and tomatoes, but it also attacks artichoke, asparagus, cabbage, cantaloupe, collards, cowpeas, cucumbers, eggplant, lettuce, lima beans, melon, okra, peas, peppers, potatoes, pumpkin, snap beans, spinach, squash, sweet potatoes, and watermelon, among other plants. CEW is also known to be resistant to certain insecticides. CL feeds on a wide variety of cultivated plants and weeds. It feeds readily on crucifers, and has been reported damaging broccoli, cabbage, cauliflower, Chinese cabbage, collards, kale, mustard, radish, rutabaga, turnip, and watercress. Other vegetable crops injured include beet, cantaloupe, celery, cucumber, lima bean, lettuce, parsnip, pea, pepper, potato, snap bean, spinach, squash, sweet potato, tomato, and watermelon. CL is also known to be resistant to certain insecticides. Consequently, because of the above factors control of these pests is important. Furthermore, molecules that control these pests are useful in controlling other pests.

Certain molecules disclosed in this document were tested against BAW, CEW and CL using procedures described in the following examples. In the reporting of the results, the "**TABLE 2: Mortality Rating for Beet Armyworm (BAW), Corn Earworm (CEW), and Cabbage Looper (CL) Insects**" was used (See Table Section).

BIOASSAYS ON BAW (*Spodoptera exigua*)

Bioassays on BAW were conducted using a 128-well diet tray assay. One to five second instar BAW larvae were placed in each well (3 mL) of the diet tray that had been previously

filled with 1 mL of artificial diet to which 50 μg/cm^2 of the test compound (dissolved in 50 μL of 90:10 acetone-water mixture) had been applied (to each of eight wells) and then allowed to dry. Trays were covered with a clear self-adhesive cover, and held at 25°C, 14:10 light-dark for five to seven days. Percent mortality was recorded for the larvae in each well; activity in the eight wells was then averaged. The results are indicated in the tables entitled "**Table 1**" (See Table Section).

BIOASSAYS ON CEW (*Helicoverpa zea*)

Bioassays on CEW were conducted using a 128-well diet tray assay. One to five second instar CEW larvae were placed in each well (3 mL) of the diet tray that had been previously filled with 1 mL of artificial diet to which 50 μg /cm^2 of the test compound (dissolved in 50 μL of 90:10 acetone–water mixture) had been applied (to each of eight wells) and then allowed to dry. Trays were covered with a clear self-adhesive cover, and held at 25°C, 14:10 light-dark for five to seven days. Percent mortality was recorded for the larvae in each well; activity in the eight wells was then averaged. The results are indicated in the table entitled "**Table 1**" (See Table Section).

Bioassays on CL (*Trichoplusia ni*)

Bioassays on CL were conducted using a 128-well diet tray assay. One to five second instar CL larvae were placed in each well (3 mL) of the diet tray that had been previously filled with 1 mL of artificial diet to which 50 μg /cm^2 of the test compound (dissolved in 50 μL of 90:10 acetone–water mixture) had been applied (to each of eight wells) and then allowed to dry. Trays were covered with a clear self-adhesive cover, and held at 25°C, 14:10 light-dark for five to seven days. Percent mortality was recorded for the larvae in each well; activity in the eight wells was then averaged. The results are indicated in the table entitled "**Table 1**" (See Table Section).

Example B: Bioassays on Green Peach Aphid ("GPA") (*Myzus persicae*).

GPA is the most significant aphid pest of peach trees, causing decreased growth, shriveling of the leaves, and the death of various tissues. It is also hazardous because it acts as a vector for the transport of plant viruses, such as potato virus Y and potato leafroll virus to members of the nightshade/potato family *Solanaceae*, and various mosaic viruses to many other food crops. GPA attacks such plants as broccoli, burdock, cabbage, carrot, cauliflower, daikon,

eggplant, green beans, lettuce, macadamia, papaya, peppers, sweet potatoes, tomatoes, watercress, and zucchini, among other plants. GPA also attacks many ornamental crops such as carnation, chrysanthemum, flowering white cabbage, poinsettia, and roses. GPA has developed resistance to many pesticides.

Certain molecules disclosed in this document were tested against GPA using procedures described in the following example. In the reporting of the results, the "**TABLE 3: Mortality Rating for Green Peach Aphid (GPA) Insects**

" was used (See Table Section).

Cabbage seedlings grown in 3-inch pots, with 2-3 small (3-5 cm) true leaves, were used as test substrate. The seedlings were infested with 20-50 GPA (wingless adult and nymph stages) one day prior to chemical application. Four pots with individual seedlings were used for each treatment. Test compounds (2 mg) were dissolved in 2 mL of acetone/MeOH (1:1) solvent, forming stock solutions of 1000 ppm test compound. The stock solutions were diluted 5X with 0.025% Tween 20 in H_2O to obtain the solution at 200 ppm test compound. A hand-held aspirator-type sprayer was used for spraying a solution to both sides of cabbage leaves until runoff. Reference plants (solvent check) were sprayed with the diluent only containing 20% by volume of acetone/MeOH (1:1) solvent. Treated plants were held in a holding room for three days at approximately 25°C and ambient relative humidity (RH) prior to grading. Evaluation was conducted by counting the number of live aphids per plant under a microscope. Percent Control was measured by using Abbott's correction formula (W.S. Abbott, "A Method of Computing the Effectiveness of an Insecticide" J. Econ. Entomol. 18 (1925), pp.265-267) as follows.

Corrected % Control = 100 * (X - Y) / X

where

X = No. of live aphids on solvent check plants and

Y = No. of live aphids on treated plants

The results are indicated in the tables entitled "**Table 1**" (See Table Section).

Example C: BIOASSAYS ON Yellow Fever Mosquito "YFM" (*Aedes aegypti*).

YFM prefers to feed on humans during the daytime and is most frequently found in or near human habitations. YFM is a vector for transmitting several diseases. It is a mosquito that can spread the dengue fever and yellow fever viruses. Yellow fever is the second most dangerous mosquito-borne disease after malaria. Yellow fever is an acute viral hemorrhagic

disease and up to 50% of severely affected persons without treatment will die from yellow fever. There are an estimated 200,000 cases of yellow fever, causing 30,000 deaths, worldwide each year. Dengue fever is a nasty, viral disease; it is sometimes called "breakbone fever" or "break-heart fever" because of the intense pain it can produce. Dengue fever kills about 20,000 people annually. Consequently, because of the above factors control of this pest is important. Furthermore, molecules that control this pest (YFM), which is known as a sucking pest, are useful in controlling other pests that cause human and animal suffering.

Certain molecules disclosed in this document were tested against YFM using procedures described in the following paragraph. In the reporting of the results, the "**TABLE 4: Mortality Rating for Yellow Fever Mosquitos (YFM)**" was used (See Table Section).

Master plates containing 400 µg of a molecule dissolved in 100 µL of dimethyl sulfoxide (DMSO) (equivalent to a 4000 ppm solution) are used. A master plate of assembled molecules contains 15 µL per well. To this plate, 135 µL of a 90:10 water:acetone mixture is added to each well. A robot (Biomek® NXP Laboratory Automation Workstation) is programmed to dispense 15 µL aspirations from the master plate into an empty 96-well shallow plate ("daughter" plate). There are 6 reps ("daughter" plates) created per master. The created daughter plates are then immediately infested with YFM larvae.

The day before plates are to be treated, mosquito eggs are placed in Millipore water containing liver powder to begin hatching (4 g. into 400 ml). After the daughter plates are created using the robot, they are infested with 220 µL of the liver powder/larval mosquito mixture (about 1 day-old larvae). After plates are infested with mosquito larvae, a non-evaporative lid is used to cover the plate to reduce drying. Plates are held at RT for 3 days prior to grading. After 3 days, each well is observed and scored based on mortality.

The results are indicated in **Table 1** (See Table Section).

TABLE 1 shows the pesticidal activities of the benzimidazole compounds against several insects: beet armyworm (BAW), corn earworm (CEW), cabbage looper (CL), green peach aphid (GPA), and yellow fever mosquitoes (YFM). The mortality efficiency of the benzimidazole compounds against BAW, CEW, CL and GPA insects is determined after five days of treatment. The mortality efficiency against YFM is determined after three days of treatment. The mortality efficiency is rated as shown in **TABLES 2–4**.

TABLE 1 shows the mortality study results of the purine compounds **1–106** against several insects: beet armyworm (BAW), corn earworm (CEW), cabbage looper (CL), green peach aphid (GPA), and yellow fever mosquitos (YFM).

TABLE 1

Compound No.	BAW Results	CEW Results	CL Results	GPA Results	YFM Results
1	A	D	C	C	D
2	A	A	C	C	D
3	A	D	C	C	D
4	A	A	C	B	D
5	A	A	C	B	D
6	D	D	C	C	D
7	D	D	C	C	B
8	D	A	C	B	D
9	A	A	C	B	D
10	A	A	C	B	D
11	A	A	C	B	A
12	D	D	C	C	D
13	A	A	C	B	D
14	A	A	C	D	D
15	A	A	C	B	A
16	D	D	C	C	D
17	A	A	C	C	D
18	A	D	C	D	D
19	A	A	C	D	D
20	A	A	C	D	D
21	A	A	C	C	D
22	A	A	C	C	B
23	A	A	C	B	A
24	A	A	C	C	D
25	D	D	C	C	D
26	D	D	C	C	D
27	D	D	C	C	D
28	D	D	C	C	D
29	D	D	C	C	D
30	D	D	C	C	D
31	D	D	C	C	D
32	D	D	C	C	D
33	D	D	C	C	D

Compound No.	BAW Results	CEW Results	CL Results	GPA Results	YFM Results
34	D	D	C	C	B
35	D	D	C	C	D
36	B	D	C	C	D
37	D	D	C	C	D
38	B	D	C	C	D
39	D	D	C	C	D
40	A	A	C	D	D
41	A	A	C	B	D
42	D	D	C	C	D
43	A	A	C	C	B
44	A	A	C	B	B
45	A	A	C	C	B
46	A	D	C	C	D
47	A	D	C	C	D
48	D	D	C	C	D
49	D	D	C	C	D
50	D	D	C	C	D
51	C	C	C	C	D
52	A	C	A	A	B
53	A	A	C	D	D
54	D	D	C	C	D
55	C	C	C	D	A
56	A	A	C	A	D
57	A	C	A	B	A
58	A	D	C	C	D
59	A	C	D	C	D
60	D	D	C	C	D
61	D	D	C	C	D
62	B	D	C	C	D
63	D	D	C	C	D
64	D	D	C	B	D
65	B	D	C	B	D
66	A	A	C	D	A
67	D	D	C	A	D
68	A	A	C	D	D
69	A	D	C	B	D
70	D	A	C	B	A
71	A	A	C	B	D
72	A	A	C	C	D

Compound No.	BAW Results	CEW Results	CL Results	GPA Results	YFM Results
73	A	A	C	C	D
74	D	D	C	D	B
75	D	D	C	D	A
76	A	B	C	C	B
77	A	D	C	B	B
78	D	D	C	B	D
79	D	D	C	C	C
80	D	D	C	C	D
81	D	D	C	C	B
82	D	D	C	C	D
83	D	D	C	C	B
84	A	A	C	C	A
85	A	A	C	C	B
86	D	D	C	C	D
87	A	A	C	C	A
88	D	D	C	C	D
89	D	D	C	C	D
90	D	A	C	C	B
91	A	B	C	C	C
92	D	D	C	C	C
93	D	D	C	C	C
94	D	D	C	C	C
95	D	D	C	C	C
96	D	D	C	C	C
97	D	D	C	C	C
98	A	A	C	C	C
99	D	D	C	C	C
100	D	D	C	C	C
101	A	D	C	C	D
102	A	A	C	C	B
103	A	A	C	C	A
104	A	A	C	C	D
105	D	D	C	C	D
106	A	A	C	C	A

TABLE 2: Mortality Rating for Beet Armyworm (BAW), Corn Earworm (CEW), and Cabbage Looper (CL) Insects

% Control (or Mortality)	Rating
50–100	A
More than 0 – Less than 50	B
Not Tested	C
No activity noticed in this bioassay	D

TABLE 3: Mortality Rating for Green Peach Aphid (GPA) Insects

% Control (or Mortality)	Rating
80–100	A
More than 0 – Less than 80	B
Not Tested	C
No activity noticed in this bioassay	D

TABLE 4: Mortality Rating for Yellow Fever Mosquitos (YFM)

% Control (or Mortality)	Rating
≥ 80	A
More than 0 – Less than 80	B
Not Tested	C
No activity noticed in this bioassay	D

Embodiments of the present disclosure further include methods of controlling pests that comprises applying an pesticidal composition comprising a purine compound of the general formula **I** near a population of pests.

In some embodiments, the pesticidal composition may comprise a purine compound of the general formula **I** in a phytologically-acceptable inert carrier (*e.g.*, solid carrier or liquid carrier), and may be applied near a population of pests.

The control of insects may be achieved by applying an pesticidally effective amount of the purine-based composition in form of sprays, topical treatment, gels, seed coatings, microcapsulations, systemic uptake, baits, eartags, boluses, foggers, fumigants aerosols, dusts, or the like.

In some embodiments, the purine-based pesticidal compositions may be in the form of solid. Non-limiting examples of the solid forms may include power, dust or granular formulations.

In other embodiments, the purine-based pesticidal compositions may be in the form of liquid formulation. Examples of the liquid forms may include, but not limited to, dispersion, suspension, emulsion or solution in appropriate liquid carrier.

In alternative embodiments, the purine-based pesticidal compositions may be in the form of liquid dispersion, wherein the purine compound may be dispersed in water or other agriculturally suitable liquid carrier.

In other embodiments, the purine-based pesticidal compositions may be in the form of solution in an appropriate organic solvent. In one embodiment, the spray oils, which are widely used in agricultural chemistry, may be used as the organic solvent for the purine-based pesticidal compositions.

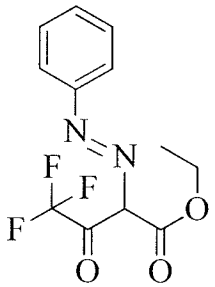
When desired, the purine-based pesticidal compositions may be used in conjunction with at least one of other pesticides, fungicides and herbicides to obtain control of a wider variety of pests, diseases and weeds. When used in conjunction with other pesticides or fungicides or herbicides, the purine-based pesticidal compositions may be formulated with the other pesticides or fungicides or herbicide, or applied sequentially with the other pesticides or fungicides or herbicides.

The following examples serve to explain embodiments of the present disclosure in more detail. These examples are not to be construed as being exhaustive or exclusive as to the scope of the disclosure.

EXAMPLES

Example 1

Preparation of ethyl 4,4,4-trifluoro-3-oxo-2-(phenyldiazenyl)butanoate [Compound VI-1]



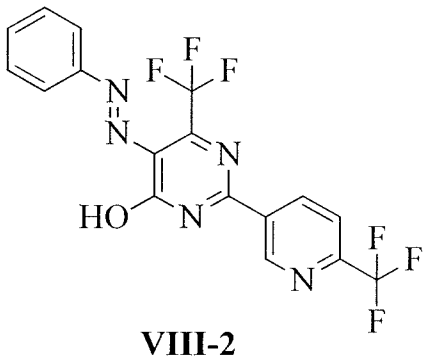
VI-1

Accoording to the procedure adapted from *J. Am. Chem. Soc.* (**1958**), 80, 5744–5752, aniline (21.2 g, 228 mmol) was dissolved in concentrated HCl (65 mL) and mixed at 0°C with a solution of $NaNO_2$ (17.7 g, 256 mmol) in distilled water (36 mL). To this mixture was slowly added a solution of NaOAc (183 g, 2231 mmol) in distilled water (440 mL) with continuous stirring, and the temperature was kept at 0°C. Ethyl 4,4,4-trifluoro-3-oxobutanoate (45.5 g, 247 mmol) in ethanol (EtOH, 36 mL) was added dropwise at 0°C, and after a few min, a yellow crystalline precipitate formed which turned red. The precipitate mixture was stirred at 0°C for 4 h and warmed to RT for overnight. The red precipitate was filtered over a Büchner funnel, washed with ice cold distilled water and dried under vacuum to give compound **VI-1** as a red solid (56.0 g, 81.0%): mp 76°C-79°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 12.95 (s, 1H), 7.57 (d, J = 7.6 Hz, 2H), 7.49 (t, J = 7.9 Hz, 2H), 7.27 (t, J = 7.3 Hz, 1H), 4.36 (q, J = 7.1 Hz, 2H), 1.33 (t, J = 7.1 Hz, 3H); ESIMS *m/z* 287.4 ([M-1]$^-$).

Example 2

Preparation of 5-(phenyldiazenyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl) pyridin-3-yl)pyrimidin-4-ol

[Compound VIII-2]



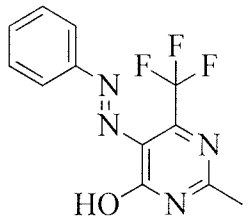
VIII-2

Accoording to the procedure adapted from *J. Am. Chem. Soc.* (**1958**), 80, 5744–5752, to a 250 mL round-bottomed flask was added NaO*n*Bu (36.7 ml, 66.8 mmol) and n-butanol (20 ml), followed by the addition of 6-(trifluoromethyl)nicotinimidamide hydrochloride (5.0 g, 22.26 mmol) and heated to 60°C with stirring for 10 min. To the suspension was added in portions over 1 min (*E*)-ethyl 4,4,4-trifluoro-3-oxo-2-(phenyldiazenyl)butanoate (**VI-1**) (6.41 g, 22.24 mmol) to give a deep red mixture and heated to 120°C for 2.5 h. The reaction mixture was cooled, and most solvent was removed under vacuum to give viscous deep red oil. The residue oil was diluted with distilled water (200 mL) and then acidified with glacial acetic acid (AcOH) until the solution had a pH 5. The mixture was extracted with ethyl acetate (EtOAc, 1 x 300 mL) and (3 x 50 mL). The combined organic layers was dried over sodium sulfate (Na_2SO_4) overnight, filtered and concentrated under vacuum to give a red solid. The solid was dissolved in CH_2Cl_2, EtOAc and MeOH solvent mixture, and dry loaded on 25 grams of SiO_2. The residue was purified by column chromatography (hexanes-EtOAc gradient; 220 grams SiO_2 column) to afford compound **VIII-2** as an orange solid (2.7 g, 26.0%): mp 181°C–183°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 14.19 (brs, 1H), 9.45 (d, J = 1.9 Hz, 1H), 8.78 (dd, J = 8.2, 1.9 Hz, 1H), 8.17 (d, J = 8.2 Hz, 1H), 7.97–7.83 (m, 2H), 7.71–7.63 (m, 3H); ESIMS *m/z* 413.9 ($[M+1]^+$).

The following compounds were made in accordance with the procedures disclosed in Example 2.

(*E*)-2-methyl-5-(phenyldiazenyl)-6-(trifluoromethyl)pyrimidin-4-ol [Compound VIII-3] was prepared from acetimidamide and was isolated as a yellow solid (1.5g, 53%): ^{1}H

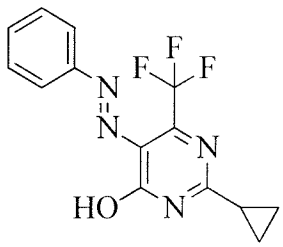
NMR (300 MHz, DMSO-d_6) δ 13.58 (brs, 1H), 7.85-7.82 (m 2H), 7.66–7.64 (m, 3H), 2.45 (s, 3H); ESIMS *m/z* 283 ([M+1]$^+$).



VIII-3

(*E*)-2-cyclopropyl-5-(phenyldiazenyl)-6-(trifluoromethyl)pyrimidin-4-ol

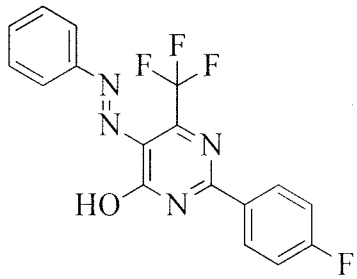
[Compound VIII-4] was prepared from cyclopropanecarboximidamide and was isolated as a yellow solid (5.6g, 60%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 7.14–7.11 (m 2H), 6.78–6.75 (m, 3H), 1.28–1.20 (m, 1H), 0.56–0.52 (m, 2H), 0.49–0.44 (m, 2H); ESIMS *m/z* 309 ([M+1]$^+$).



VIII-4

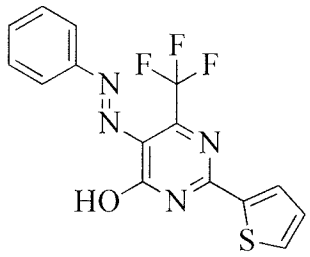
(*E*)-2-(4-fluorophenyl)-5-(phenyldiazenyl)-6-(trifluoromethyl)pyrimidin-4-ol

[Compound VIII-5] was prepared from 4-fluorobenzimidamide and was isolated as a yellow solid (3.0g, 28.6%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 13.89 (s, 1H), 8.35–8.31 (m, 2H), 7.89–7.87 (m 2H), 7.67–7.65 (m 2H), 7.50–7.44 (m, 3H); ESIMS *m/z* 363 ([M+1]$^+$).



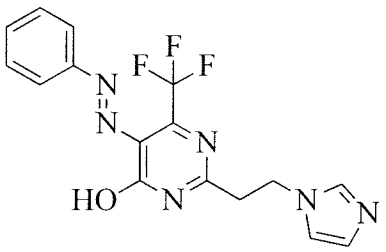
VIII-5

(*E*)-5-(phenyldiazenyl)-2-(thiophen-2-yl)-6-(trifluoromethyl)pyrimidin-4-ol [Compound VIII-6] was prepared from thiophene-2-carboximidamide and was isolated as a crude yellow solid (5.8g, 55%): ESIMS *m/z* 351 ($[M+1]^+$).



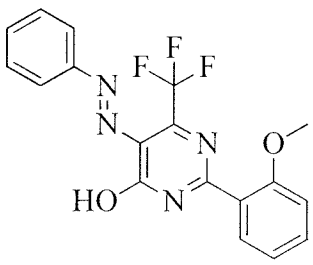
VIII-6

(*E*)-2-(2-(1H-imidazol-1-yl)ethyl)-5-(phenyldiazenyl)-6-(trifluoromethyl)-pyrimidin -4-ol [Compound VIII-7] was prepared from 3-(1*H*-imidazol-1-yl)propanimidamide) and was isolated as a crude yellow solid (1.8g, 99%): ESIMS *m/z* 363 ($[M+1]^+$).



VIII-7

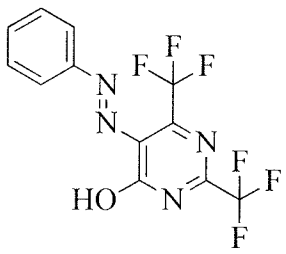
(*E*)-2-(2-methoxyphenyl)-5-(phenyldiazenyl)-6-(trifluoromethyl)pyrimidin-4-ol [Compound VIII-8] was prepared from 2-methoxybenzimidamide and was isolated as a crude yellow solid (3.7g, 50%): ESIMS *m/z* 375 ($[M+1]^+$).



VIII-8

Example 3

Preparation of (*E*)-5-(phenyldiazenyl)-2,6-bis(trifluoromethyl)pyrimidin-4-ol [Compound VIII-9]



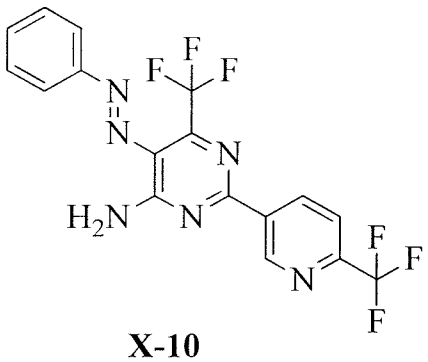
VIII-9

Accoording to the procedure adapted from *J. Am. Chem. Soc.* (**1958**), 80, 5744–5752, 2,2,2-trifluoroacetimidamide (1.2 g, 10.7 mmol) was added to a solution of sodium (231.4 mg, 10.0 mmol) in 1-butanol (8.0 mL), and the mixture stirred at 60°C for 15 min. To the mixture was added (*E*)-ethyl 4,4,4-trifluoro-3-oxo-2-(phenyldiazenyl)butanoate (**VI-1**) (2.9 g, 10.0 mmol) and heated to reflux for 3 h. The reaction mixture was cooled, and most solvent was removed under vacuum. The residue was diluted with distilled water and then acidified with glacial AcOH until the solution had a pH 5. The mixture was extracted with EtOAc (1 x 50 mL), dried over Na_2SO_4, filtered and concentrated under vacuum to afford compound **VIII-9** (1.0 g, 29.6%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 7.94–7.82 (m, 2H), 7.72–7.59 (m, 3H); ESIMS *m/z* 335 ([M-1]$^-$).

Example 4

Preparation of (*E*)-5-(phenyldiazenyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)pyrimidin-4-amine

[Compound X-10]

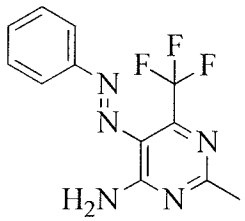


X-10

To a mixture of compound **VI-2** (4.9 g, 11.9 mmol) in $POCl_3$ (40 mL), *N,N*-diethylbenzenamine (3.5 g, 23.5 mmol) was added dropwise while the temperature was maintained between 20°C to 25°C. The mixture was stirred and refluxed for 2 h, followed by removal of $POCl_3$ by vacuum distillation. The residue was added to cracked ice and extracted with EtOAc (2 x 100 mL). The extracts were washed with brine, dried over Na_2SO_4, and concentrated under vacuum. The resulting dark oil was dissolved into a MeOH solution of ammonia (2M, 50 mL), and stirred at RT overnight. Most of the solvent was removed under vacuum, and the residue was extracted with EtOAc (2 x 100 mL). The organic phases were dried over Na_2SO_4, concentrated and purified by column chromatography (petroleum ether - EtOAc = 5: 1) to afford compound **X-10** as a yellow foam (1.6 g, 32.6%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 9.66 (s, 1H), 9.36–9.25 (m, 2H), 8.96 (d, J = 8.4 Hz, 1H), 8.19–8.06 (m, 3H), 7.67–7.65 (m, 3H); ESIMS m/z 413 ([M+1]$^+$).

The following intermediates were made in accordance with the procedures disclosed in Example 4.

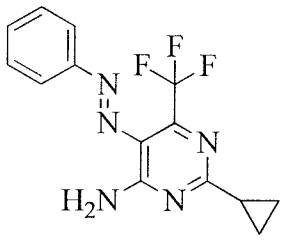
(*E*)-2-methyl-5-(phenyldiazenyl)-6-(trifluoromethyl)pyrimidin-4-amine [Compound X-11] was prepared from compound **VIII-3** and was isolated as a yellow solid (1.5g, 58%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 9.15 (brs, 1H), 8.91 (brs, 1H), 8.02–7.99 (m, 2H), 7.66–7.58 (m, 3H), 2.57 (s, 3H); ESIMS m/z 282 ([M+1]$^+$).



X-11

(*E*)-2-cyclopropyl-5-(phenyldiazenyl)-6-(trifluoromethyl)pyrimidin-4-amine

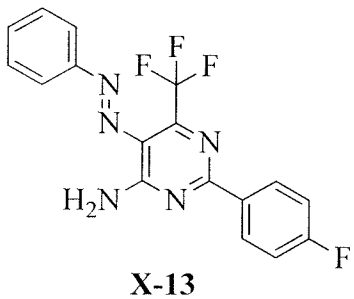
[Compound X-12] was prepared from compound **VIII-4** and was isolated as a yellow solid (2.6g, 46%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 9.144 (brs, 1H), 8.811 (brs, 1H), 7.99–7.97 (m, 2H), 7.66–7.57 (m, 3H), 2.21–2.12 (m, 1H), 1.14–1.13 (m, 2H), 1.12–1.11 (m, 2H); ESIMS *m/z* 308 ([M+1]$^+$).



X-12

(*E*)-2-(4-fluorophenyl)-5-(phenyldiazenyl)-6-(trifluoromethyl)pyrimidin-4-amine

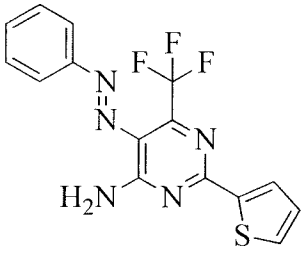
[Compound X-13] was prepared from compound **VIII-5** and was isolated as a yellow solid (1.8g, 60%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 8.51–8.46 (m, 2H), 8.01–7.97 (m, 2H), 7.79-7.72 (m, 3H), 7.52–7.46 (m, 2H); ESIMS *m/z* 362 ([M+1]$^+$).



X-13

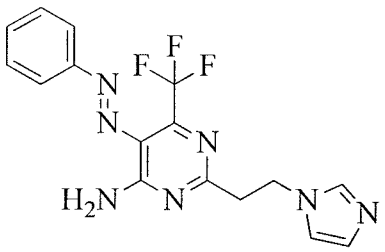
(*E*)-5-(phenyldiazenyl)-2-(thiophen-2-yl)-6-(trifluoromethyl)pyrimidin-4-amine

[Compound X-14] was prepared from compound **VIII-6** and was isolated as a yellow solid (2.6g, 46%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 8.11–8.09 (m, 1H). 7.96–7.93 (m, 2H), 7.71-7.69 (m, 1H), 7.61–7.53 (m, 3H), 7.22–7.19 (m, 1H); ESIMS *m/z* 350 ([M+1]$^+$).



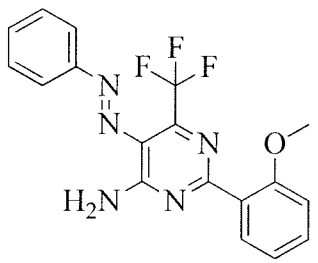
X-14

(*E*)-2-(2-(1*H*-imidazol-1-yl)ethyl)-5-(phenyldiazenyl)-6-(trifluoromethyl)-pyrimidin-4-amine [Compound X-15] was prepared from compound **VIII-7** and was isolated as a yellow solid (1.0g, 48%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 9.16 (s, 1H). 8.96 (s, 1H), 7.99–7.97 (m, 2H), 7.69–7.59 (m, 2H), 7.19 (s, 1H), 7.04 (brs, 2H), 6.86 (s, 1H), 4.46 (t, J = 6.8 Hz, 2H), 3.28 (t, J = 6.8 Hz, 2H); ESIMS *m/z* 362 ([M+1]$^+$).



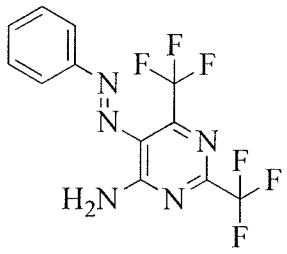
X-15

(*E*)-2-(2-methoxyphenyl)-5-(phenyldiazenyl)-6-(trifluoromethyl)pyrimidin-4-amine [Compound X-16] was prepared from compound **VIII-8** and was isolated as a yellow solid (2.8g, 75%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 9.23 (s, 1H), 9.05 (s, 1H), 8.06–8.03 (m, 3H), 7.69–7.61 (m, 3H), 7.56–7.50 (m, 1H), 7.22–7.08 (m, 2H), 3.84 (s, 3H); ESIMS *m/z* 374 ([M+1]$^+$).



X-16

(*E*)-5-(phenyldiazenyl)-2,6-bis(trifluoromethyl)pyrimidin-4-amine [Compound X-17] was prepared from compound **VIII-9** and was isolated (186 mg, 50%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 9.58 (s, 1H), 9.40 (s, 1H), 8.25–7.98 (m, 2H), 7.80–7.52 (m, 3H); ESIMS *m/z* 334 ([M-1]$^-$).



X-17

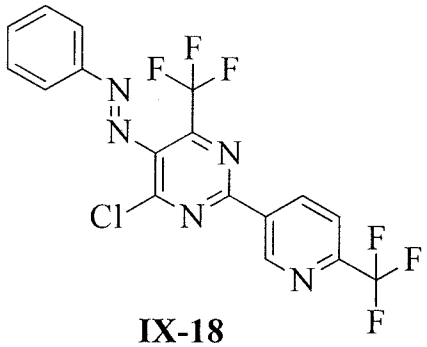
Example 5

Preparation of

(*E*)-4-chloro-5-(phenyldiazenyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)pyr

imidine

[Compound IX-18]



IX-18

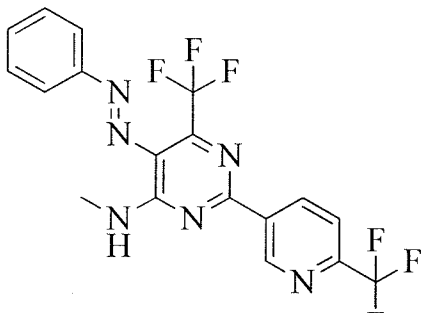
In a 100 mL round-bottomed flask was added compound **VI-2** (2.6 g, 6.29 mmol) and $POCl_3$ (15 ml, 161 mmol). *N,N*-diethylaniline (2.001 ml, 12.58 mmol) was added dropwisely into the solution to gave a deep red solution. The reaction mixture was heated to 105°C for two h. After being cooled down, $POCl_3$ was removed under vacuum to give red oil. Toluene (4 mL) was added to the residue, and the solvent was removed under vacuum. The residue red oil was then poured over cracked ice (100 g), and transferred into a separatory funnel with EtOAc (200 mL) and distilled water (75 mL). The mixture was shook into separated layers, and the aqueous layer was extracted with EtOAc (2 x 25mL). The combined organic layers were washed with saturated sodium chloride (NaCl) solution (2x100mL). The organic phase was dried over Na_2SO_4, filtered and concentrated under vacuum to afford compound **IX-18** as crude red oil (3g): ESIMS *m/z* 432 ($[M+1]^+$). Compound **IX-18** was used without further purification.

Example 6

Preparation of

(*E*)-*N*-methyl-5-(phenyldiazenyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)pyrimidin-4-amine

[Compound X-19]



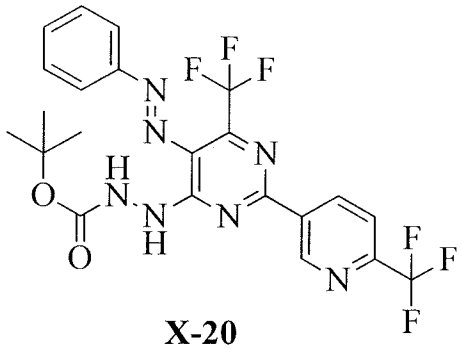
X-19

To a 25 mL vial was added 2M methylamine in THF (7.5 mL, 15 mmol), followed by a solution of **IX-18** (0.648 g, 1.5 mmol) in THF (5 mL) to give a deep red solution that immediately turned to a thick orange-red suspension. The mixture was stirred at RT for one h and then concentrated under vacuum to give an orange-red residue. The residue was diluted in EtOAc (50 mL), transferred to a separatory funnel containing EtOAc (100 mL) and washed with saturated NaCl solution (2 x 100mL). The organic phase was dried over Na_2SO_4, filtered and concentrated under vacuum to give a brown residue. The residue was dissolved in CH_2Cl_2 (50mL) and EtOAc (100 mL), dried onto SiO_2 (10g), and followed by column chromatography (hexanes-EtOAc; gradient 80g column) to afford compound **X-19** as an orange solid (0.547 g, 81%): mp 203°C-206°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 9.93 (d, J = 4.7 Hz, 1H), 9.68 (d, J = 1.9 Hz, 1H), 8.97 (dd, J = 8.1, 1.7 Hz, 1H), 8.12 (d, J = 8.3 Hz, 1H), 8.08–8.01 (m, 2H), 7.69-7.57 (m, 3H), 3.29 (d, J = 4.9 Hz, 3H); ESIMS *m/z* 427.9 ([M+1]$^+$).

The following intermediates were made in accordance with the procedures disclosed in Example 6.

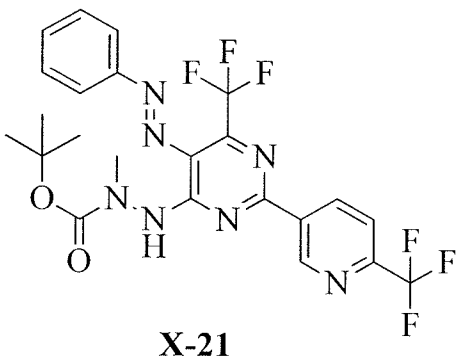
(*E*)-tert-butyl 2-(5-(phenyldiazenyl)-6-(trifluoromethyl)-2-(6-(trifluoro-methyl)-pyridin-3-yl)pyrimidin-4-yl)hydrazinecarboxylate [Compound X-20] was prepared from *tert*-butyl hydrazinecarboxylate, and was isolated as an orange solid (0.655 g, 79%): mp 184°C–187°C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 11.03 (s, 1H), 9.86 (s, 1H), 9.67 (s, 1H), 8.96 (d, J = 7.6 Hz,

1H), 8.20 (d, J = 7.8 Hz, 1H), 8.15–8.09 (m, 2H), 7.73–7.56 (m, 3H), 1.51 (s, 9H). ESIMS *m/z* 529.1 ($[M+1]^+$).



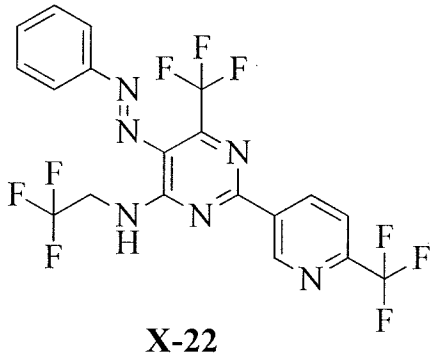
X-20

(*E*)-tert-butyl 1-methyl-2-(5-(phenyldiazenyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)pyrimidin-4-yl)hydrazinecarboxylate [Compound X-21] was prepared from *tert*-butyl 1-methylhydrazinecarboxylate, and was isolated as an orange solid (0.769 g, 90%): mp 198°C-200°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 11.27–11.08 (m, 1H), 9.62 (s, 1H), 8.93 (d, J = 7.8 Hz, 1H), 8.26–8.11 (m, 3H), 7.66 (s, 3H), 3.31–3.18 (m, 3H), 1.50 (s, 4H), 1.28–1.17 (m, 5H); ESIMS *m/z* 543.1 ($[M+1]^+$).



X-21

(*E*)-5-(phenyldiazenyl)-N-(2,2,2-trifluoroethyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)pyrimidin-4-amine [Compound X-22] was prepared from 2,2,2-trifluoroethanamine, and was isolated as an orange solid (0.521 g, 67%): mp 190°C-192°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.16 (t, J = 6.5 Hz, 1H), 9.74 (d, J = 1.9 Hz, 1H), 9.01 (dd, J = 8.1, 1.7 Hz, 1H), 8.14 (d, J = 8.2 Hz, 1H), 8.08–8.00 (m, 2H), 7.74– 7.63 (m, 3H), 4.87–4.68 (m, 2H); ESIMS *m/z* 494.75 ($[M+1]^+$).

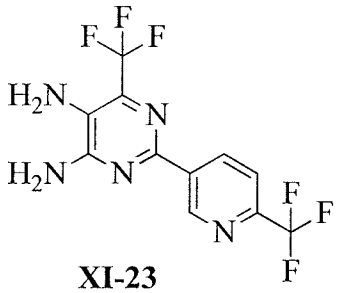


X-22

Example 7

Preparation of

6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)pyrimidine-4,5-diamine [Compound XI-23]

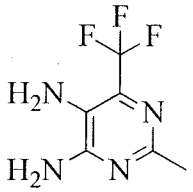


XI-23

A solution of compound **X-10** (2.4 g, 5.8 mmol) in absolute EtOH (50 mL) was hydrogenated at atmosphere pressure and RT in the presence of 5% palladium-charcoal (1.2 g) for 3 h. The reaction mixture was filtered, concentrated under vacuum to give a residue that was purified by column chromatography to afford compound **XI-23** as a yellow solid (1.8 g, 95.0%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 9.43 (s, 1H), 8.68 (d, J = 8.4 Hz, 1H), 8.00 (d, J = 8.4 Hz, 1H), 7.40 (brs, 2H), 5.83 (brs, 2H); ESIMS m/z 324 ([M+1]$^+$).

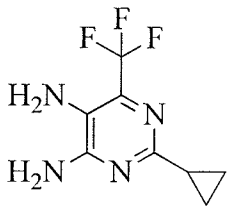
The following intermediates were made in accordance with the procedures disclosed in Example 7.

2-methyl-6-(trifluoromethyl)pyrimidine-4,5-diamine [Compound XI-24] was prepared from compound **X-11**, and was isolated as a yellow solid (564g, 95%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 6.97 (brs, 2H), 5.14 (brs, 2H), 2.256 (s, 3H); ESIMS m/z 193 ([M+1]$^+$).



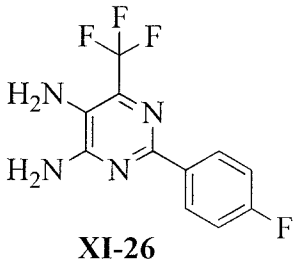
XI-24

2-cyclopropyl-6-(trifluoromethyl)pyrimidine-4,5-diamine [Compound XI-25] was prepared from compound **X-12**, and was isolated as a yellow solid (1.6g, 90%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 6.93 (brs, 2H), 5.07 (brs, 2H), 1.88–1.80 (m, 1H), 0.81–0.79 (m, 4H); ESIMS *m/z* 219 ([M+1]$^+$).



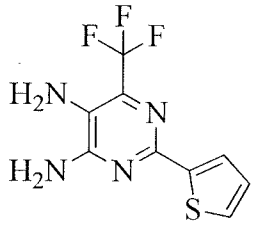
XI-25

2-(4-fluorophenyl)-6-(trifluoromethyl)pyrimidine-4,5-diamine [Compound XI-26] was prepared from compound **X-13**, and was isolated as a yellow solid (1.2g, 88%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 8.24–8.19 (m, 2H), 7.30–7.24 (m, 2H), 7.19 (brs, 2H), 5.52 (brs, 2H); ESIMS *m/z* 273 ([M+1]$^+$).



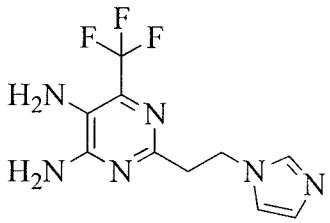
XI-26

2-(thiophen-2-yl)-6-(trifluoromethyl)pyrimidine-4,5-diamine [Compound XI-27] was prepared from compound **X-14**, and was isolated as a yellow solid (1.4g, 70%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 7.62–7.60 (m, 1H), 7.55–7.53 (m, 1H), 7.20 (brs, 2H), 7.12–7.10 (m, 1H), 5.50 (brs, 2H); ESIMS *m/z* 261 ([M+1]$^+$).



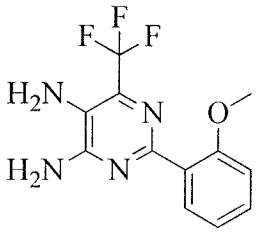
XI-27

2-(2-(1*H*-imidazol-1-yl)ethyl)-6-(trifluoromethyl)pyrimidine-4,5-diamine [Compound XI-28] was prepared from compound **X-15**, and was isolated as a yellow solid (0.3 g, 40%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 7.59 (s, 1H), 7.12 (s, 1H), 7.04 (brs, 2H), 6.83 (s, 1H), 5.23 (brs, 2H), 4.31 (t, J = 7.1 Hz, 2H), 2.96 (t, J = 7.1 Hz, 2H); ESIMS m/z 273 ([M+1]$^+$).



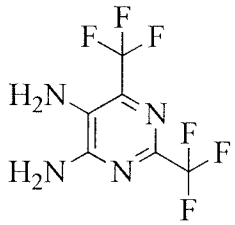
XI-28

2-(2-methoxyphenyl)-6-(trifluoromethyl)pyrimidine-4,5-diamine [Compound XI-29] was prepared from compound **X-16**, and was isolated as a yellow solid (1.95g, 91%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 7.40–7.33 (m, 2H), 7.08 (brs, 2H), 7.05–6.96 (m, 2H), 5.39 (brs, 2H), 3.74 (s, 3H); ESIMS m/z 285 ([M+1]$^+$).



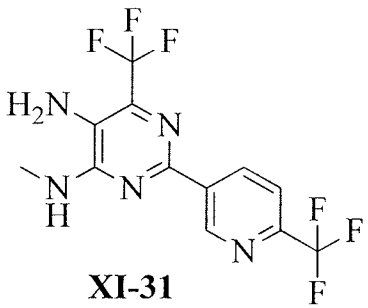
XI-29

2,6-bis(trifluoromethyl)pyrimidine-4,5-diamine[Compound XI-30] was prepared from compound **X-17** and was isolated (110 mg, 89%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 7.68 (brs, 1H), 6.06 (brs, 1H): ESIMS m/z 247 ([M+1]$^+$).



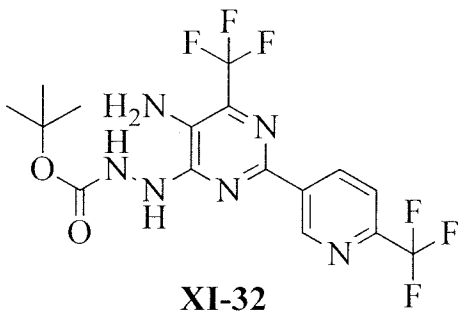
XI-30

4-*N*-methylamine-6-trifluoromethyl-2-(6-(trifluoromethyl)pyridin-3-yl)pyrimidine-4,5-diamine [Compound XI-31] was prepared from compound **X-19**, and was isolated as an off-white solid (0.334 g, 76%): mp 182°C–184°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 9.48 (d, J = 1.9 Hz, 1H), 8.72 (dd, J = 8.2, 1.4 Hz, 1H), 8.02– 7.92 (m, 1H), 7.53 (d, J = 4.4 Hz, 1H), 5.80 (s, 2H), 3.07 (d, J = 4.4 Hz, 3H); ESIMS m/z 338.4 ([M+1]$^+$).



XI-31

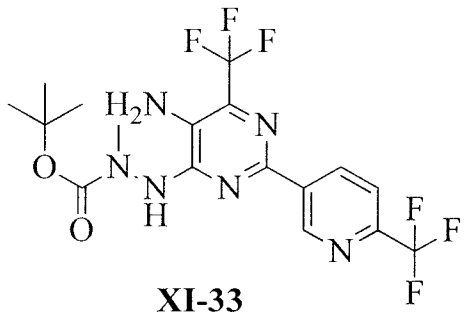
***tert*-butyl 2-(5-amino-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl) pyrimidin-4-yl)hydrazinecarboxylate [Compound XI-32]** was prepared from compound **X-20**, and was isolated as a white solid (0.476 g, 86%): mp 208°C–210°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 9.45 (d, J = 1.5 Hz, 1H), 9.24 (s, 1H), 9.12 (s, 1H), 8.68 (d, J = 8.3 Hz, 1H), 8.03 (d, J = 8.2 Hz, 1H), 5.92 (s, 2H), 1.48 (s, 9H); ESIMS m/z 438.6 ([M+1]$^+$).



XI-32

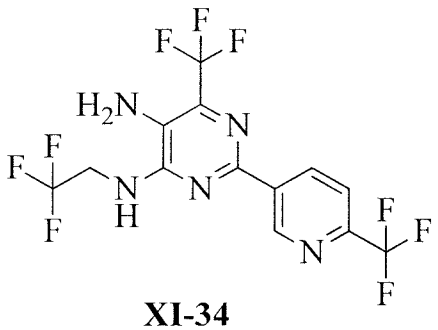
***tert*-butyl 2-(5-amino-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl) pyrimidin-4-yl)-1-methylhydrazinecarboxylate [Compound XI-33]** was prepared from

compound **X-21**, and was isolated as a white solid (0.551 g, 84%): mp 192°C–194°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 9.81–9.65 (m, 1H), 9.41 (s, 1H), 8.66 (dd, J = 8.2, 1.5 Hz, 1H), 8.02 (d, J = 8.3 Hz, 1H), 5.92 (s, 2H), 3.29–3.11 (m, 3H), 1.47 (s, 4H), 1.27–1.13 (m, 5H); ESIMS *m/z* 453.2 ([M+1]$^+$).



XI-33

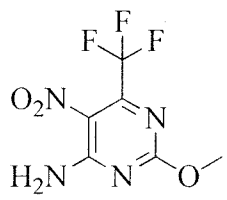
N4-(2,2,2-trifluoroethyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)pyrimidine-4,5-diamine [Compound XI-34] was prepared from compound **X-22**, and was isolated an an off-white solid (0.348 g, 80%): mp 220°C–222°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 9.50 (s, 1H), 8.73 (d, J = 8.2 Hz, 1H), 8.05–7.89 (m, 2H), 6.03 (s, 2H), 4.56 (d, J = 8.6 Hz, 2H); ESIMS *m/z* 403.0 ([M-1]$^-$).



XI-34

Example 8

Preparation of 2-methoxy-5-nitro-6-(trifluoromethyl)pyrimidin-4-amine [Compound XIII-35]

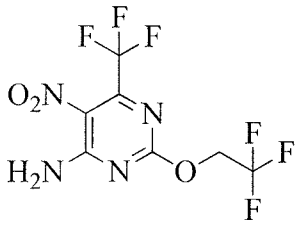


XIII-35

Using a modified procedure adapted from *J. Chem. Soc. [Section] C: Organic* (**1971**), 12, 2278–2282, to a solution of 4-amino-2-chloro-5-nitro-6-trifluoromethyl pyrimidine (300 mg, 1.24 mmol), as prepared in *J. Chem. Soc. [Section] C: Organic* (**1969**), (13), 1751–1754, in MeOH (5.0 mL) was added pyridine (2.0 mL). The reaction mixture was stirred overnight at RT, and the solvent was removed under vacuum. The residue was diluted with EtOAc (30 mL) and washed with water (20 mL), then HCl (1 M, 20 mL). The organic phase was dried over Na_2SO_4, filtered and concentrated to afford compound **XIII-35** as a yellow foam (300 mg, 100%): ^{1}H NMR (300 MHz, $CDCl_3$) δ 4.050 (s, 3H); ESIMS *m/z* 239 ($[M+H]^+$).

The following intermediate was made in accordance with the procedures disclosed in Example 8.

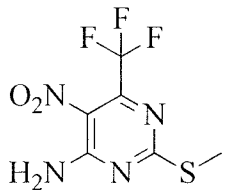
5-nitro-2-(2,2,2-trifluoroethoxy)-6-(trifluoromethyl)pyrimidin-4-amine[Compound XIII-36] was prepared from 2,2,2-trifluoroethanol, and was isolated as a yellow solid (1.6g, 100%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 8.96 (brs, 1H). 8.32 (brs, 1H), 5.03 (q, J = 8.9 Hz, 2H); ESIMS *m/z* 307 ($[M+H]^+$).



XIII-36

Example 9

Preparation of 2-(methylthio)-5-nitro-6-(trifluoromethyl)pyrimidin-4-amine [Compound XIII-37]



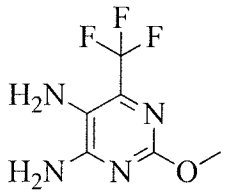
XIII-37

To a solution of 4-amino-2-chloro-5-nitro-6-trifluoromethylpyrimidine (1.5 g, 6.2 mmol) in THF (20 mL) and water (10 mL) was added sodium methanethiolate (870 mg, 12.4 mmol). The reaction mixture was stirred for overnight at RT and then concentrated under vacuum. The

resulting residue was extracted with EtOAc (3 x 20 mL). The combined organics dried over Na_2SO_4, concentrated and purified by column chromatography (CH_2Cl_2-EtOAc = 50:1) to afford compound **XIII-37** as a yellow solid (1.4 g, 89%): ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.36 (s, 3H); ESIMS *m/z* 255 ([M+H]$^+$).

Example 10

Preparation of 2-methoxy-6-(trifluoromethyl)pyrimidine-4,5-diamine [Compound XI-38]

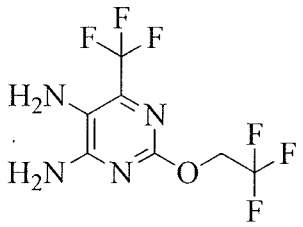


XI-38

Using a modified procedure adapted from *J. Chem. Soc. [Section] C: Organic* (**1971**), 12, 2278–2282, saturated $NaHCO_3$ solution (10 mL) was added to a solution of compound **XIII-35** (100 mg, 0.42 mmol) in acetone (10 mL). To the mixture was added $Na_2S_2O_3$ (3.6 g, 21 mmol) in portions, and the mixture was stirred for 20 min. The mixture was filtered. The filtrate was diluted with water, extracted with EtOAc, dried over Na_2SO_4, and concentrated. The residue was purified by preparative thin layer chromatography to afford compound **XI-38** as a white solid (60 mg, 68.7%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 7.20 (brs, 2H), 4.86 (brs, 2H), 3.72 (s, 3H); ESIMS *m/z* 209 ([M+H]$^+$).

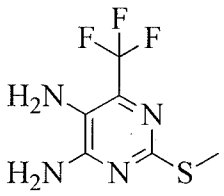
The following intermediates were made in accordance with the procedures disclosed in Example 10.

2-(2,2,2-trifluoroethoxy)-6-(trifluoromethyl)pyrimidine-4,5-diamine [Compound XI-39] was prepared from compound **XIII-36**), and was isolated as a yellow solid (0.66 g, 46%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 7.41 (brs, 2H), 5.07 (brs, 2H), 4.80 (q, J = 9.1 Hz, 2H; ESIMS *m/z* 277 ([M+H]$^+$).



XI-39

2-(methylthio)-6-(trifluoromethyl)pyrimidine-4,5-diamine [Compound XI-40] was prepared from compound **XIII-37**), and was isolated as a yellow solid (0.78 g, 63%): ^{1}H NMR (300 MHz, DMSO-d_6) δ 7.19 (brs, 2H), 5.15 (brs, 2H), 2.36 (s, 3H); ESIMS *m/z* 225 ([M+H]$^+$).

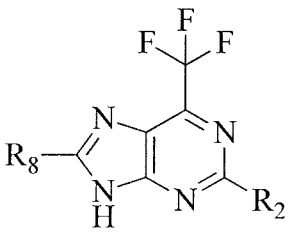


XI-40

Example 11

Preparation of 2,8-(substituted)-6-(trifluoromethyl)-9*H*-purines

[Compounds 1–63]



Separately, compound **XI-23, XI -24, XI -25, XI-26, XI-27, XI-28, XI-29, XI-38, XI-39** and **XI-40** (1 eq.) each was mixed with an appropriate aldehyde (2 eq.) in anhydrous dioxane (5 mL). The reaction mixture was treated with $FeCl_3/SiO_2$ (15%, 2 eq.) at 100°C under nitrogen for 18 h. The cooled mixture was filtered and washed with EtOAc (2 x 15 mL). The filtrate was concentrated under vacuum, and the residue was purified by silica gel chromatography to give 2,8-(Substituted)-6-(trifluoromethyl)-9*H*-purine (**Compounds 1–63**), respectively.

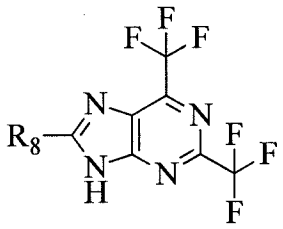
Aldehydes used include: 2-chloro-5-(trifluoromethyl)benzaldehyde, 2-fluoro-4-(trifluoromethyl)benzaldehyde, 2-methoxy-4-(trifluoromethyl)benzaldehyde, 6-(trifluoromethyl)-nicotinaldehyde, 2,5-dichlorobenzaldehyde, 2,6-dichloro-4-(trifluoromethyl) benzaldehyde, 4-(dimethylamino)benzaldehyde, 2,4,6-trimethoxybenzaldehyde, or 3,4,5-trimethoxybenzaldehyde.

The purine **compounds 1–63** in **TABLE 5** were made in accordance with the procedures disclosed in Example 11.

Example 12

Preparation of 8-Substituted-2,6-bis(trifluoromethyl)-9*H*-purine

[Compounds 64–80]



In separate flasks, a solution of intermediate **XI-30** (0.24 mmol) in anhydrous dioxane (3 mL) was mixed with an aldehyde (0.24 mmol). The reaction mixture was treated with 15% $FeCl_3/SiO_2$ (0.48 mmol) and heated with stirring at 100°C under nitrogen for 20 h. The mixture was cooled, filtered and washed with EtOAc (15 mL). The filtrate was concentrated under vacuum to give a residue, which was dissolved with EtOAc (15 mL) and washed with distilled water (10 mL). The organic phase was dried over Na_2SO_4, and concentrated under vacuum. The residue was purified by preparative HPLC to afford 8-Substituted-2,6-bis(trifluoromethyl)-9*H*-purine (**Compounds 64-80**).

Aldehydes used include: 2,6-dichlorobenzaldehyde, 2,6-dichloro-4-(trifluoromethyl) benzaldehyde, 2-chloro-5-(trifluoromethyl)benzaldehyde, 3-chlorothiophene-2-carbaldehyde, 2,4-dichlorobenzaldehyde,2-chloro-4-(dimethylamino)benzaldehyde,2-chloro-6-methylbenzaldehyde, 2-methoxy-4-(trifluoromethyl)benzaldehyde, 2-fluoro-4-(trifluoromethyl)-benzaldehyde, 2,4,6-trichlorobenzaldehyde,2,5-dichlorothiophene-3-carbaldehyde,5-chloro-thiophene-2-carbaldehyde,5-(trifluoromethyl)picolinaldehyde,2,6-dichloronicotinaldehyde,6-(trifluoromethyl)nicotinaldehyde, 3,5-dichloroisonicotinaldehyde, 3-chloropicolinaldehyde.

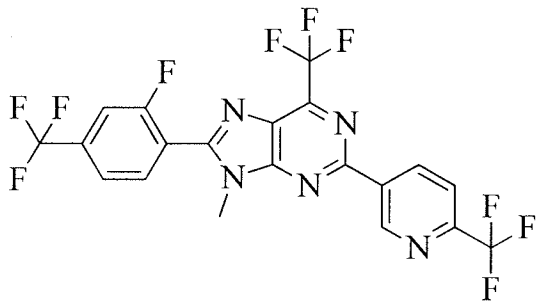
The purine **Compounds 64–80** in **TABLE 5** were made in accordance with the procedures disclosed in Example 12.

Example 13

Preparation of

8-(2-fluoro-4-(trifluoromethyl)phenyl)-9-methyl-6-(trifluoromethyl)-2-(6-(trifluoromethyl) pyridin-3-yl)-9*H*-purine

[Compound 81]



To a 25 mL vial was added compound **XI-31** (0.1 g, 0.297 mmol) and 2-fluoro-4-(trifluoromethyl)benzaldehyde (0.114 g, 0.593 mmol) dissolved in 1,4-dioxane (5 mL). To the solution was added 15% $FeCl_3/SiO_2$ (0.641 g, 0.593 mmol) followed by addition of 1,4-dioxane (10 mL) to give a brown suspension that was heated to a temperature of about 100°C. After 4 h, an additional 15% $FeCl_3/SiO_2$ (0.2 g) was added, and the reaction mixture was heated overnight. Then, an additional 2-fluoro-4-trifluoromethyl benzaldehyde (0.1 g) was added, and the reaction mixture was continued to be heated at a temperature of about 100°C for another 10 h. The reaction mixture was cooled to RT, filtered over silica gel. The filtrate was washed with EtOAc (4 x 10mL) and CH_2Cl_2 (3 x 10mL). The organic mixture was dried over SiO_2 (5 g) and the solvent was removed under vacuum. The residue was purified by column chromatography (hexanes - EtOAc: gradient; 40g column) to afford the purine **Compound 81** as a white solid (0.072 g, 47%): mp 159°C–161°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.88 (d, J = 1.8 Hz, 1H), 9.04 (dd, J = 8.2, 1.6 Hz, 1H), 8.01 (t, J = 7.4 Hz, 1H), 7.85 (d, J = 8.3 Hz, 1H), 7.71 (d, J = 8.1 Hz, 1H), 7.62 (d, J = 9.8 Hz, 1H), 4.01 (d, J = 2.6 Hz, 3H); ESIMS m/z 511.0 ($[M+1]^+$).

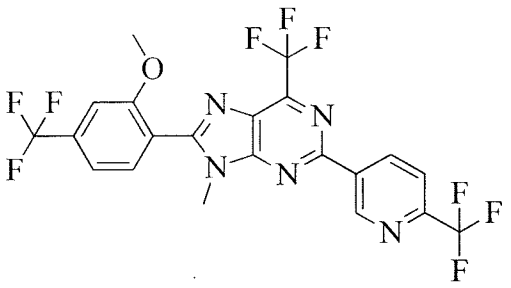
Example 14

Preparation of

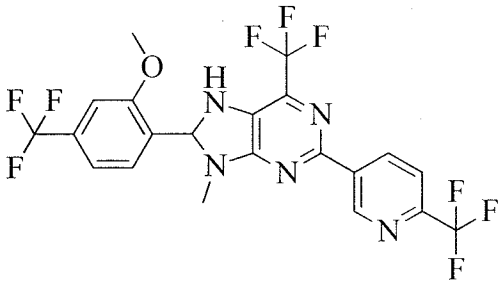
8-(2-methoxy-4-(trifluoromethyl)phenyl)-9-methyl-6-(trifluoromethyl)-2-(6-(trifluorometh yl)pyridin-3-yl)-9*H*-purine [Compound 82]

and

8-(2-methoxy-4-(trifluoromethyl)phenyl)-9-methyl-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-8,9-dihydro-7*H*-purine [Compound 83]



Compound 82



Compound 83

To a 25 mL vial was added compound **XI-31** (0.1 g, 0.297 mmol) and 2-methoxy-4-(trifluoromethyl)benzaldehyde (0.121 g, 0.593 mmol) dissolved in 1,4-dioxane (5 mL). To the solution was added 15% $FeCl_3/SiO_2$ (0.641 g, 0.593 mmol) followed by addition of 1,4-dioxane (10 mL) to give a brown suspension that was heated to 100°C for 4 h, and then cooled to RT and stirred overnight. The mixture was filtered over silica gel and washed with EtOAc (4 x 10mL) and CH_2Cl_2 (3 x 10mL). The organic mixture was dried over SiO_2 (5 g), and the solvent was removed under vacuum. The residue was purified by column chromatography (hexanes - EtOAc: gradient; 40g column) to afford the purine **Compound 82** and **Compound 83.**

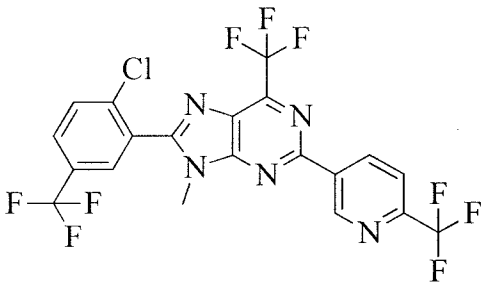
Compound 82 was a white solid (0.086 g, 52%): mp 200°C–202°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 9.78 (d, J = 1.9 Hz, 1H), 9.05 (dd, J = 8.2, 1.7 Hz, 1H), 8.16 (d, J = 8.3 Hz, 1H), 7.86 (d, J = 7.8 Hz, 1H), 7.63 (s, 1H), 7.58 (d, J = 7.9 Hz, 1H), 3.99 (s, 3H), 3.83 (s, 3H); ESIMS m/z 522.0 ([M+1]$^+$).

Compound 83 was as a pale white solid (0.042 g, 27%): mp 154°C–157°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.60 (d, J = 1.6 Hz, 1H), 8.74 (dd, J = 8.2, 1.4 Hz, 1H), 7.70 (d, J = 8.1 Hz, 1H), 7.46 (d, J = 7.9 Hz, 1H), 7.33 (d, J = 8.1 Hz, 1H), 7.20 (s, 1H), 6.67 (s, 1H), 5.05 (s, 1H), 3.92 (s, 3H), 3.03 (s, 3H); ESIMS m/z 524.9 ([M+1]$^+$).

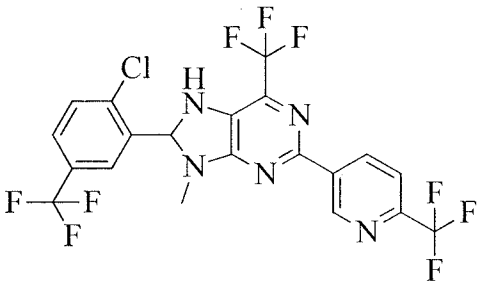
The following purine compounds were prepared in accordance with the procedures disclosed in Example 14.

8-(2-chloro-5-(trifluoromethyl)phenyl)-9-methyl-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-9*H*-purine [**Compound 84**] and 8-(2-chloro-5-(trifluoromethyl)-phenyl)-

9-methyl-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-8,9-dihydro-7*H*-purine [**Compound 85**] was prepared from 2-chloro-5-(trifluoromethyl)benzaldehyde).



Compound 84



Compound 85

Compound 84 was isolated as pale yellow foam (0.046 g, 29%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.89 (d, J = 1.9 Hz, 1H), 9.10– 9.00 (m, 1H), 7.94 (d, J = 2.1 Hz, 1H), 7.91– 7.82 (m, 2H), 7.77 (d, J = 8.5 Hz, 1H), 3.92 (s, 3H); ^{19}F NMR (376 MHz, $CDCl_3$): δ -62.71 (s), -66.14 (s), -67.96 (s); ESIMS *m/z*; 527.2 ($[M+1]^+$).

Compound 85 was isolated as as pale yellow foam (0.055 g, 34%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.61 (d, J = 1.8 Hz, 1H), 8.75 (dd, J = 8.2, 1.4 Hz, 1H), 7.77–7.61 (m, 4H), 6.82 (s, 1H), 5.20 (s, 1H), 3.04 (s, 3H); ^{19}F NMR (376 MHz, $CDCl_3$): δ -62.64 (s), -65.94 (s), -67.76 (s); ESIMS *m/z* 529.0 ($[M+1]^+$).

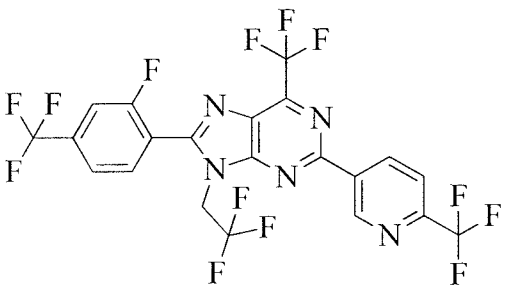
Example 15

Preparation of

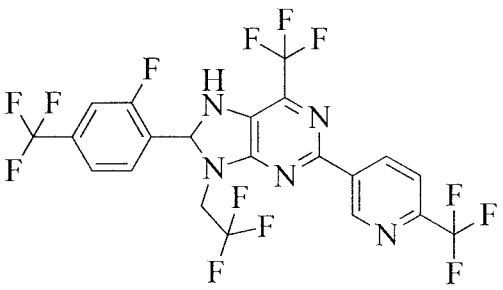
8-(2-fluoro-4-(trifluoromethyl)phenyl)-9-(2,2,2-trifluoroethyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-9*H*-purine [Compound 86]

and

8-(2-fluoro-4-(trifluoromethyl)phenyl)-9-(2,2,2-trifluoroethyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-8,9-dihydro-7*H*-purine [Compound 87]



Compound 86



Compound 87

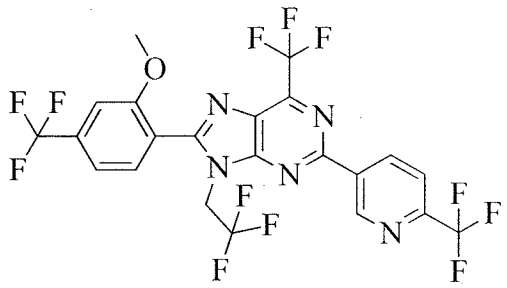
To a 25 mL vial was added compound **XI-34** (0.1 g, 0.247 mmol) and 2-fluoro-4-(trifluoromethyl)benzaldehyde (0.119 g, 0.617 mmol) dissolved in 1,4-dioxane (5 mL). To the solution was added 15% $FeCl_3/SiO_2$ (0.534 g, 0.494 mmol) followed by addition of 1,4-dioxane (10 mL) to give a brown suspension that was heated to 100°C for 18 h. Then, additional 2-fluoro-4-(trifluoromethyl)benzaldehyde (0.1 g) was added, and the reaction mixture was heated for 24 h. The reaction mixture was cooled to RT, filtered with silica gel, and washed with EtOAc (4 x 10mL) and CH_2Cl_2 (3 x 10mL). Then, the solvent was removed under vacuum. The resulting residue was dissolved in CH_2Cl_2 (25 mL), cooled to 0°C with ice bath, followed by the addition of DDQ (0.056 g, 0.247 mmol). The reaction mixture was stirred cold for 30 min, and warmed to RT for 45 min. Then, the reaction mixture was poured into a separatory funnel containing CH_2Cl_2 (50 mL), washed with sodium hydroxide (NaOH) aqueous solution (1 N, 3 x 25 mL). The aqueous layer was back-extracted with CH_2Cl_2 (1 x 25mL), and combined with the organic phases. The combined organic phases were dried over magnesium sulfate ($MgSO_4$), and filtered. After addition of SiO_2 (5g), the solvent was removed under vacuum. The residue was purified by column chromatography (hexanes - EtOAc:gradient; 25g column) to afford the purine **Compound 86 and Compound 87.**

Compound 86 was isolated as an off-white solid (0.064 g, 44%): mp 194°C–196°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 9.83 (d, J = 1.9 Hz, 1H), 9.09 (dd, J = 8.2, 1.6 Hz, 1H), 8.19 (d, J = 8.3 Hz, 1H), 8.15–8.07 (m, 2H), 7.92 (d, J = 8.0 Hz, 1H), 5.49 (q, J = 8.9 Hz, 2H); ESIMS *m/z* 578.2 ([M+1]$^+$).

Compound 87 was isolated as a pale white solid (0.025 g, 17%): mp 159°C–162°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.59 (d, J = 1.6 Hz, 1H), 8.73 (dd, J = 8.2, 1.4 Hz, 1H), 7.73 (d, J = 8.3 Hz, 1H), 7.68–7.54 (m, 2H), 7.48 (d, J = 10.2 Hz, 1H), 6.87 (s, 1H), 5.20 (s, 1H), 4.56 (dt, J = 15.8, 9.2 Hz, 1H), 3.48 (dq, J = 16.3, 8.2 Hz, 1H); ESIMS *m/z* 581.1 ([M+1]$^+$).

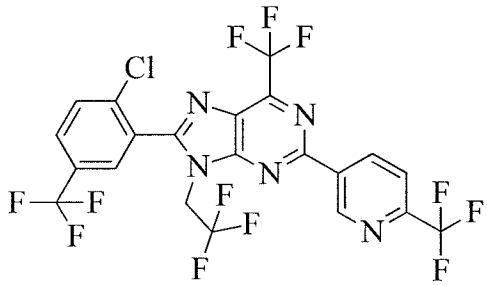
The following compounds were made in accordance with the procedures disclosed in Example 15.

8-(2-methoxy-4-(trifluoromethyl)phenyl)-9-(2,2,2-trifluoroethyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-9*H*-purine **[Compound 88]** was prepared from 2-methoxy-5-(trifluoromethyl)benzaldehyde) and isolated as an off-white solid (0.122 g, 82%): mp 192°C–194°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 9.81 (d, J = 1.9 Hz, 1H), 9.07 (dd, J = 8.2, 1.7 Hz, 1H), 8.18 (d, J = 8.3 Hz, 1H), 7.87 (d, J = 7.8 Hz, 1H), 7.62 (s, 1H), 7.58 (d, J = 7.9 Hz, 1H), 5.39 (q, J = 8.9 Hz, 2H), 3.96 (s, 3H); ESIMS *m/z* 588.5 ([M-1]$^-$).

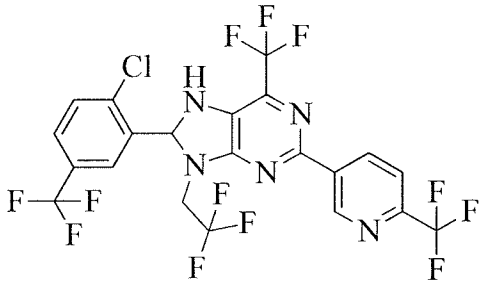


Compound 88

8-(2-chloro-5-(trifluoromethyl)phenyl)-9-(2,2,2-trifluoroethyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-9*H*-purine [**Compound 89**] and 8-(2-chloro-5-(trifluoromethyl)phenyl)-9-(2,2,2-trifluoroethyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-8,9-dihydro-7*H*-purine [**Compound 90**] were prepared from 2-chloro-5-(trifluoromethyl)-benzaldehyde.



Compound 89



Compound 90

Compound 89 was isolated as an off-white solid (0.076 g, 51%): mp 208°C–211°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.88 (d, J = 1.8 Hz, 1H), 9.04 (dd, J = 8.2, 1.6 Hz, 1H), 7.96 (s, 1H), 7.93– 7.84 (m, 2H), 7.78 (d, J = 8.5 Hz, 1H), 5.13– 4.86 (m, 2H); ESIMS *m/z* 595.2 ([M+1]$^+$).

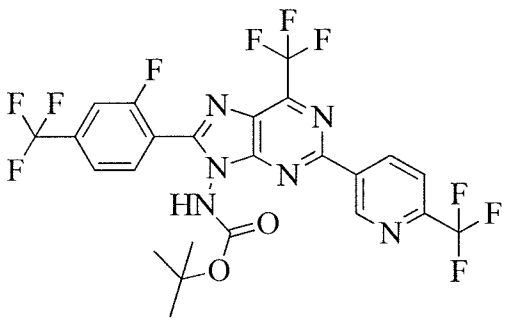
Compound 90 was isolated as an off white solid (0.024 g, 16%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.61 (d, J = 1.6 Hz, 1H), 8.75 (dd, J = 8.2, 1.5 Hz, 1H), 7.83– 7.59 (m, 4H), 7.02 (s, 1H), 5.24 (s, 1H), 4.70– 4.39 (m, 1H), 3.64–3.42 (m, 1H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -62.69 (s), -66.01 (s), -67.84 (s), -69.03 (s); ESIMS *m/z* 596.5 ([M+1]$^+$).

Example 16

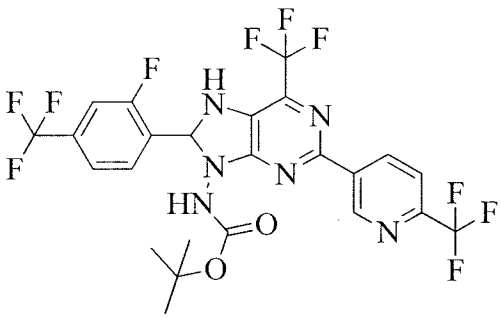
Preparation of *tert*-butyl (8-(2-fluoro-4-(trifluoromethyl)phenyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-9*H*-purin-9-yl)carbamate [Compound 91]

and

***tert*-butyl (8-(2-fluoro-4-(trifluoromethyl)phenyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-7*H*-purin-9(8*H*)-yl)carbamate [Compound 92]**



Compound 91



Compound 92

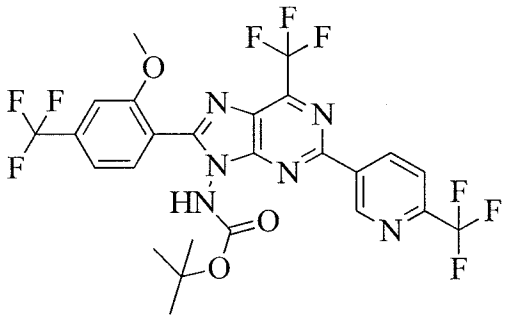
To a solution of **XI-32** (0.105 g, 0.24 mmol) and 2-fluoro-4-(trifluoromethyl)-benzaldehyde (0.092 g, 0.479 mmol) in *N,N*-dimethylformamide (DMF, 3 mL) was added chlorotrimethylsilane (0.065 g, 0.599 mmol) to give a pale yellow solution that was stirred at RT for 18 h. The reaction mixture was added 2-fluoro-4-(trifluoromethyl)-benzaldehyde (0.2 g) and stirred for 72 h, followed by the addition of chlorotrimethylsilane (0.05 g) stirring for 16 h. The reaction mixture was poured into a separatory funnel containing EtOAc (50 mL) and washed with saturated NaCl solution (3 x 50mL). The organic phase was dried over $MgSO_4$, filtered and concentrated under vacuum to give a yellow residue material that was purified by column chromatography (hexanes–EtOAc; gradient 40g column) to afford a white solid **Compound 92** (0.097 g, 64%): mp 185°C–186°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.44 (s, 1H), 9.40 (d, J = 1.8 Hz, 1H), 8.67 (dd, J = 8.2, 1.6 Hz, 1H), 8.02 (d, J = 8.1 Hz, 1H), 7.86–7.69 (m, 2H), 7.58 (d, J = 7.9 Hz, 1H), 7.41 (t, J = 7.8 Hz, 1H), 6.80 (d, J = 4.1 Hz, 1H), 1.47 (s, 9H); ESIMS *m/z* 611.5 ([M-1]$^-$).

To a cooled solution of **Compound 92** (0.087 g, 0.14 mmol) in CH_2Cl_2 (5 mL) was added DDQ (54.4 mg, 0.240 mmol), changing the color of the solution change to pale orange. After 15 min the opaque red mixture was warmed to RT and stirred for two h. The reaction mixture was poured into a separatory funnel containing CH_2Cl_2 (20 mL) and washed with 1N

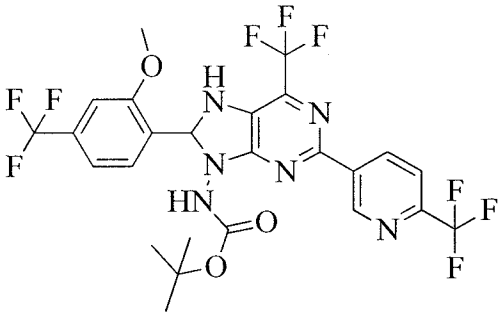
NaOH aqueous solution (3 x 25 mL). The organic phase was dried over $MgSO_4$, filtered and added SiO_2 (5g). The solvent was removed under vacuum, and the residue was purified by column chromatography (hexanes–EtOAc: gradient; 40g column) to afford **Compound 91** (0.075 g, 88%): mp 191°C–193°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 11.50 (s, 1H), 9.68 (s, 1H), 8.99 (d, J = 8.7 Hz, 1H), 8.19 (d, J = 8.3 Hz, 1H), 8.13 (d, J = 10.3 Hz, 1H), 8.07–7.99 (m, 1H), 7.92 (d, J = 8.1 Hz, 1H), 1.38 (s, 9H); ESIMS *m/z* 609.1 ([M-1]$^-$).

The following compounds were made in accordance with the procedures disclosed in Example 16.

tert-butyl (8-(2-methoxy-4-(trifluoromethyl)phenyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-y)-9*H*-purin-9-yl)carbamate [**Compound 93**] and tert-butyl (8-(2-methoxy-4-(trifluoromethyl)phenyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-y)-7*H*-purin-9(8*H*)-yl)carbamate [**Compound 94**] was prepared from 2-methoxy-4-(trifluoromethyl)-benzaldehyde).



Compound 93



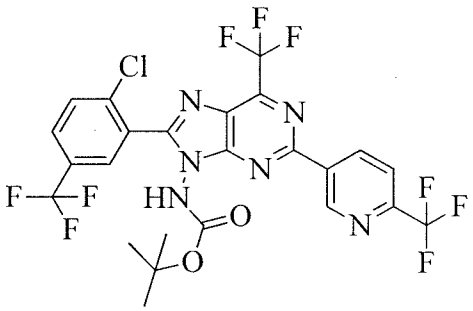
Compound 94

Compound 93 was isolated as a white solid (0.110 g, 72%) having a melting point of about 205°–207° C. ^{1}H NMR (400 MHz, DMSO-d_6): δ 11.16 (s, 1H), 9.67 (s, 1H), 8.98 (d, J = 7.5 Hz, 1H), 8.18 (d, J = 8.3 Hz, 1H), 7.78 (d, J = 7.7 Hz, 1H), 7.67–7.44 (m, 2H), 3.92 (s, 3H), 1.39 (s, 9H). ESIMS *m/z* 621.7 ([M-1]$^-$).

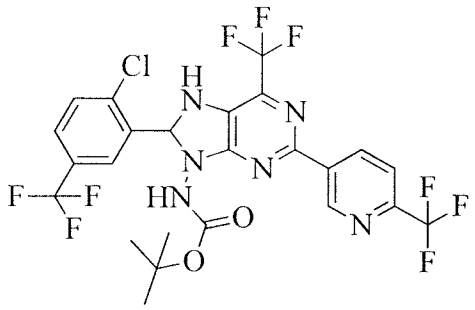
Compound 94 was isolated as a light yellow solid (0.126 g, 83%): mp 163°C–165°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.34 (s, 1H), 9.40 (d, J = 1.6 Hz, 1H), 8.66 (dd, J = 8.3, 1.6 Hz, 1H), 8.02 (d, J = 8.3 Hz, 1H), 7.61 (s, 1H), 7.37 (s, 1H), 7.29 (d, J = 8.1 Hz, 1H), 7.22 (d, J = 8.0 Hz, 1H), 6.79 (d, J = 3.8 Hz, 1H), 3.95 (s, 3H), 1.48 (s, 9H); ESIMS *m/z* 624.9 ([M+1]$^+$).

tert-butyl (8-(2-chloro-5-(trifluoromethyl)phenyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-9*H*-purin-9-yl)carbamate [**Compound 95**] and tert-butyl (8-(2-chloro-5-(trifluoromethyl)

phenyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-7*H*-purin-9(8*H*)-yl)carbamate [**Compound 96**] were prepared from 2-chloro-5-(trifluoromethyl)-benzaldehyde).



Compound 95



Compound 96

Compound 95 was isolated as a white solid (0.120 g, 78%): mp 185°C–187°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.87 (s, 1H), 9.04 (dd, J = 8.2, 1.7 Hz, 1H), 8.15 (s, 1H), 8.01 (s, 1H), 7.91– 7.78 (m, 2H), 7.74 (d, J = 8.5 Hz, 1H), 1.40 (s, 9H); ESIMS *m/z* 628.5 ([M+1]$^+$).

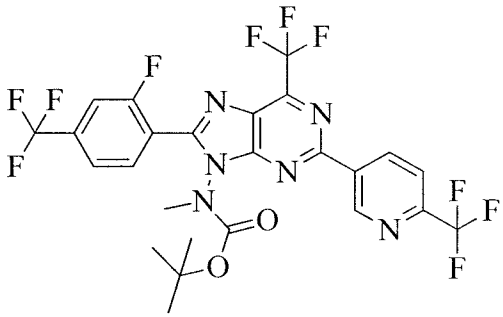
Compound 96 was isolated as a light yellow solid (0.137 g, 89%): mp 189°C–191°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.39 (s, 1H), 9.41 (d, J = 1.7 Hz, 1H), 8.68 (dd, J = 8.2, 1.6 Hz, 1H), 8.02 (d, J = 8.3 Hz, 1H), 7.88 - 7.75 (m, 3H), 7.41 (s, 1H), 6.78 (d, J = 4.2 Hz, 1H), 1.47 (s, 9H); ESIMS *m/z* 630.4 ([M+1]$^+$).

Example 19

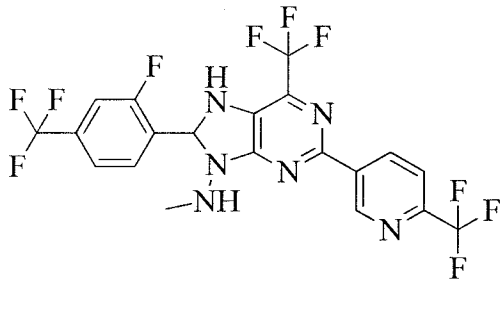
8-(2-fluoro-4-(trifluoromethyl)phenyl)-*N*-methyl-6-(trifluoromethyl)-2-(6-(trifluoromethyl) pyridin-3-yl)-7*H*-purin-9(8*H*)-amine [Compound 97]

and

8-(2-fluoro-4-(trifluoromethyl)phenyl)-*N*-methyl-6-(trifluoromethyl)-2-(6-(trifluoromethyl) pyridin-3-yl)-7*H*-purin-9(8*H*)-amine [Compound 98]



Compound 97



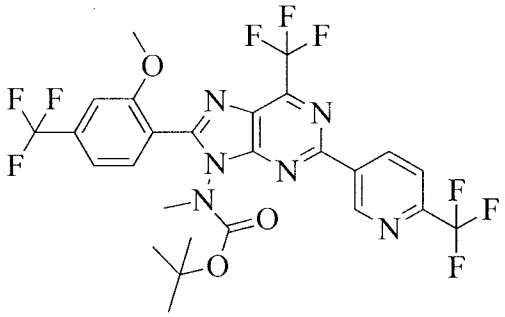
Compound 98

To a solution of compound **XI-33** (0.125 g, 0.276 mmol) and 2-fluoro-4-(trifluoromethyl)benzaldehyde (0.106 g, 0.553 mmol) in DMF (2 mL) was added chlorotrimethylsilane (0.075 g, 0.691 mmol) to give a pale yellow solution that was stirred at RT for 72 h. The reaction mixture was added 2-fluoro-4-(trifluoromethyl)benzaldehyde (0.1 g) and chlorotrimethylsilane (0.1 g) and stirred for 48 h. Then, the reaction mixture was poured into a separatory funnel containing EtOAc (50 mL) and washed with saturated NaCl solution (3 x 50 mL). The organic phase was dried over $MgSO_4$ and filtered. The solvent was removed under vacuum to give a yellow residue that was purified by column chromatography (hexanes–EtOAc; gradient 40g column) to afford an off-white solid **Compound 98** (0.018 g, 11.7%): mp 137°C–139°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.55 (d, J = 1.6 Hz, 1H), 8.70 (dd, J = 8.1, 1.5 Hz, 1H), 7.72 (d, J = 8.2 Hz, 1H), 7.53 (t, J = 7.7 Hz, 1H), 7.39 (t, J = 8.7 Hz, 2H), 7.11 (s, 1H), 5.60 (d, J = 2.0 Hz, 1H), 5.29 (s, 1H), 2.94 (s, 3H); ESIMS *m/z* 527.0 ($[M+1]^+$)

The yellow residue was dissolved in CH_2Cl_2 (5 mL) and cooled in an ice bath. To the solution was added DDQ (62.7 mg, 0.276 mmol), causing a color change to pale orange. The reaction mixture was allowed to warm to RT, and was stirred overnight. The reaction mixture was poured into a separatory funnel containing CH_2Cl_2 (20 mL) and washed with 1 N NaOH aqueous solution (3 x 25 mL). The organic phase was dried over $MgSO_4$, filtered and added SiO_2 (2g). The solvent was removed under vacuum, and the residue was purified by column

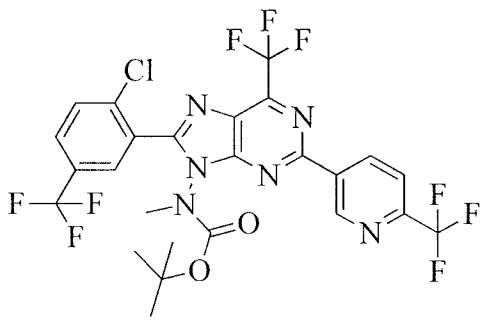
chromatography (hexanes– EtOAc: gradient; 40g column) to afford **Compound 97** (0.085 g, 44%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.85 (s, 1H), 9.01 (dd, J = 8.2, 1.6 Hz, 1H), 7.94 (s, 1H), 7.86 (d, J = 8.2 Hz, 1H), 7.73–7.53 (m, 2H), 3.61 (s, 3H), 1.45 (s, 4H), 1.16 (s, 5H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.24 (s), -66.08 (s), -68.04 (s); ESIMS *m/z* 625.1 ($[M+1]^+$).

The following compounds were made in accordance with the procedures disclosed in Example 17.



Compound 99

tert-butyl (8-(2-methoxy-4-(trifluoromethyl)phenyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-9*H*-purin-9-yl)(methyl)carbamate [**Compound 99**] was prepared from 2-methoxy-4-(trifluoromethyl)benzaldehyde, and was isolated as a white solid (0.155 g, 84%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.85 (s, 1H), 9.07–8.95 (m, 1H), 7.85 (d, J = 8.2 Hz, 1H), 7.72 (s, 1H), 7.41 (s, 1H), 7.28 (s, 1H), 3.95 (s, 3H), 3.64–3.45 (m, 3H), 1.45 (s, 4H), 1.16 (s, 5H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.11 (s), -65.9, -66.03 (m), -68.01 (s); ESIMS *m/z* 638.9 ($[M+1]^+$).



Compound 100

tert-butyl (8-(2-chloro-5-(trifluoromethyl)phenyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-9*H*-purin-9-yl)(methyl)carbamate [**Compound 100**] was prepared from 2-chloro-5-(trifluoromethyl)benzaldehyde), and was isolated as white solid (0.150 g, 83%): mp 155°C–157°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.85 (s, 1H), 9.02 (dd, J =

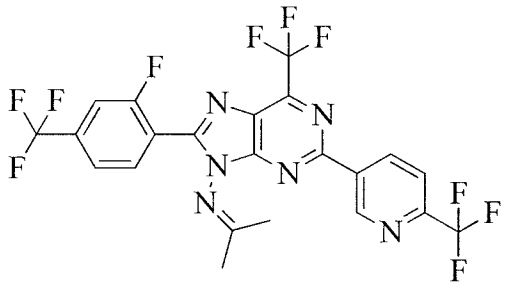
8.2, 1.6 Hz, 1H), 8.01–7.66 (m, 4H), 3.54 (s, 3H), 1.57–1.19 (m, 9H); ESIMS *m/z* 642.4 ([M+1]$^+$).

Example 18

Preparation of

8-(2-fluoro-4-(trifluoromethyl)phenyl)-*N*-(propan-2-ylidene)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-9*H*-purin-9-amine

[Compound 101]



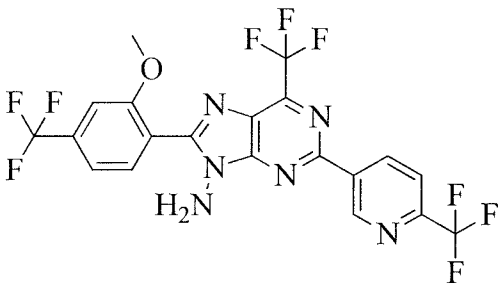
To a solution of **Compound 91** (110 mg, 0.180 mmol) in CH_2Cl_2 (10 mL) was added triethylsilane (0.230 mL, 1.442 mmol) followed by the addition of TFA (0.833 mL, 10.81 mmol) to give a colorless solution. Then, the solution was heated to a temperature of about 40°C and stirred for 90 min. The reaction mixture was removed under vacuum, and the residue was re-dissolved in CH_2Cl_2 (10 mL), poured mixture into a separatory funnel containing CH_2Cl_2 (25mL) and washed with saturated $NaHCO_3$ solution (2 x 25 mL). The organic phase was dried over $MgSO_4$, filtered and added SiO_2 (3 g). Then, the solvent was removed under vacuum to give a residue that was purified by column chromatography (hexanes–EtOAc; gradient 12g column). The resulting residue was mixed in acetone and concentrated under vaccum to afford **Compound 101** as a white solid (0.049 g, 48%): mp 227°C–229°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.80 (d, *J* = 1.8 Hz, 1H), 8.98 (dd, *J* = 8.2, 1.5 Hz, 1H), 8.09 (t, *J* = 7.4 Hz, 1H), 7.85 (d, *J* = 8.3 Hz, 1H), 7.66 (d, *J* = 8.1 Hz, 1H), 7.50 (d, *J* = 10.0 Hz, 1H), 2.42 (s, 3H), 2.22 (s, 3H); ESIMS *m/z* 551.0 ([M+1]$^+$).

Example 19

Preparation of

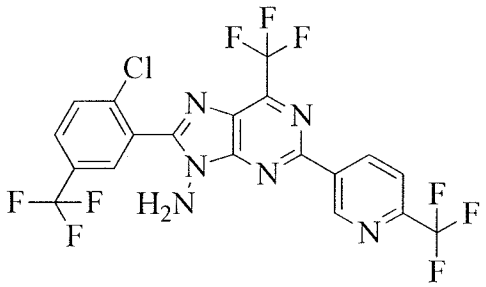
8-(2-methoxy-4-(trifluoromethyl)phenyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-9*H*-purin-9-amine

[Compound 102]



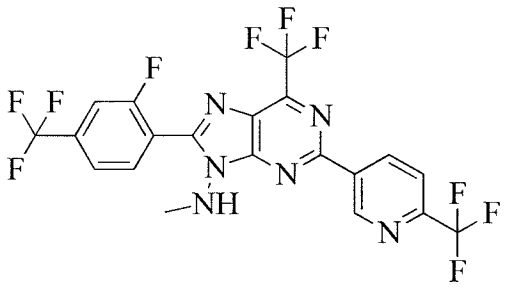
To a solution of **Compound 93** (100 mg, 0.161 mmol) in CH_2Cl_2 (10 mL) was added triethylsilane (0.103 mL, 0.643 mmol) followed by the addition of TFA (1.25 mL, 16.2 mmol) to give a colorless solution. The solution was heated to a temperature of about 40°C and stirred for 4 h. The reaction mixture was removed under vacuum. The residue was re-dissolved in CH_2Cl_2 (10 mL), poured into a separatory funnel containing CH_2Cl_2 (25 mL) and washed with saturated $NaHCO_3$ solution (2 x 25 mL). The organic phase was dried over $MgSO_4$, filtered and added SiO_2 (3g). The solvent was removed under vacuum give a residue that was purified by column chromatography (hexanes–EtOAc; gradient 12g column) to afford **Compound 102** as a white solid (0.056 g, 65%): mp 200°C–202°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.86 (d, J = 1.8 Hz, 1H), 9.04 (dd, J = 8.2, 1.6 Hz, 1H), 7.91–7.80 (m, 2H), 7.45 (d, J = 7.9 Hz, 1H), 7.33 (s, 1H), 5.30 (s, 2H), 4.01 (s, 3H); ESIMS *m/z* 521.4 ([M-1]$^-$).

The following compounds were made in accordance with the procedures disclosed in Example 19.



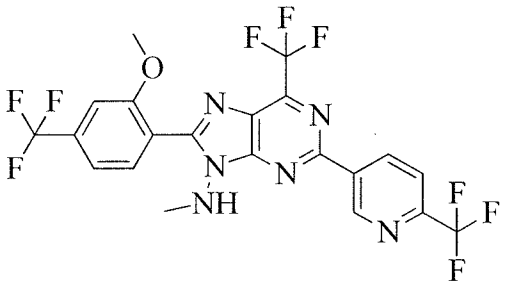
Compound 103

8-(2-chloro-5-(trifluoromethyl)phenyl)-6-(trifluoromethyl)-2-(6-(trifluoromethyl)-pyridin-3-yl)-9*H*-purin-9-amine [**Compound 103**] was isolated as a white solid (0.079 g, 84%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.87 (d, J = 1.7 Hz, 1H), 9.04 (dd, J = 8.2, 1.5 Hz, 1H), 7.99 (d, J = 2.0 Hz, 1H), 7.90–7.80 (m, 2H), 7.74 (d, J = 8.5 Hz, 1H), 5.28 (s, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -62.69 (s), -66.03 (s), -67.97 (s); ESIMS *m/z* 527.0 ([M+1]$^+$).



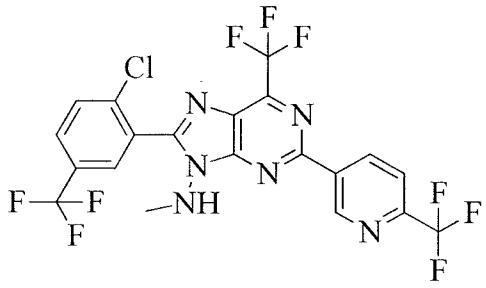
Compound 104

8-(2-fluoro-4-(trifluoromethyl)phenyl)-*N*-methyl-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-9*H*-purin-9-amine [**Compound 104**] was isolated as a white solid (0.052 g, 80%): mp 110°C–112°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.86 (d, J = 1.9 Hz, 1H), 9.03 (dd, J = 8.2, 1.5 Hz, 1H), 7.96 (t, J = 7.3 Hz, 1H), 7.92–7.78 (m, 1H), 7.65 (d, J = 8.0 Hz, 1H), 7.56 (d, J = 9.6 Hz, 1H), 5.39 (q, J = 5.7 Hz, 1H), 3.16 (d, J = 5.7 Hz, 3H); ESIMS *m/z* 526.1 ([M+1]$^+$).



Compound 105

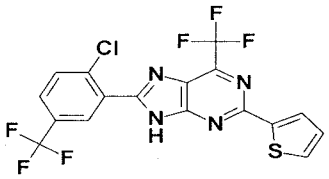
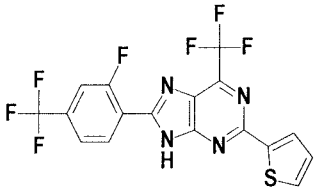
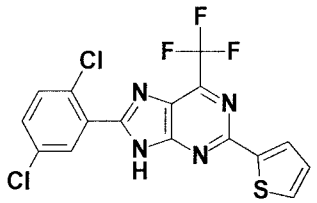
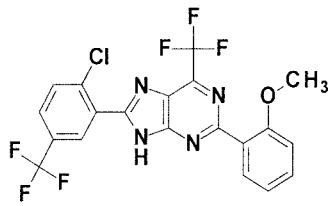
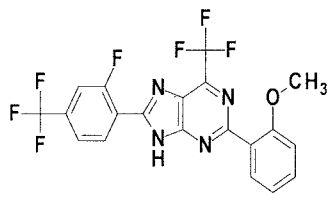
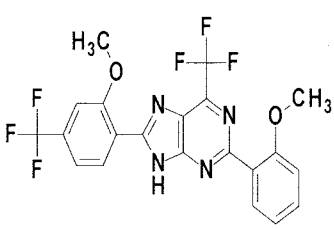
8-(2-methoxy-4-(trifluoromethyl)phenyl)-*N*-methyl-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-9*H*-purin-9-amine [**Compound 105**] was isolated as a white solid (0.109 g, 82%): mp 206°C–208°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.87 (d, J = 1.8 Hz, 1H), 9.03 (dd, J = 8.2, 1.6 Hz, 1H), 7.84 (d, J = 8.2 Hz, 1H), 7.79 (d, J = 7.8 Hz, 1H), 7.45 (d, J = 7.9 Hz, 1H), 7.31 (s, 1H), 5.41 (q, J = 5.7 Hz, 1H), 3.96 (s, 3H), 3.03 (d, J = 5.7 Hz, 3H); ESIMS *m/z* 537.9 ([M+1]$^+$).

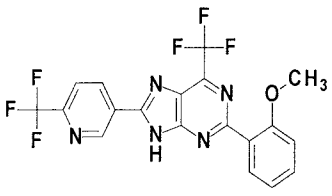
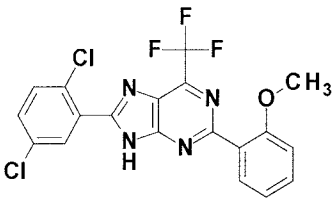
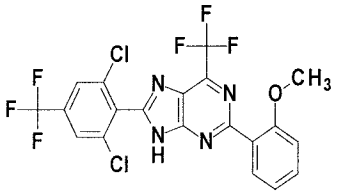
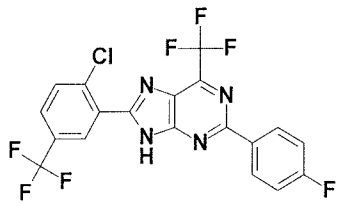
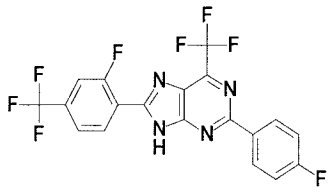
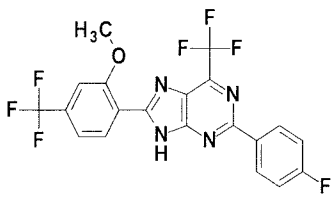


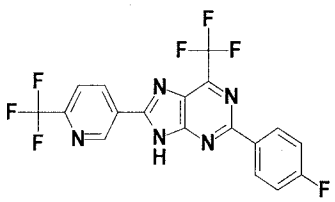
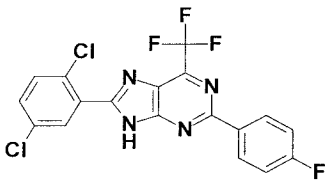
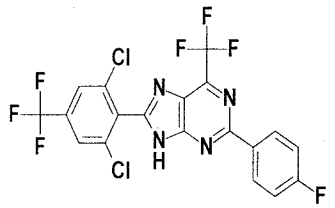
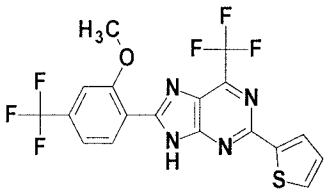
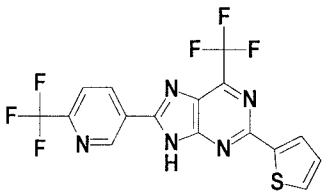
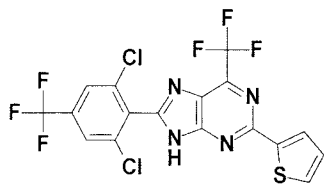
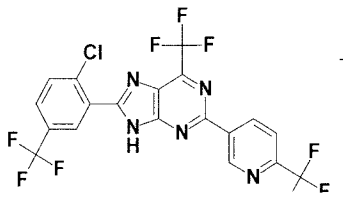
Compound 106

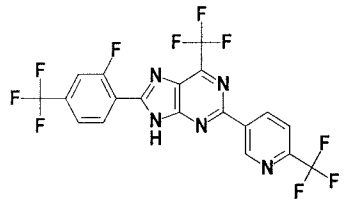
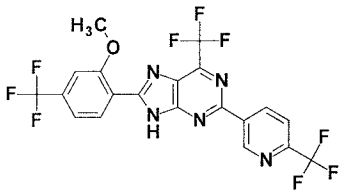
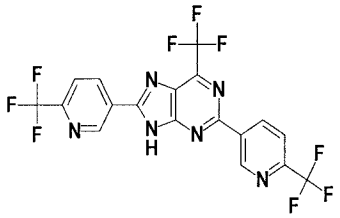
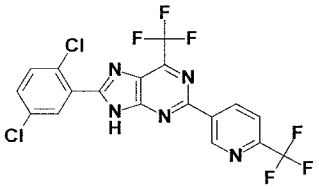
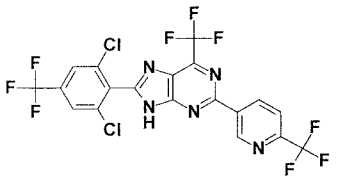
8-(2-chloro-5-(trifluoromethyl)phenyl)-*N*-methyl-6-(trifluoromethyl)-2-(6-(trifluoromethyl)pyridin-3-yl)-9*H*-purin-9-amine [**Compound 106**] was isolated as a white solid (0.085 g, 66%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.89– 9.83 (m, 1H), 9.04 (dd, *J* = 8.2, 1.5 Hz, 1H), 7.92 (d, *J* = 1.6 Hz, 1H), 7.89–7.79 (m, 2H), 7.73 (d, *J* = 8.5 Hz, 1H), 5.40 (q, *J* = 5.7 Hz, 1H), 3.09 (d, *J* = 5.7 Hz, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -62.66 (s), -66.08 (s), -67.99 (s); ESIMS *m/z* 541.0 ($[M+1]^+$).

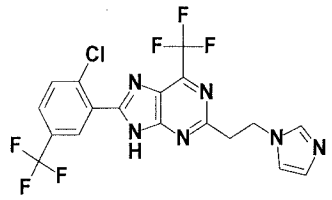
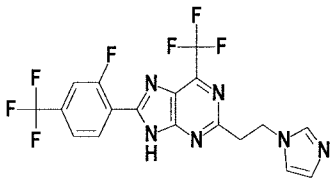
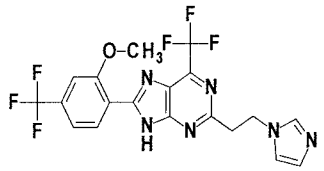
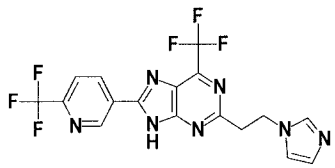
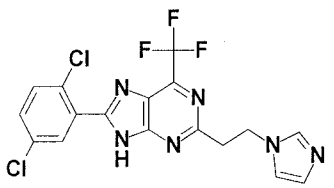
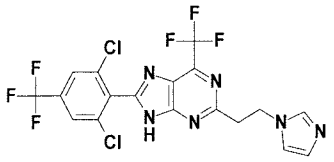
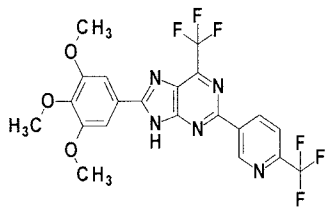
TABLE 5

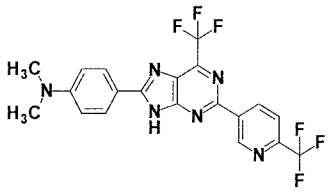
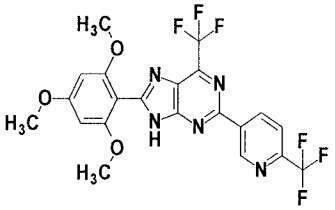
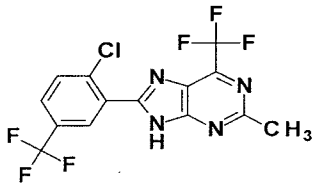
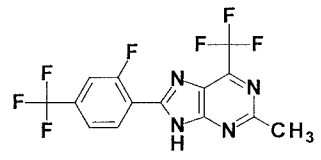
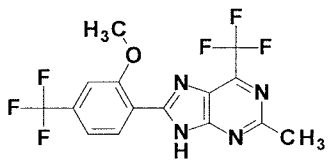
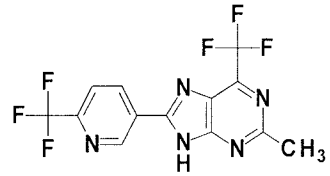
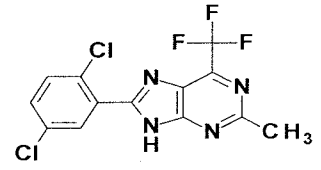
No	Structure		MP (°C)	ESI-MS (*m/z*)	^{1}H NMR (300 MHz)
1		Yellow Solid	196.2–198.8	448.7 ([M+H]$^+$)	(DMSO-d_6) δ 14.65 (s, 1H), 8.32 (s, 1H), 8.14 –7.99 (m, 3H), 7.86 (d, J = 5.1 Hz, 1H), 7.29 (dd, J = 5.0, 3.7 Hz, 1H)
2		Yellow Solid	255.7–256.5	432.8 ([M+H]$^+$)	(DMSO-d_6) δ 14.55 (s, 1H), 8.45 (t, J = 7.6 Hz, 1H), 8 .15–8.01 (m, 2H), 7.95–7.82 (m, 2H), 7.34–7.25 (m, 1H)
3		Yellow Solid	223.1-225.1	414.7 ([M+H]$^+$)	(DMSO-d_6) δ 14.56 (s, 1H), 8.11–7.98 (m, 2H), 7.91–7.74 (m, 3H), 7.29 (dd, J = 5.0, 3.7 Hz, 1H)
4		Yellow Solid	219.7–220.8	472.8 ([M+H]$^+$)	(DMSO-d_6) δ 14.71 (s, 1H), 8.32 (s, 1H), 8.13–7.98 (m, 2H), 7.68 (d, J = 7.5 Hz, 1H), 7.59–7.50 (m, 1H), 7.25 (d, J = 8.3 Hz, 1H), 7.14 (t, J = 7.3 Hz, 1H), 3.83 (s, 3H)
5		Yellow Solid	186.3–188.9	457.2 ([M+H]$^+$)	(DMSO-d_6) δ 14.63 (s, 1H), 8.46 (t, J = 7.4 Hz, 1H), 8.09 (d, J = 10.6 Hz, 1H), 7.90 (d, J = 8.2 Hz, 1H), 7.69 (dd, J = 7.6, 1.6 Hz, 1H), 7.55 (t, J = 7.0 Hz, 1H), 7.25 (d, J = 8.3 Hz, 1H), 7.14 (t, J = 7.5 Hz, 1H), 3.84 (s, 3H)
6		Yellow Solid	201.9–202.6	468.8 ([M+H]$^+$)	(DMSO-d_6) δ 13.89 (s, 1H), 8.48 (d, J = 7.8 Hz, 1H), 7.68– .42 (m, 4H), 7.19 (d, J = 8.3 Hz, 1H), 7.09 (t, J = 7.5

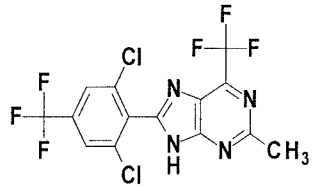
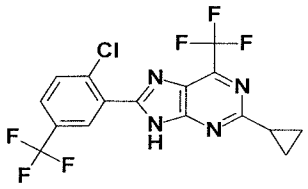
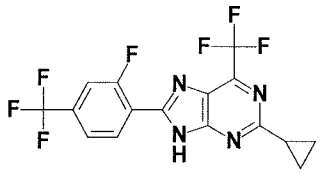
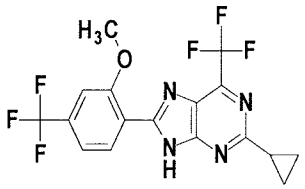
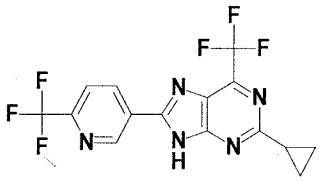
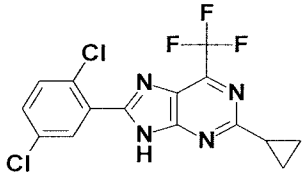
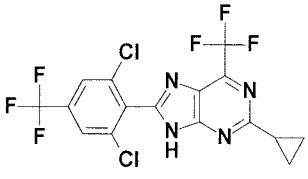
No	Structure		MP (°C)	ESI-MS (*m/z*)	^{1}H NMR (300 MHz)
					Hz, 1H), 4.08 (s, 3H), 3.78 (s, 3H)
7		White Solid	228.8–229.8	439.8 ([M+H]$^+$)	(DMSO-d_6) δ 15.08 (s, 1H), 9.63 (s, 1H), 8.95 (d, J = 8.2 Hz, 1H), 8.25 (d, J = 8.3 Hz, 1H), 7.73 (d, J = 8.0 Hz, 1H), 7.55 (t, J = 7.0 Hz, 1H), 7.26 (d, J = 8.4 Hz, 1H), 7.15 (t, J = 7.6 Hz, 1H), 3.85 (s, 3H)
8		Yellow Solid	196.0–197.9	438.7 ([M+H]$^+$)	(DMSO-d_6) δ 14.62 (s, 1H), 8.06–8.00 (m, 1H), 7.84–7.75 (m, 2H), 7.67 (dd, J = 7.6, 1.6 Hz, 1H), 7.59–7.49 (m, 1H), 7.24 (d, J = 8.3 Hz, 1H), 7.14 (td, J = 7.5, 0.9 Hz, 1H), 3.83 (s, 3H)
9		White Solid	265.9–268.1	508.5 ([M+H]$^+$)	(DMSO-d_6) δ 14.86 (s, 1H), 8.33 (d, J = 2.7 Hz, 2H), 7.75–7.64 (m, 1H), 7.6 –7.50 (m, 1H), 7.30–7.21 (m, 1H), 7.19–7.09 (m, 1H), 4.04–3.61 (m, 3H)
10		Yellow Solid	226.8–229.0	460.8 ([M+H]$^+$)	(DMSO-d_6) δ 14.63 (s, 1H), 8.59–8.43 (m, 2H), 8.29 (s, 1H), 8.13–7.95 (m, 2H), 7.42 (t, J = 8.8 Hz, 2H)
11		White Solid	200.0–201.2	444.8 ([M+H]$^+$)	(DMSO-d_6) δ 14.52 (s, 1H), 8.75–8.26 (m, 3H), 8.05 (d, J = 10.7 Hz, 1H), 7.87 (d, J = 8.2 Hz, 1H), 7.41 (t, J = 8.7 Hz, 2H)
12		White Solid	235.6–236.3	456.8 ([M+H]$^+$)	(DMSO-d_6) δ 13.85 (s, 1H), 8.59–8.39 (m, 3H), 7.63–7.50 (m, 2H), 7.42 (t, J = 8.7 Hz,

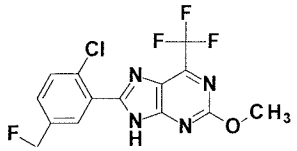
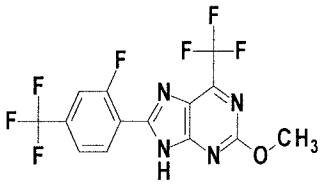
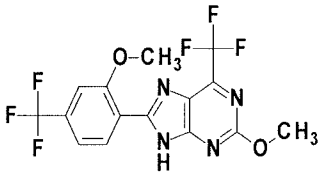
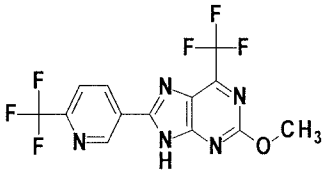
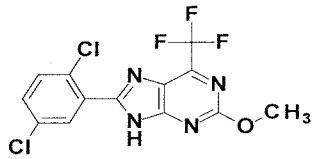
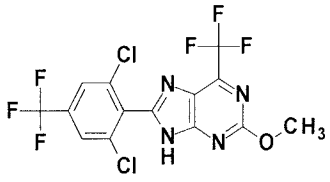
No	Structure		MP (°C)	ESI-MS (*m/z*)	^{1}H NMR (300 MHz)
					2H), 4.11 (s, 3H)
13		Pink Solid	246.1–247.9	427.7 ([M+H]$^+$)	(DMSO-d_6) δ 15.00 (s, 1H), 9.60 (s, 1H), 8.92 (d, J = 8.3 Hz, 1H), 8.50 (dd, J = 8.7, 5.7 Hz, 2H), 8.22 (d, J = 8.5 Hz, 1H), 7.43 (t, J = 8.8 Hz, 2H)
14		White Solid	233.8–234.2	426.7 ([M+H]$^+$)	(DMSO-d_6) δ 14.56 (s, 1H), 8.52–8.44 (m, 2H), 8.01 (d, J = 1.7 Hz, 1H), 7.91–7.60 (m, 2H), 7.42 (t, J = 8.9 Hz, 2H)
15		Yellow Solid	154.0–156.0	494.7 ([M+H]$^+$)	(DMSO-d_6) δ 14.79 (s, 1H), 8.58–8.42 (m, 2H), 8.29 (s, 2H), 7.43 (t, J = 8.8 Hz, 2H)
16		Yellow Solid	211.2–212.5	444.7 ([M+H]$^+$)	(DMSO-d_6) δ 13.83 (s, 1H), 8.49 (d, J = 7.6 Hz, 1H), 8.12–7.92 (m, 1H), 7.92–7.74 (m, 1H), 7.68–7.45 (m, 2H), 7.29 (dd, J = 5.0, 3.7 Hz, 1H), 4.14 (s, 3H)
17		Yellow Solid	230.0–232.0	415.8 ([M+H]$^+$)	(DMSO-d_6) δ 14.98 (s, 1H), 9.60 (s, 1H), 8.92 (d, J = 8.0 Hz, 1H), 8.23 (d, J = 8.4 Hz, 1H), 8.08–8.00 (m, 1H), 7.89–7.82 (m, 1H), 7.29 (dd, J = 4.9, 3.7 Hz, 1H)
18		White Solid	168.9–171.0	482.7 ([M+H]$^+$)	(DMSO-d_6) δ 14.73 (s, 1H), 8.28 (s, 2H), 8.03 (d, J = 2.7 Hz, 1H), 7.83 (d, J = 4.6 Hz, 1H), 7.26 (dd, J = 4.8, 3.9 Hz, 1H)
19		White Solid	220.0–221.6	511.8 ([M+H]$^+$)	(DMSO-d_6) δ 14.90 (s, 1H), 9.72 (s, 1H), 9.01 (d, J = 8.3

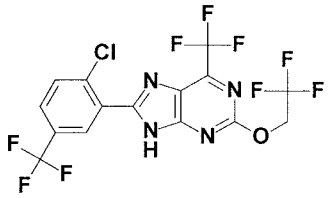
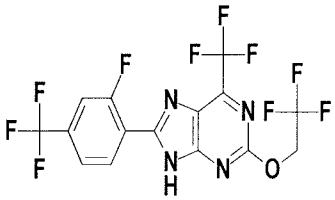
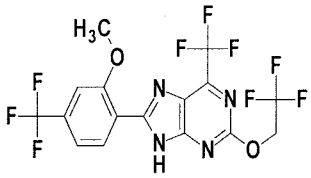
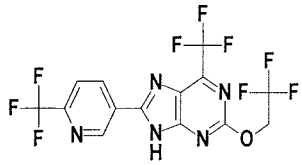
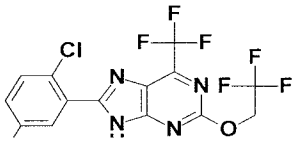
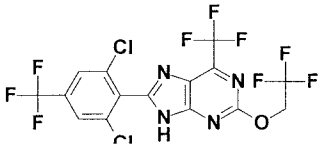
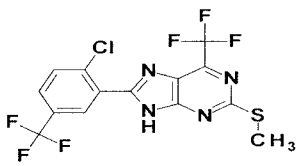
No	Structure		MP (°C)	ESI-MS (*m/z*)	^{1}H NMR (300 MHz)
					Hz, 1H), 8.31 (s, 1H), 8.15 (d, *J* = 8.3 Hz, 1H), 8.10–7.97 (m, 2H)
20		Yellow Solid	224.5–225.9	495.8 ($[M+H]^+$)	(DMSO-d_6) δ 14.71 (s, 1H), 9.69 (s, 1H), 8.97 (d, *J* = 8.0 Hz, 1H), 8.44 (t, *J* = 7.6 Hz, 1H), 8.19–7.99 (m, 2H), 7.87 (d, *J* = 7.4 Hz, 1H)
21		Yellow Solid	252.5–253.6	507.8 ($[M+H]^+$)	(DMSO-d_6) δ 14.03 (s, 1H), 9.71 (s, 1H), 8.98 (d, *J* = 6.6 Hz, 1H), 8.49 (d, *J* = 7.7 Hz, 1H), 8.14 (d, *J* = 8.3 Hz, 1H), 7.71–7.37 (m, 2H), 4.12 (s, 3H)
22		White Solid	237.1–238.9	478.7 ($[M+H]^+$)	(DMSO-d_6) δ 15.21 (s, 1H), 9.70 (s, 1H), 9.62 (s, 1H), 9.08–8.82 (m, 2H), 8.22 (d, *J* = 8.3 Hz, 1H), 8.14 (d, *J* = 8.4 Hz, 1H)
23		White Solid	220.5–221.4	477.7 ($[M+H]^+$)	(DMSO-d_6) δ 14.82 (s, 1H), 9.71 (s, 1H), 9.00 (d, *J* = 8.2 Hz, 1H), 8.15 (d, *J* = 8.3 Hz, 1H), 8.03 (s, 1H), 7.87–7.69 (m, 2H)
24		White Solid	220.4–222.9	545.6 ($[M+H]^+$)	(DMSO-d_6) δ 15.08 (s, 1H), 9.71 (s, 1H), 9.00 (d, *J* = 8.0 Hz, 1H), 8.30 (s, 2H), 8.15 (d, *J* = 8.3 Hz, 1H)

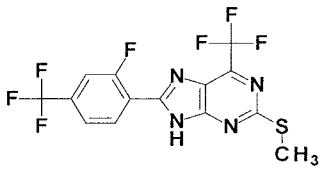
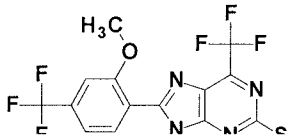
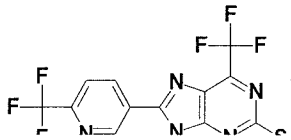
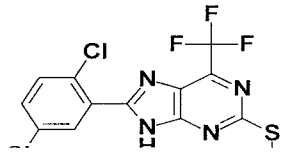
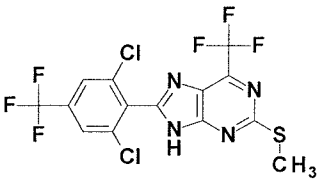
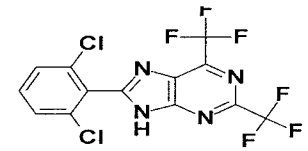
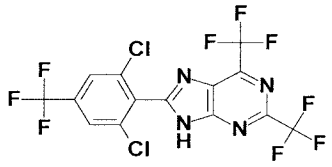
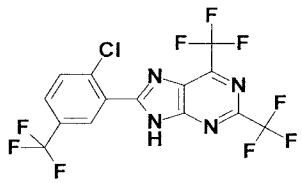
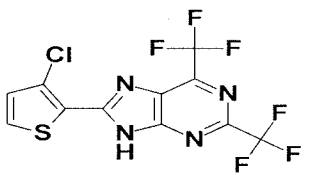
No	Structure		MP (°C)	ESI-MS (*m/z*)	^{1}H NMR (300 MHz)
25		Yellow Oil	---	460.8 ($[M+H]^+$)	(CD_3CN) δ 8.77 (s, 1H), 8.28 (s, 1H), 7.98–7.82 (m, 2H), 7.52 (s, 1H), 7.40 (s, 1H), 5.24 (s, 1H) 4.83 (t, *J* = 6.2 Hz, 2H), 3.71 (t, *J* = 6.3 Hz, 2H)
26		White Solid	173.6–175.8	444.8 ($[M+H]^+$)	^{1}H NMR ($CDCl_3$, 300 MHz) δ 9.48 (s, 1H), 8.55 (s, 1H), 7.58 (d, *J* = 7.6 Hz, 1H), 7.50 – 7.37 (m, 1H), 7.30 – 7.25 (m, 2H), 4.86 (s, 2H), 3.72 (s, 2H)
27		White Solid	181.6–183.0	456.9 ($[M+H]^+$)	(DMSO-d_6) δ 13.83 (s, 1H), 9.09 (s, 1H), 8.41 (d, *J* = 8.3 Hz, 1H), 7.82 (s, 1H), 7.66 (s, 1H), 7.61–7.48 (m, 2H), 4.75 (t, *J* = 6.8 Hz, 2H), 4.08 (s, 3H), 3.67 (t, *J* = 6.8 Hz, 2H)
28		White Solid	166.8–168.9	427.8 ($[M+H]^+$)	(DMSO-d_6) δ 14.75 (s, 1H), 9.56 (d, *J* = 1.8 Hz, 1H), 9.06 (s, 1H), 8.88 (dd, *J* = 8.1, 1.7 Hz, 1H), 8.19 (d, *J* = 8.3 Hz, 1H), 7.83–7.79 (m, 1H), 7.65–7.61 (m, 1H), 4.74 (t, *J* = 6.8 Hz, 2H), 3.69 (t, *J* = 6.9 Hz, 2H)
29		White Oil	---	426.8 ($[M+H]^+$)	($CDCl_3$) δ 9.37 (s, 1H), 8.16 (s, 1H), 7.46 (s, 2H), 7.37–7.26 (m, 3H), 4.87 (s, 2H), 3.74 (s, 2H)
30		Yellow Oil	---	494.8 ($[M+H]^+$)	($CDCl_3$) δ 9.50 (s, 1H), 7.68 (s, 2H), 7.30–7.26 (m, 3H), 4.83 (s, 2H), 3.73 (s, 2H)
31		Off-White Solid	240–242	498.83 ($[M-H]^-$)	(400 MHz, DMSO-d_6) δ 14.68 (s, 1H), 9.67 (s, 1H), 8.94 (dd, *J* = 8.2, 1.7 Hz, 1H), 8.12 (d, *J* = 8.1 Hz, 1H), 7.67

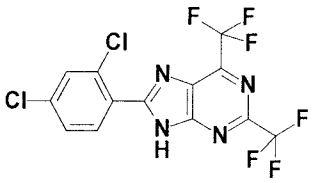
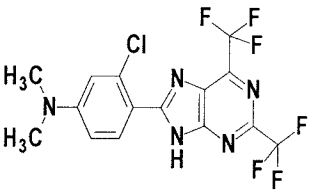
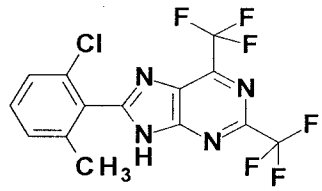
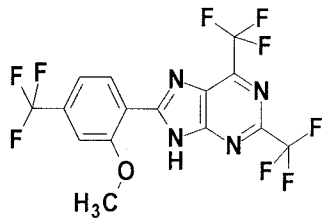
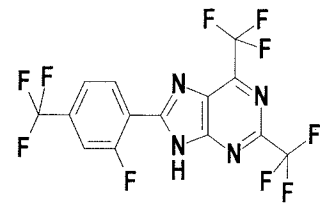
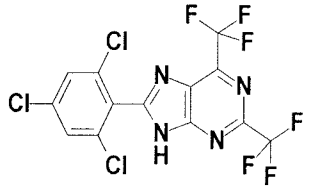
No	Structure		MP (°C)	ESI-MS (*m/z*)	^{1}H NMR (300 MHz)
					(s, 2H), 3.93 (s, 6H), 3.79 (s, 3H)
32		Yellow Solid	251–253	451.8 ([M-H]$^-$)	(400 MHz, DMSO-d_6) δ 14.31 (s, 1H), 9.66 (s, 1H), 8.93 (d, J = 8.1 Hz, 1H), 8.41 –7.82 (m, 3H), 6.88 (d, J = 9.1 Hz, 2H), 3.06 (s, 6H)
33		Pale White Solid	251–253	498.2 ([M-H]$^-$)	(400 MHz, DMSO-d_6) δ 14.15 (s, 1H), 9.69 (s, 1H), 8.96 (d, J = 8.4 Hz, 1H), 8.13 (d, J = 8.3 Hz, 1H), 6.42 (s, 2H), 3.90 (s, 3H), 3.77 (s, 6H)
34		White Solid	195.2–197.1	380.8 ([M+H]$^+$)	(DMSO-d_6) δ 14.39 (s, 1H), 8.28 (s, 1H), 8.11–7.97 (m, 2H), 2.83 (s, 3H)
35		White Solid	179.9–182.6	364.8 ([M+H]$^+$)	(DMSO-d_6) δ 14.34 (s, 1H), 8.42 (t, J = 7.7 Hz, 1H), 8.07 (d, J = 10.9 Hz, 1H), 7.88 (d, J = 8.5 Hz, 1H), 2.83 (s, 3H)
36		Yellow Solid	196.8–198.2	376.8 ([M+H]$^+$)	(DMSO-d_6) δ 13.67 (s, 1H), 8.44 (d, J = 8.1 Hz, 1H), 7.65–7.42 (m, 2H), 4.08 (s, 3H), 2.80 (s, 3H)
37		Yellow Solid	215.5–217.6	347.8 ([M+H]$^+$)	(DMSO-d_6) δ 14.76 (s, 1H), 9.59 (s, 1H), 8.91 (d, J = 8.2 Hz, 1H), 8.23 (d, J = 8.3 Hz, 1H), 2.84 (s, 3H)
38		Yellow Solid	197.9–199.0	346.8 ([M+H]$^+$)	(DMSO-d_6) δ 14.35 (s, 1H), 8.11–7.89 (m, 1H), 7.86–7.65 (m, 2H), 2.83 (s, 3H)

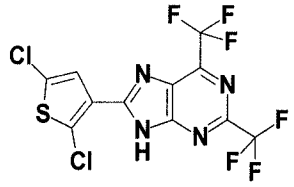
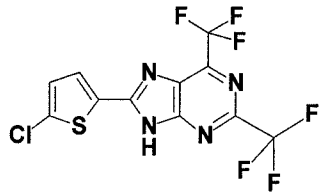
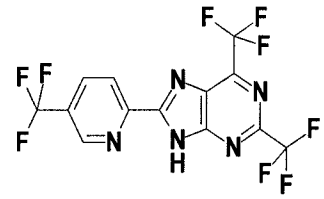
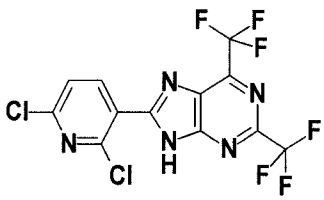
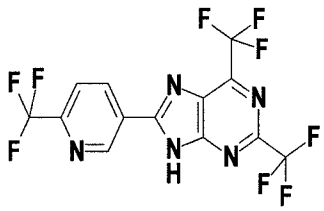
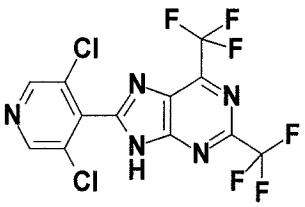
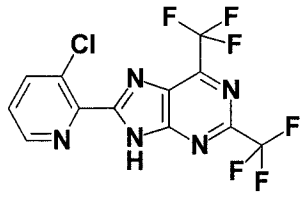
No	Structure		MP (°C)	ESI-MS (*m/z*)	^{1}H NMR (300 MHz)
39		Yellow Solid	212.7–214.2	414.7 ($[M+H]^+$)	(DMSO-d_6) δ 14.55 (s, 1H), 8.28 (s, 2H), 2.82 (s, 3H)
40		White Solid	154.8–156.1	406.8 ($[M+H]^+$)	(DMSO-d_6) δ 14.39 (s, 1H), 8.27 (s, 1H), 8.12–7.96 (m, 2H), 2.50–2.32 (m, 1H), 1.27–1.04 (m, 4H)
41		White Solid	134.6–135.9	390.1 ($[M+H]^+$)	(DMSO-d_6) δ 14.29 (s, 1H), 8.40 (t, J = 7.6 Hz, 1H), 8.06 (d, J = 11.0 Hz, 1H), 7.87 (d, J = 8.4 Hz, 1H), 2.50–2.32 (m, 1H), 1.26–1.03 (m, 4H)
42		White Solid	202.4–205.0	402.8 ($[M+H]^+$)	(DMSO-d_6) δ 13.64 (s, 1H), 8.45 (d, J = 8.3 Hz, 1H), 7.65–7.44 (m, 2H), 4.10 (s, 3H), 2.49–2.33 (m, 1H), 1.27–1.07 (m, 4H)
43		Purple Solid	225.4–227.3	373.8 ($[M+H]^+$)	(DMSO-d_6) δ 14.73 (s, 1H), 9.54 (s, 1H), 8.86 (d, J = 10.2 Hz, 1H), 8.19 (d, J = 8.2 Hz, 1H), 2.48–2.33 (m, 1H), 1.28–1.02 (m, 4H)
44		Yellow Solid	160.9–163.0	372.8 ($[M+H]^+$)	(DMSO-d_6) δ 14.31 (s, 1H), 7.98 (s, 1H), 7.83–7.71 (m, 2H), 2.49–2.35 (m, 1H), 1.24–1.06 (m, 4H)
45		White Solid	250.3–252.7	440.7 ($[M+H]^+$)	(DMSO-d_6) δ 14.50 (s, 1H), 8.30 (s, 2H), 2.49–2.43 (m, 1H), 1.25–1.08 (m, 4H)

No	Structure		MP (°C)	ESI-MS (*m/z*)	^{1}H NMR (300 MHz)
46		Yellow Solid	186.6–188.4	ESIMS *m/z* 396.8 ($[M+H]^+$)	1H NMR (300 MHz, CDCl3) δ 10.69 (s, 1H), 8.75 (s, 1H), 7.73 (q, J = 8.5 Hz, 2H), 4.14 (s, 3H).
47		White Solid	197.8–199.1	380.9 ($[M+H]^+$)	1H NMR (300 MHz, CDCl3) δ 10.3 – 10.1 (m, 1H), 8.58-8.64 (m, 1H), 7.71 – 7.45 (m, 2H), 4.27 – 4.1 (m, 3H).
48		White Solid	218.9–220.6	392.9 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 10.97 (s, 1H), 8.79 (s, 1H), 7.58 – 7.32 (m, 2H), 4.19 (s, 3H), 4.14 (s, 3H).
49		White Solid	211.4–213.6	363.9 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 13.14 (s, 1H), 9.65 (s, 1H), 8.86 (d, J = 7.3 Hz, 1H), 7.91 (d, J = 8.2 Hz, 1H), 4.24 (s, 3H).
50		White Solid	176.7–179.0	362.8 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 10.70 (s, 1H), 8.49 (s, 1H), 7.48 (s, 2H), 4.14 (s, 3H).
51		Yellow Solid	206.1–207.7	430.8 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 12.39 (s, 1H), 7.81 (s, 2H), 4.06 (s, 3H).

No	Structure		MP (°C)	ESI-MS (*m/z*)	^{1}H NMR (300 MHz)
52		White Solid	138.4–140.1	464.8 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 11.0-10.7 (m, 1H), 9.09 – 8.61 (m, 1H), 7.93 – 7.58 (m, 2H), 5.05-4.85 (m, 2H).
53		White Solid	131.1–132.7	448.8 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 10.52 – 10.07 (m, 1H), 8.73 (s, 1H), 7.82 – 7.48 (m, 2H), 5.11 – 4.78 (m, 2H).
54		Yellow Solid	160.7–162.4	460.9 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 10.97 (s, 1H), 8.80 (s, 1H), 7.60 – 7.29 (m, 2H), 5.02 – 4.84 (m, 2H), 4.21 (s, 3H).
55		Yellow Solid	107.4–109.2	431.9 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 9.49 (s, 1H), 8.79 (d, J = 7.7 Hz, 1H), 7.92 (d, J = 8.2 Hz, 1H), 4.98 (q, J = 8.2 Hz, 2H).
56		Yellow Solid	142.3–144.1	430.8 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 10.74 (s, 1H), 8.54 (s, 1H), 7.51 (s, 2H), 4.94 (q, J = 8.2 Hz, 2H).
57		Yellow Solid	197.9–199.4	498.8 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 12.14 (s, 1H), 7.76 (s, 2H), 5.00 – 4.70 (m, 2H).
58		White Solid	154.3–155.9	412.8 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 10.64 (s, 1H), 8.78 (s, 1H), 7.73 (d, J = 9.5 Hz, 2H), 2.69 (s, 3H).

No	Structure		MP (°C)	ESI-MS (*m/z*)	^{1}H NMR (300 MHz)
59		Yellow Solid	137.7–138.8	396.8 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 10.25 (s, 1H), 8.74 (s, 1H), 7.62 (dd, J = 24.8, 9.7 Hz, 2H), 2.68 (s, 3H).
60		Yellow Solid	204.9–206.5	408.9 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 10.93 (s, 1H), 8.80 (d, J = 7.9 Hz, 1H), 7.46 (d, J = 8.2 Hz, 1H), 7.34 (s, 1H), 4.20 (s, 3H), 2.70 (s, 3H).
61		Yellow Solid	225.6–227.4	379.9 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 10.73 (s, 1H), 9.36 (s, 1H), 8.73 (d, J = 7.7 Hz, 1H), 7.91 (d, J = 8.1 Hz, 1H), 2.67 (s, 3H).
62		Yellow Solid	154.8–156.3	378.8 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 10.67 (s, 1H), 8.57 (s, 1H), 7.48 (s, 2H), 2.69 (s, 3H).
63		White Solid	203.2–205.1	446.7 ($[M+H]^+$)	^{1}H NMR (300 MHz, $CDCl_3$) δ 12.23 (s, 1H), 7.76 (s, 2H), 2.59 (s, 3H).
64		Red Solid	186.0–189.1	400.8 ($[M+H]^+$)	(DMSO-d_6) δ 15.29 (s, 1H), 7.89–7.67 (m, 3H)
65		Red Solid	169.3–171.5	468.8 ($[M+H]^+$)	(DMSO-d_6) δ 15.2 (s, 1H), 8.31 (s, 2H)
66		Yellow Solid	159.2–161.3	434.8 ($[M+H]^+$)	(DMSO-d_6) δ 15.17 (s, 1H), 8.30 (s, 1H), 8.14–7.99 (m, 2H)
67		Red Solid	133.3–135.7	372.9 ($[M+H]^+$)	(DMSO-d_6) δ 14.88 (s, 1H), 8.14 (d, J = 5.3 Hz, 1H), 7.40 (d, J = 5.3 Hz, 1H)

No	Structure		MP (°C)	ESI-MS (*m/z*)	^{1}H NMR (300 MHz)
68		White Solid	97.0–99.4	400.8 ([M+H]$^+$)	(DMSO-d_6) δ 15.0 (s, 1H), 8.0–7.92 (m, 2H), 7.74 (dd, *J* = 8.4, 2.0 Hz, 1H)
69		Yellow Solid	167.4–169.7	410.0 ([M+H]$^+$)	(DMSO-d_6) δ 14.39 (s, 1H), 7.87 (d, *J* = 8.3 Hz, 1H), 6.94–6.82(m, 2H), 3.06 (s, 6H)
70		White Solid	200.8–202.6	380.8 ([M+H]$^+$)	(DMSO-d_6) δ 14.98 (s, 1H), 7.61–7.56 (m, 2H), 7.48–7.40 (m, 1H), 2.19 (s, 3H)
71		White Solid	152.0–153.8	431.0 ([M+H]$^+$)	(DMSO-d_6) δ 14.29 (s, 1H), 8.52 (d, *J* = 6.6 Hz, 1H), 7.64–7.51 (m, 2H), 4.11 (s, 3H)
72		White Solid	160.1–162.5	417.0 ([M+H]$^+$)	(DMSO-d_6) δ 14.89 (s, 1H), 8.51–8.39 (m, 1H), 8.10 (d, *J* = 10.6 Hz, 1H), 7.90 (d, *J* = 7.6 Hz, 1H)
73		White Solid	106.1–108.0	436.8 ([M+H]$^+$)	(DMSO-d_6) δ 15.01 (s, 1H), 8.06 (s, 2H)

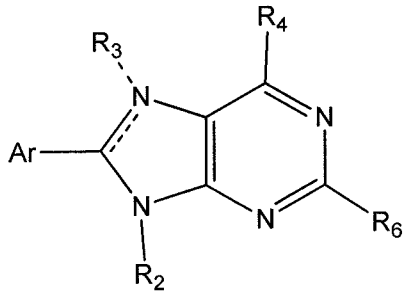
No	Structure		MP (°C)	ESI-MS (*m/z*)	^{1}H NMR (300 MHz)
74		White Solid	157.7–158.9	406.4 ($[M+H]^+$)	(DMSO-d_6) δ 14.8 (s, 1H), 7.81 (s, 1H)
75		White Solid	112.8-114.8	372.9 ($[M+H]^+$)	(DMSO-d_6) δ 15.8 (s, 1H), 8.13–7.98 (m, 1H), 7.42 (d, J = 4.1 Hz, 1H)
76		White Solid	114.1–116.9	400.0 ($[M-H]^-$)	(DMSO-d_6) δ 15.58 (s, 1H), 9.26 (s, 1H), 8.71 (d, J = 8.2 Hz, 1H), 8.54 (d, J = 7.7 Hz, 1H)
77		White Solid	119.6–121.9	400.0 ($[M-H]^-$)	(DMSO-d_6) δ 15.6 (s, 1H), 8.46 (d, J = 8.1 Hz, 1H), 7.89 (d, J = 8.1 Hz, 1H)
78		White Solid	105.6–108.0	400.0 ($[M-H]^-$)	(DMSO-d_6) δ 9.62 (s, 1H), 8.95 (d, J = 8.0 Hz, 1H), 8.24 (d, J = 8.3 Hz, 1H)
79		White Solid	108.7–109.5	400.0 ($[M+H]^+$)	(DMSO-d_6) δ 8.97 (s, 2H)
80		White Solid	155.8–156.9	367.9 ($[M+H]^+$)	(DMSO-d_6) δ 15.19 (s, 1H), 8.85 (d, J = 3.5 Hz, 1H), 8.29 (d, J = 7.9 Hz, 1H), 7.75 (dd, J = 7.9, 4.0 Hz, 1H)

While this invention has been described in certain embodiments, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.

CLAIMS

What is claimed is:

1. A purine compound of formula **I** or a salt thereof:



I

wherein

Ar is an aryl group, and

R_2, R_3, R_4 and R_6 each is independently selected from the group consisting of:

(a) hydrogen, halogen, haloalkyl, alkoxy, haloalkoxy, alkylthio, haloalkylthio, halothio;

(b) C1-C8 alkyl, C2-C8 alkenyl or C2-C8 alkynyl;

(c) O–C1-C8 alkyl, O-C2-C8 alkenyl or C2-C8 alkynyl;

(d) C1-C8 alkyl, C2-C8 alkenyl or C2-C8 alkynyl substituted with at least one heteroatom;

(e) alkyl amine, alkenyl amine, alkynyl amine, alkoxyamine, cyano amine;

(f) C(O)R′, C(O)OR′ or C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety substituted with at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide or substituted amine group, unsubstituted aryloxy and substituted aryloxy;

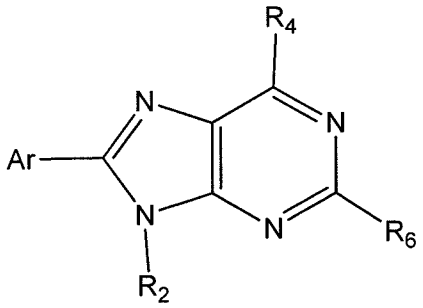
(g) SO_n (n = 0, 1, 2) substituted with C1-C8 alkyl group having at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, amine, and aryloxy;

(h) aryl or heteroaryl substituted with any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, amine, and aryloxy, wherein the alkyl, alkenyl or alkynyl group is substituted with at least one heteroatom;

(i) an amino moiety substituted with hydrogen, C1-C8 alkyl, C2-C8 alkenyl or alkynyl moiety substituted with one or more heteroatoms at any position, halogen, alkoxy, haloalkyl, or haloalkoxy,C(O)R′, C(O)OR′ or C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety substituted with at least one heteroatom at any position, halogen, alkoxy, haloalkyl, or haloalkoxy, an aryl or heteroaryl with at least one substituent being any combination of hydrogen, C1-C8 alkyl, C2-C8 alkenyl or alkynyl moiety substituted with one or more heteroatoms at any position, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide or substituted amine group, unsubstituted aryloxy and substituted aryloxy ;

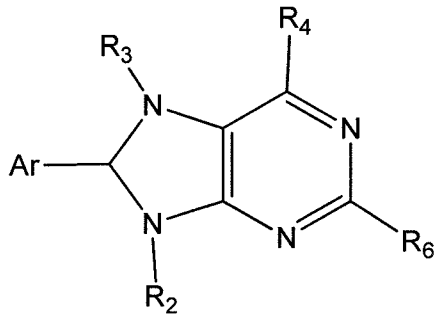
(j) an amino moiety substituted with any combination of hydrogen, alkyl, alkenyl, alkynyl moiety, wherein the alkyl, alkenyl, or alkynyl group is substituted with at least one of heteroatom, halogen, alkoxy, haloalkyl, and haloalkoxy.

2. The compound of claim 1, having formula **II** or a salt thereof.



II

3. The compound of claim 1, having formula **III** or a salt thereof.



III

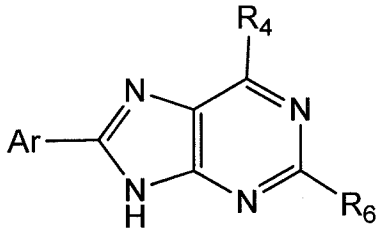
4. The compound of claim 1, wherein the aryl group is selected from the group consisting of phenyl, pyridyl, pyrimidinyl, pyridazinyl, pyrazinyl, triazinyl, pyrazolo, imidazolo, thiophenyl and furyl, and wherein the aryl group is substituted at any open position with at least one of hydrogen, halogen, alkyl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, alkoxy, cycloalkoxy haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, substituted amine, unsubstituted amines, aryloxy, and combinations thereof, wherein the alkyl, alkenyl or alkynyl group is unsubstituted or substituted with one or more heteroatoms at any position.

5. The compound of claim 1, wherein:

R_4 is selected from the group consisting of C1-C8 alkyl substituted with at least two halogen atoms, C3-C8 cycloalkyl substituted with at least two halogen atoms, O–(C1-C8) alkyl unsubstituted or substituted with two halogen atoms, O–(C3-C8) cycloalkyl unsubstituted or substituted with at least one halogen atom, phenyl optionally substituted with at least one ~~of~~ halogen, haloalkyl and haloalkoxy, and heteroaryl optionally substituted with at least one of halogen, haloalkyl and haloalkoxy, and

R_6 is selected from the group consisting of C1-C8 alkyl, C1-C8 alkyl substituted with at least two halogen atoms, C3-C8 cycloalkyl, C3-C8 cycloalkyl substituted with at least two halogen atoms, O–(C1-C8) alkyl , O–(C1-C8) alkyl unsubstituted or substituted with two halogen atoms, O–(C3-C8) cycloalkyl, O–(C3-C8) cycloalkyl substituted with at least one halogen atom, phenyl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, O–phenyl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, O–heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, S–(C1-C8)alkyl, S–(C1-C8)alkyl optionally substituted with at least one halogen atom, S–phenyl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, S–heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy.

6. The compound of claim 1, having formula **II-1** or a salt thereof:



II-1

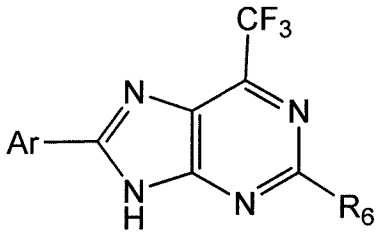
wherein,

Ar is the aryl or heteraryl group selected from the group consisting of phenyl, pyridyl, pyrimidinyl, pyridazinyl, pyrazinyl, triazinyl, pyrazolo, imidazolo, thiophenyl and furyl, and wherein the aryl group is substituted at any open position with at least one of hydrogen, halogen, alkyl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, alkoxy, cycloalkoxy haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, substituted amine, unsubstituted amine, aryloxy, and combinations thereof, and wherein the alkyl, alkenyl, or alkynyl group is unsubstituted or substituted with one or more heteroatoms at any position,

R_4 is selected from the group consisting of C1-C8 alkyl substituted with at least two halogen atoms, C3-C8 cycloalkyl substituted with at least two halogen atoms, O–(C1-C8) alkyl unsubstituted or substituted with two halogen atoms, O–(C3-C8) cycloalkyl unsubstituted or substituted with at least one halogen atom, phenyl optionally substituted with at least one ~~of~~ halogen, haloalkyl and haloalkoxy, and heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, and

R_6 is selected from the group consisting of C1-C8 alkyl, C1-C8 alkyl substituted with at least two halogen atoms, C3-C8 cycloalkyl, C3-C8 cycloalkyl substituted with at least two halogen atoms, O–(C1-C8) alkyl , O–(C1-C8) alkyl ~~unsubstituted or~~ substituted with two halogen atoms, O–(C3-C8) cycloalkyl, O–(C3-C8) cycloalkyl ~~unsubstituted or~~ substituted with at least one halogen atom, phenyl optionally substituted with at least one ~~of~~ halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, O–phenyl optionally substituted with at least one ~~of~~ halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, O–heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, S–(C1-C8)alkyl, S–(C1-C8)alkyl optionally substituted with at least one halogen atom, S–phenyl optionally substituted with at least one ~~of~~ halogen, alkyl, haloalkyl, alkoxy, and haloalkoxy, S–heteroaryl substituted with at least one ~~of~~ halogen, alkyl, haloalkyl, alkoxy and haloalkoxy.

7. The purine compound of claim 1, having formula **II-2** or a salt thereof:



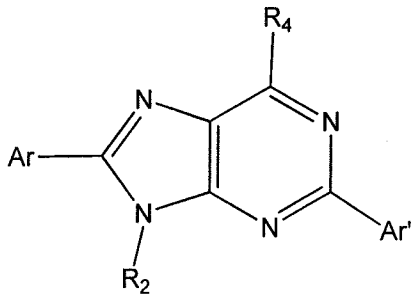
II-2

wherein

Ar is aryl or heteroaryl group selected from the group consisting of phenyl, pyridyl, pyrimidinyl, pyridazinyl, pyrazinyl, triazinyl, pyrazolo, imidazolo, thiophenyl and furyl, and wherein the aryl group is substituted at any open position with at least one ~~of~~ hydrogen, halogen, alkyl, cycloalkyl, alkenyl, cycloalkenyl,, alkynyl, alkoxy, cycloalkoxy haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, substituted and unsubstituted amines, aryloxy, and combinations thereof, wherein the alkyl, alkenyl, or alkynyl group is unsubstituted or substituted with one or more heteroatoms at any position, and

R_6 is selected from the group consisting of C1-C8 alkyl, C1-C8 alkyl substituted with at least two halogen atoms, C3-C8 cycloalkyl, C3-C8 cycloalkyl substituted with at least two halogen atoms, O–(C1-C8) alkyl , O–(C1-C8) alkyl ~~unsubstituted or~~ substituted with two halogen atoms, O–(C3-C8) cycloalkyl, O–(C3-C8) cycloalkyl ~~unsubstituted or~~ substituted with at least one halogen atom, phenyl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, O–phenyl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, O–heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, S–(C1-C8)alkyl, S–(C1-C8)alkyl optionally substituted with at least one halogen atom, S–phenyl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy, and haloalkoxy, S–heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy.

8. The purine compound of claim 1, having formula **II-3** or a salt thereof:



II-3

wherein

Ar and Ar′ each is an aryl or heteroaryl group independently selected from the group consisting of phenyl, pyridyl, pyrimidinyl, pyridazinyl, pyrazinyl, triazinyl, pyrazolo, imidazolo, thiophenyl and furyl, and wherein the aryl group is substituted at any open position with at least one of hydrogen, halogen, alkyl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, alkoxy, cycloalkoxy haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, substituted amine, unsubstituted amine, aryloxy, and combinations thereof, ansd wherein the alkyl, alkenyl, or alkynyl group is unsubstituted or substituted with one or more heteroatoms at any position, and

R_2 and R_4 each is independently selected from the group consisting of:

(a) hydrogen, halogen, haloalkyl, alkoxy, haloalkoxy, alkylthio, haloalkylthio, halothio;

(b) C1-C8 alkyl, C2-C8 alkeny or C2-C8alkynyl;

(c) O–C1-C8 alkyl, O-C2-C8 alkenyl or C2-C8alkynyl;

(d) C1-C8 alkyl, C2-C8 alkenyl or C2-C8alkynyl optionally substituted with at least one heteroatom;

(e) amine, alkoxyamine, cyano amine;

(f) C(O)R′, C(O)OR′ or C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety optionally substituted with at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, amine, and aryloxy;

(g) SO_n (n = 0, 1, 2) substituted with C1-C8 alkyl group optionally substituted with at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone sulfoxide, ester, acetate, amide, amine, and aryloxy;

(h) aryl or heteroaryl substituted with any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, amine, and aryloxy, wherein the alkyl, alkenyl, or alkynyl group is optionally substituted with at least one heteroatom;

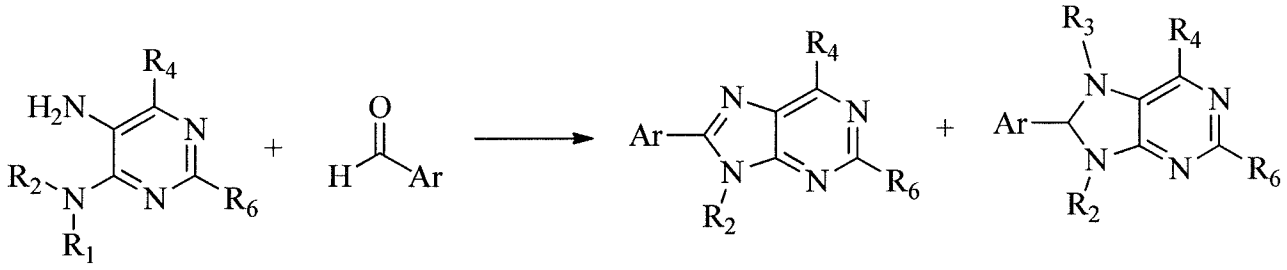
(i) an amino moiety substituted with hydrogen, C1-C8 alkyl, C2-C8 alkenyl or C2-C8alkynyl moiety unsubstituted or substituted with one or more heteroatoms at any position, halogen, alkoxy, haloalkyl, or haloalkoxy, C(O)R′, C(O)OR′ or C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety unsubstituted or substituted with at least one heteroatom at any position, halogen, alkoxy, haloalkyl, haloalkoxy, an aryl or heteroaryl with at least one substituent being any combination of hydrogen, C1-C8 alkyl, C2-C8 alkenyl or C2-C8alkynyl moiety unsubstituted or substituted with one or more heteroatoms at any position, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, substituted amine, unsubstituted aryloxy, substituted aryloxy; and

(j) an amino moiety substituted with any combination of hydrogen, alkyl, alkenyl, alkynyl moiety, wherein the alkyl, alkenyl, or alkynyl group is substituted with at least one of heteroatom, halogen, alkoxy, haloalkyl, and haloalkoxy.

9. The purine compound of claim 1 selected from the group consisting of **Compounds 1–106** as specified in Experimental section and **TABLE 5**.

10. A method of preparing a purine compound, comprising:

reacting 2-R_6-4-*N*′,*N*′-R_1,R_2-amine-6-R_4-pyrimidine-5-amine compound of formula **XI** with an aldehyde of formula **IV:**



XI IV II III

wherein

Ar is an aryl or heteraryl group selected from the group consisting of phenyl, pyridyl, pyrimidinyl, pyridazinyl, pyrazinyl, triazinyl, pyrazolo, imidazolo, thiophenyl and furyl, and wherein the aryl group is substituted at any open position with at least one ~~of~~ hydrogen, halogen, alkyl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, alkoxy, cycloalkoxy haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, substituted amine, unsubstituted amine, aryloxy, and combinations thereof, and wherein the alkyl, alkenyl, or alkynyl group is unsubstituted or substituted with one or more heteroatoms at any position, and

R_1, R_2, R_3, R_4 and R_6 each is independently selected from the group consisting of:

(a) hydrogen, halogen, haloalkyl, alkoxy, haloalkoxy, alkylthio, haloalkylthio, halothio;

(b) C1-C8 alkyl, C2-C8 alkeny or C2-C8 alkynyl;

(c) O–C1-C8 alkyl, O-C2-C8 alkenyl or C2-C8 alkynyl;

(d) C1-C8 alkyl, C2-C8 alkenyl or C2-C8 alkynyl substituted with at least one heteroatom;

(e) amine, alkoxyamine, cyano amine;

(f) C(O)R′, C(O)OR′ or C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety optionally substituted with at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, amine, and aryloxy;

(g) SO_n (n = 0, 1, 2) substituted with C1-C8 alkyl group optionally substituted wtih at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone sulfoxide, ester, acetate, amide, amine, and aryloxy;

(h) aryl or heteroaryl substituted with any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, amine, and aryloxy, wherein the alkyl, alkenyl, or alkynyl group is optionally substituted with at least one heteroatom;

(i) an amino moiety substituted with hydrogen, C1-C8 alkyl, C2-C8 alkenyl or alkynyl moiety unsubstituted or substituted with one or more heteroatoms at any position, halogen, alkoxy, haloalkyl, or haloalkoxy, C(O)R′, C(O)OR′ or C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety unsubstituted or substituted with at least one heteroatom at any position, halogen, alkoxy, haloalkyl, haloalkoxy, aryl or heteroaryl with at least one substituent being any combination of hydrogen, C1-C8 alkyl, C2-C8 alkenyl or alkynyl moiety unsubstituted or substituted with one or more heteroatoms at any position, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, substituted amine, unsubstituted aryloxy and substituted aryloxy;

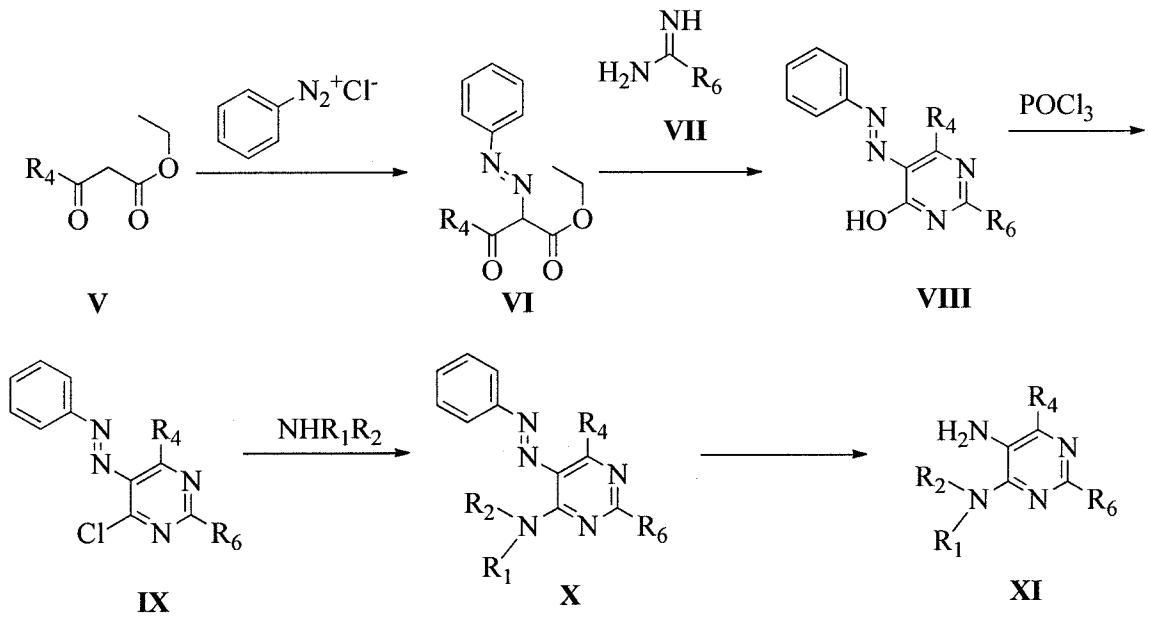
(j) an amino moiety substituted with any combination of hydrogen, alkyl, alkenyl, alkynyl moiety, wherein the alkyl, alkenyl, or alkynyl group is substituted with at least one of heteroatom, halogen, alkoxy, haloalkyl, and haloalkoxy.

11. The method of claim 10, wherein:

R_4 is selected from the group consisting of C1-C8 alkyl substituted with at least two halogen atoms, C3-C8 cycloalkyl substituted with at least two halogen atoms, O–(C1-C8) alkyl unsubstituted or substituted with two halogen atoms, O–(C3-C8) cycloalkyl unsubstituted or substituted with at least one halogen atom, phenyl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, and heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, and

R_6 is selected from the group consisting of C1-C8 alkyl, C1-C8 alkyl substituted with at least two halogen atoms, C3-C8 cycloalkyl, C3-C8 cycloalkyl substituted with at least two halogen atoms, O–(C1-C8) alkyl , O–(C1-C8) alkyl unsubstituted or substituted with two halogen atoms, O–(C3-C8) cycloalkyl, O–(C3-C8) cycloalkyl unsubstituted or substituted with at least one halogen atom, phenyl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, O–phenyl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, O–heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, S–(C1-C8)alkyl, S–(C1-C8)alkyl substituted with at least one halogen atom, S–phenyl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy, and haloalkoxy, S–heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy.

12. The method of claim 10, further comprising preparing the 2-R_6-4-*N'*,*N'*-R_1,R_2-amine-6-R_4-pyrimidine-5-amine compound of formula **XI** by a process comprising:



diazotizing ethyl R_4-substituted-β–diketoacetate compound of formula **V** with a phenyldiazonium salt in a basic solution to provide ethyl 4-R_4-3-oxo-2-(phenyldiazenyl)butanoate of formula **VI**;

reacting the ethyl 4-R_4-3-oxo-2-(phenyldiazenyl)butanoate of formula **VI** with R_6-substituted imidamide compound of formula **VII** in a presence of base, in a polar protic solvent to provide 2-R_6-5-(phenyldiazenyl)-6-R_4-pyrimidin-4-ol compound of formula **VIII**;

reacting the 2-R_6-5-(phenyldiazenyl)-6-R_4-pyrimidin-4-ol compound of formula **VIII** with phosphorus oxychloride in a presence of base to afford 2-R_6-4-chloro-5-(phenyldiazenyl)-6-R_4-pyrimidine compound of formula **IX**;

reacting the pyrimidine compound of formula **IX** with an amine compound having formula NHR_1R_2 to provide 2-R_6-4-*N',N'*-R_1,R_2-amine-5-(phenyldiazenyl)-6-R_4-pyrimidine compound of formula **X**; and

hydrogenating the pyrimidine compound of formula **X** to provide the 2-R_6-4-*N',N'*-R_1,R_2-amine-6-R_4-pyrimidine-5-amine compound of formula **XI**.

13. The method of claim 12, wherein reacting the pyrimidine compound of formula **IX** with an amine compound having formula NHR_1R_2 comprise:

reacting the pyrimidine compound of formula **IX** with ammonia in a polar protic solvent to provide 2-R_6-4-*N',N'*-R_1,R_2-amine-5-(phenyldiazenyl)-6-R_4-pyrimidine compound of formula **X**, wherein R_1 and R_2 is hydrogen.

14. The method of claim 12, wherein reacting the pyrimidine compound of formula **IX** with an amine compound having formula NHR_1R_2 comprise:

reacting the pyrimidine compound of formula **IX** with the NHR_1R_2 amine in a polar aprotic solvent at an ambient temperature to provide 2-R_6-4-*N',N'*-R_1,R_2-amine-5-(phenyldiazenyl)-6-R_4-pyrimidine compound of formula **X**, wherein R_1 is hydrogen and R_2 is selected from the group consisting of:

(a) hydrogen, haloalkyl, alkoxy, haloalkoxy, alkylthio, haloalkylthio, halothio;

(b) C1-C8 alkyl, C2-C8 alkeny or alkynyl;

(c) C1-C8 alkyl, C2-C8 alkenyl or alkynyl substituted with at least one heteroatom;

(d) amine, alkoxyamine, cyano amine;

(e) C(O)R′, C(O)OR′ or C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety optionally substituted with at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, amine, and aryloxy;

(f) SO_n (n = 0, 1, 2) substituted with C1-C8 alkyl group optionally substituted with at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone sulfoxide, ester, acetate, amide, amine, and aryloxy;

(g) aryl or heteroaryl substituted with any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, amine, and aryloxy, wherein the alkyl, alkenyl, or alkynyl group is optionally substituted with at least one heteroatom;

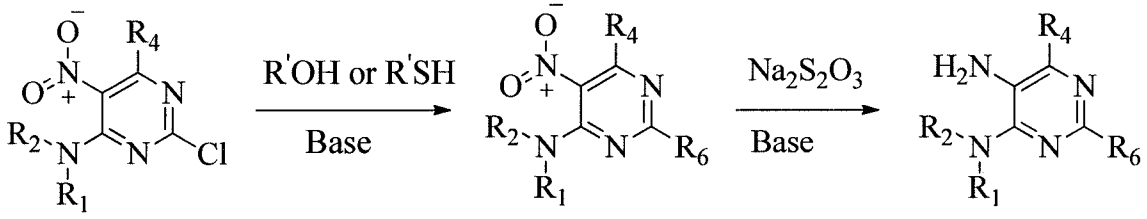
(h) an amino moiety substituted with any combination of hydrogen, alkyl, alkenyl, alkynyl, C(O)R′, C(O)OR′, C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety optionally substituted with at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, amine, and aryloxy; and

(i) an amino moiety substituted with any combination of hydrogen, alkyl, alkenyl, alkynyl moiety, wherein the alkyl, alkenyl, or alkynyl group is optionally substituted with at least one of heteroatom, halogen, alkoxy, haloalkyl, and haloalkoxy.

15. The method of claim 12, wherein hydrogenating the pyrimidine compound of formula **X** comprises:

hydrogenating the pyrimidine compound of formula **X** in a polar protic solvent under a hydrogen atmosphere at an ambient temperature to provide to provide the 2-R_6-4-*N*′,*N*′-R_1,R_2-amine-6-R_4-pyrimidine-5-amine compound of formula **XI**.

16. The method of claim 10, further comprising preparing the 2-R_6-4-*N',N'*-R_1,R_2-amine-6-R_4-pyrimidine-5-amine compound of formula **XI** by a process comprising:



XII **XIII** **XI**

reacting 2-chloro-4-*N',N'*-R_1,R_2-amine-5-nitro-6-R_4-pyrimidine compound of formula **XII** with alcohol or thiol in a presence of base and a polar aprotic solvent to provide 2-R_6-4-*N',N'*-R_1,R_2-amine-5-nitro-6-R_4-pyrimidine compound of formula **XIII**; and

reducing the 2-R_6-4-*N',N'*-R_1,R_2-amine-5-nitro-6-R_4-pyrimidine compound of formula **XIII** with sodium hyposulfite in a presence of base in a polar solvent to convert the nitro substituent group at 5-position of the pyrimidine compound **XIII** to amine substituent group.

17. An pesticidal composition, comprising a purine compound of claim 1.

18. An pesticidal composition, comprising a purine compound of claim 2.

19. An pesticidal composition, comprising a purine compound of claim 3.

20. An pesticidal composition, comprising a purine compound of claim 9.

21. A method of controlling insect, comprising applying an pesticidal composition near a population of insects, wherein the pesticidal composition comprises a purine compound of claim 1.

22. A method of controlling insect, comprising applying an pesticidal composition near a population of insects, wherein the pesticidal composition comprises a purine compound of claim 2.

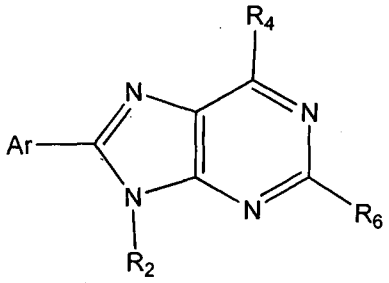
23. A method of controlling insect, comprising applying an pesticidal composition near a population of insects, wherein the pesticidal composition comprises a purine compound of claim 3.

24. A method of controlling insect, comprising applying an pesticidal composition of claim 9.

AMENDED CLAIMS
received by the International Bureau on 26 July 2014 (26.07.2014)

What is claimed is:

1. A purine compound of formula **I** or a salt thereof:



I

wherein

Ar is an aryl group, and

R_2, R_4 and R_6 each is independently selected from the group consisting of:

(a) halogen, alkylthio, haloalkylthio, halothio;

(b) C2-C8 alkenyl or C2-C8 alkynyl;

(c) O-C2-C8 alkenyl or O-C2-C8 alkynyl;

(d) C2-C8 alkenyl or C2-C8 alkynyl substituted with at least one heteroatom;

(e) C(O)R′, C(O)OR′ or C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety substituted with at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide or substituted amine group, unsubstituted aryloxy and substituted aryloxy;

(f) SO_n (n = 0, 1, 2) substituted with C1-C8 alkyl group having at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, amine, and aryloxy;

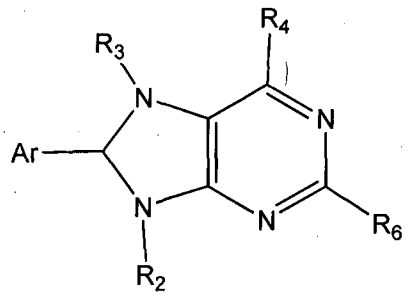
(g) an amino moiety substituted with hydrogen, C1-C8 alkyl, C2-C8 alkenyl or alkynyl moiety substituted with one or more heteroatoms at any position, halogen, alkoxy, haloalkyl, or haloalkoxy, C(O)R′, C(O)OR′ or C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety substituted with at least one heteroatom at any position,

halogen, alkoxy, haloalkyl, or haloalkoxy, heteroaryl with at least one substituent being any combination of hydrogen, C1-C8 alkyl, C2-C8 alkenyl or alkynyl moiety substituted with one or more heteroatoms at any position, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide or substituted amine group; and

(h) an amino moiety substituted with any combination of hydrogen, alkyl, alkenyl, alkynyl moiety, wherein the alkyl, alkenyl, or alkynyl group is substituted with at least one of heteroatom, halogen, alkoxy, haloalkyl, and haloalkoxy.

2. (Canceled)

3. A purine compound of formula **III** or a salt thereof.



III

wherein

Ar is an aryl group, and

R_2, R_3, R_4 and R_6 each is independently selected from the group consisting of:

(a) hydrogen, halogen, haloalkyl, alkoxy, haloalkoxy, alkylthio, haloalkylthio, halothio;

(b) C1-C8 alkyl, C2-C8 alkenyl or C2-C8 alkynyl;

(c) O–C1-C8 alkyl, O-C2-C8 alkenyl or O-C2-C8 alkynyl;

(d) C1-C8 alkyl, C2-C8 alkenyl or C2-C8 alkynyl substituted with at least one heteroatom;

(e) alkyl amine, alkenyl amine, alkynyl amine, alkoxyamine, cyano amine;

(f) C(O)R′, C(O)OR′ or C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety substituted with at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl,

alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide or substituted amine group, unsubstituted aryloxy and substituted aryloxy;

(g) SO_n (n = 0, 1, 2) substituted with C1-C8 alkyl group having at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, amine, and aryloxy;

(h) aryl or heteroaryl substituted with any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, amine, and aryloxy, wherein the alkyl, alkenyl or alkynyl group is substituted with at least one heteroatom;

(i) an amino moiety substituted with hydrogen, C1-C8 alkyl, C2-C8 alkenyl or alkynyl moiety substituted with one or more heteroatoms at any position, halogen, alkoxy, haloalkyl, or haloalkoxy, C(O)R′, C(O)OR′ or C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety substituted with at least one heteroatom at any position, halogen, alkoxy, haloalkyl, or haloalkoxy, an aryl or heteroaryl with at least one substituent being any combination of hydrogen, C1-C8 alkyl, C2-C8 alkenyl or alkynyl moiety substituted with one or more heteroatoms at any position, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide or substituted amine group, unsubstituted aryloxy and substituted aryloxy; and

(j) an amino moiety substituted with any combination of hydrogen, alkyl, alkenyl, alkynyl moiety, wherein the alkyl, alkenyl, or alkynyl group is substituted with at least one of heteroatom, halogen, alkoxy, haloalkyl, and haloalkoxy.

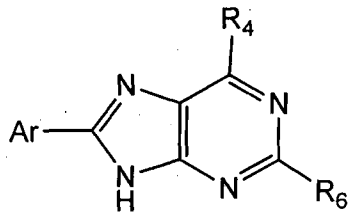
4. The compound of claim 1, wherein Ar is an aryl group selected from the group consisting of phenyl, pyridyl, pyrimidinyl, pyridazinyl, pyrazinyl, triazinyl, pyrazolo, imidazolo, thiophenyl and furyl, and wherein the aryl group is substituted at any open position with at least one of hydrogen, halogen, alkyl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, alkoxy, cycloalkoxy haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, substituted amine, unsubstituted amines, aryloxy, and combinations thereof, wherein the

alkyl, alkenyl or alkynyl group is unsubstituted or substituted with one or more heteroatoms at any position.

5. The compound of claim 1, wherein:

R_6 is selected from the group consisting of S–(C1-C8)alkyl, S–(C1-C8)alkyl optionally substituted with at least one halogen atom, S–phenyl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, S–heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy.

6. The compound of claim 1, having formula **II-1** or a salt thereof:



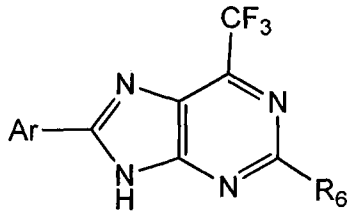
II-1

wherein,

Ar is the aryl or heteraryl group selected from the group consisting of phenyl, pyridyl, pyrimidinyl, pyridazinyl, pyrazinyl, triazinyl, pyrazolo, imidazolo, thiophenyl and furyl, and wherein the aryl group is substituted at any open position with at least one of hydrogen, halogen, alkyl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, alkoxy, cycloalkoxy haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, substituted amine, unsubstituted amine, aryloxy, and combinations thereof, and wherein the alkyl, alkenyl, or alkynyl group is unsubstituted or substituted with one or more heteroatoms at any position, and

R_6 is selected from the group consisting of S–(C1-C8)alkyl, S–(C1-C8)alkyl optionally substituted with at least one halogen atom, S–phenyl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy, and haloalkoxy, S–heteroaryl substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy.

7. A purine compound of formula **II-2** or a salt thereof:



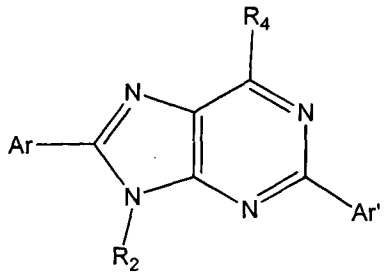
II-2

wherein

Ar is aryl or heteroaryl group selected from the group consisting of phenyl, pyridyl, pyrimidinyl, pyridazinyl, pyrazinyl, triazinyl, pyrazolo, imidazolo, thiophenyl and furyl, and wherein the aryl group is substituted at any open position with at least one of hydrogen, halogen, alkyl, cycloalkyl, alkenyl, cycloalkenyl,, alkynyl, alkoxy, cycloalkoxy haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, substituted and unsubstituted amines, aryloxy, and combinations thereof, wherein the alkyl, alkenyl, or alkynyl group is unsubstituted or substituted with one or more heteroatoms at any position, and

R_6 is selected from the group consisting of C1-C8 alkyl, C1-C8 alkyl substituted with at least two halogen atoms, C3-C8 cycloalkyl, C3-C8 cycloalkyl substituted with at least two halogen atoms, O–(C1-C8) alkyl , O–(C1-C8) alkyl substituted with two halogen atoms, O–(C3-C8) cycloalkyl, O–(C3-C8) cycloalkyl substituted with at least one halogen atom, phenyl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, O–phenyl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, O–heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy, S–(C1-C8)alkyl, S–(C1-C8)alkyl optionally substituted with at least one halogen atom, S–phenyl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy, and haloalkoxy, S–heteroaryl optionally substituted with at least one of halogen, alkyl, haloalkyl, alkoxy and haloalkoxy.

8. A purine compound of formula **II-3** or a salt thereof:



II-3

wherein

Ar and Ar′ each is an aryl or heteroaryl group independently selected from the group consisting of phenyl, pyridyl, pyrimidinyl, pyridazinyl, pyrazinyl, triazinyl, pyrazolo, imidazolo, thiophenyl and furyl, and wherein the aryl group is substituted at any open position with at least one of hydrogen, halogen, alkyl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, alkoxy, cycloalkoxy haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, substituted amine, unsubstituted amine, aryloxy, and combinations thereof, and wherein the alkyl, alkenyl, or alkynyl group is unsubstituted or substituted with one or more heteroatoms at any position, and

R_2 and R_4 each is independently selected from the group consisting of:

(a) halogen, alkylthio, haloalkylthio, halothio;

(b) C2-C8 alkeny or C2-C8alkynyl;

(c) O-C2-C8 alkenyl or O-C2-C8alkynyl;

(d) C2-C8 alkenyl or C2-C8alkynyl optionally substituted with at least one heteroatom;

(e) C(O)R′, C(O)OR′ or C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety optionally substituted with at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, amine, and aryloxy;

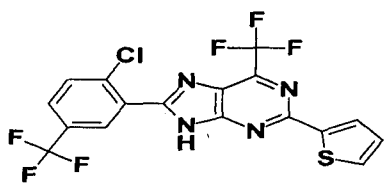
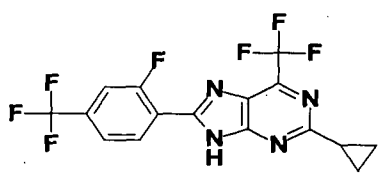
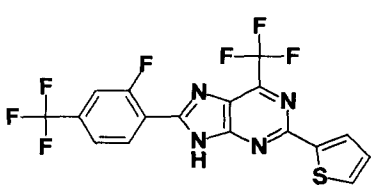
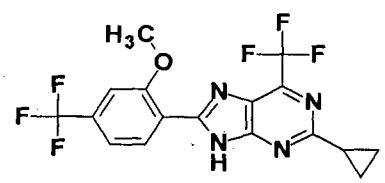
(f) SO_n (n = 0, 1, 2) substituted with C1-C8 alkyl group optionally substituted with at least one heteroatom, aryl or heteroaryl with at least one substituent being any combination of hydrogen, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl,

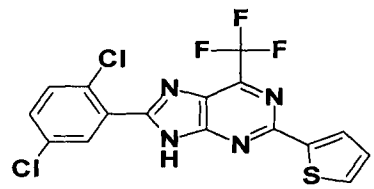
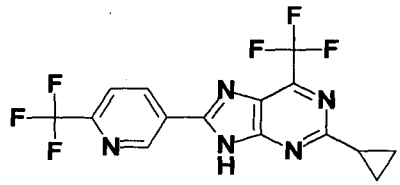
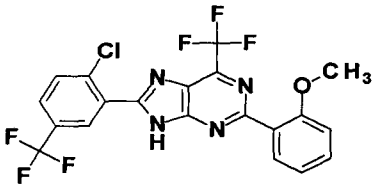
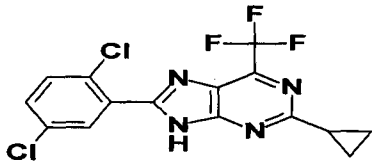
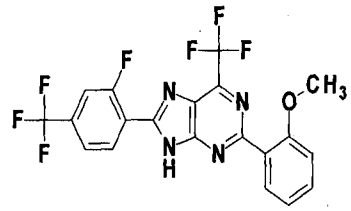
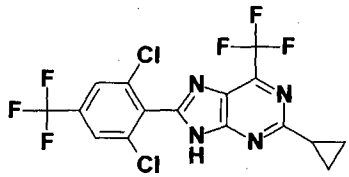
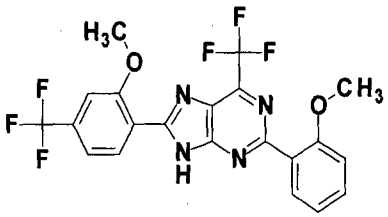
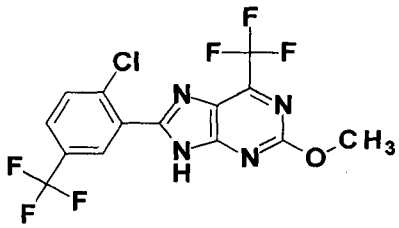
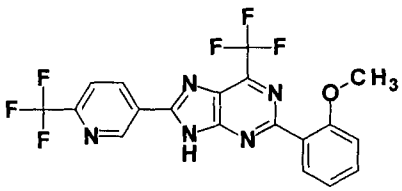
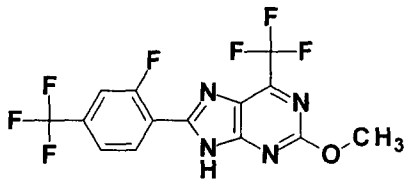
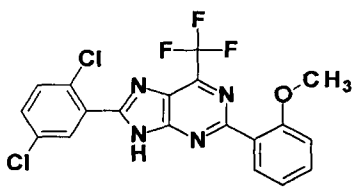
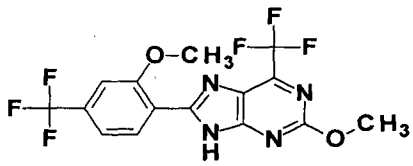
cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone sulfoxide, ester, acetate, amide, amine, and aryloxy;

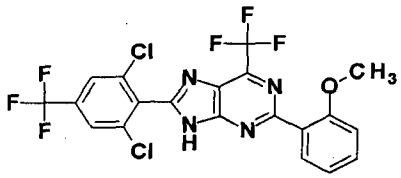
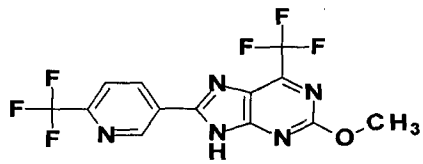
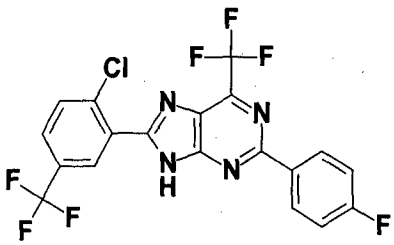
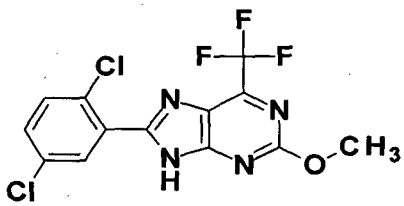
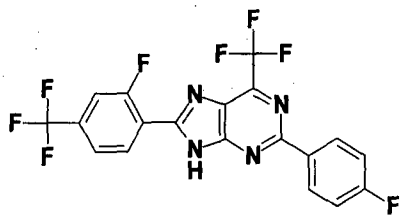
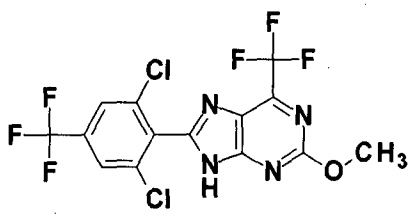
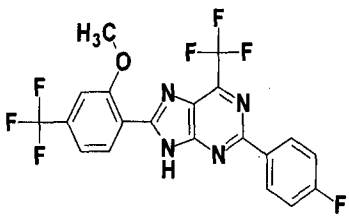
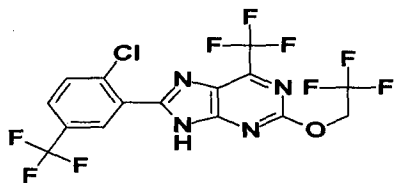
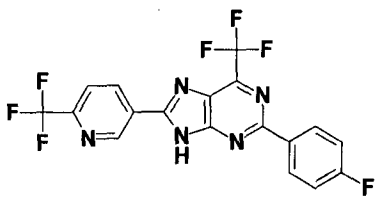
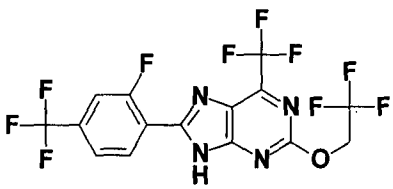
(g) an amino moiety substituted with hydrogen, C1-C8 alkyl, C2-C8 alkenyl or C2-C8alkynyl moiety unsubstituted or substituted with one or more heteroatoms at any position, halogen, alkoxy, haloalkyl, or haloalkoxy, C(O)R′, C(O)OR′ or C(O)NR′ where R′ is selected from the group consisting of an alkyl moiety unsubstituted or substituted with at least one heteroatom at any position, halogen, alkoxy, haloalkyl, haloalkoxy, heteroaryl with at least one substituent being any combination of hydrogen, C1-C8 alkyl, C2-C8 alkenyl or C2-C8alkynyl moiety unsubstituted or substituted with one or more heteroatoms at any position, halogen, alkyl, cycloalkyl, alkoxy, cycloalkoxy, haloalkyl, cyclohaloalkyl, haloalkoxy, cyclohaloalkoxy, alkenyl, cycloalkenyl, alkynyl, alkylthio, haloalkylthio, halothio, cyano, nitro, sulfone, sulfoxide, ester, acetate, amide, substituted amine; and

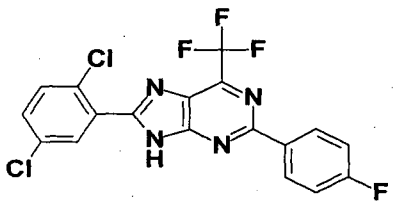
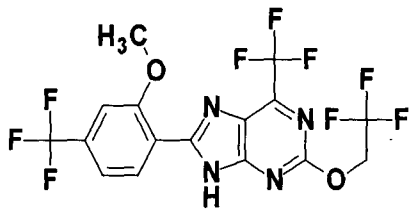
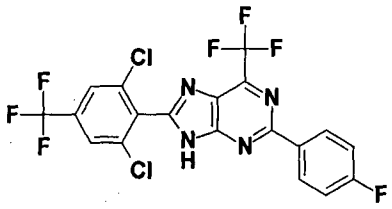
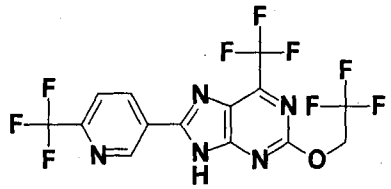
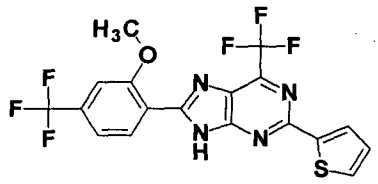
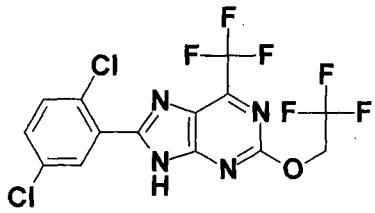
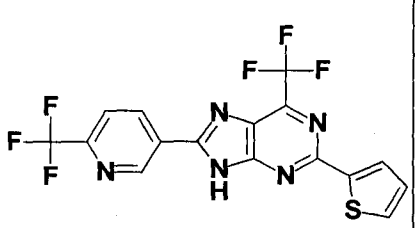
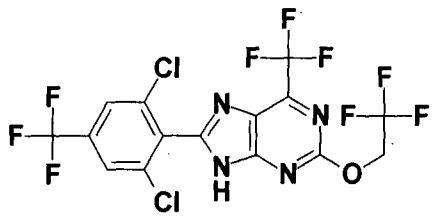
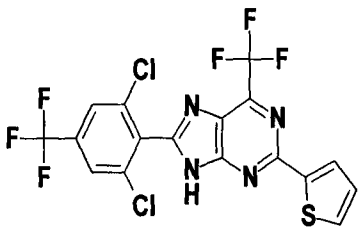
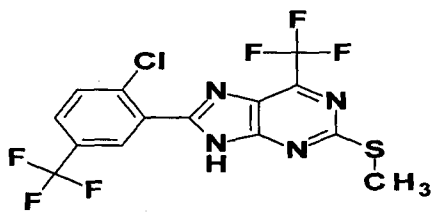
(h) an amino moiety substituted with any combination of hydrogen, alkyl, alkenyl, alkynyl moiety, wherein the alkyl, alkenyl, or alkynyl group is substituted with at least one of heteroatom, halogen, alkoxy, haloalkyl, and haloalkoxy.

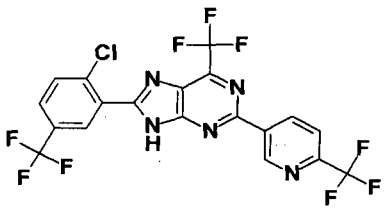
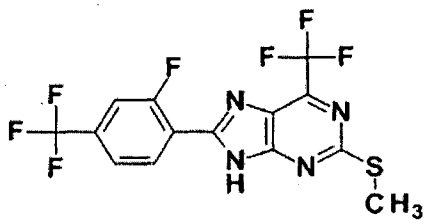
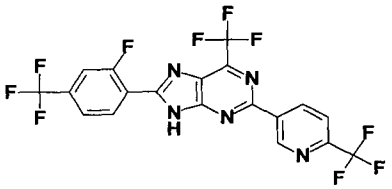
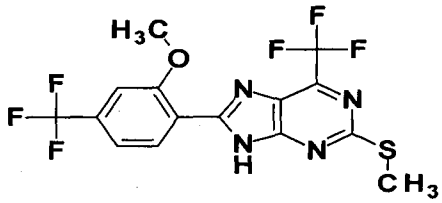
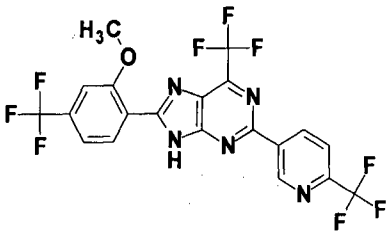
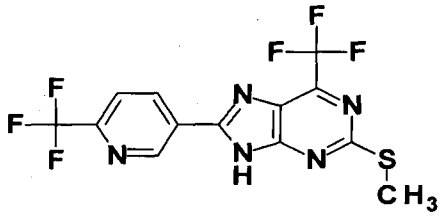
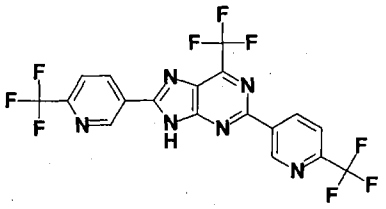
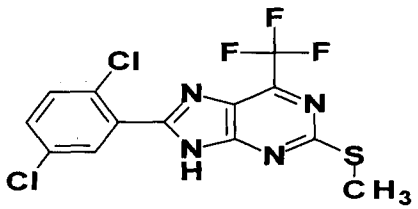
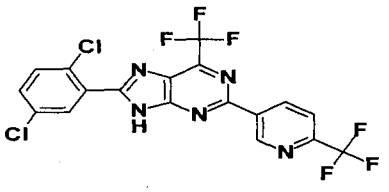
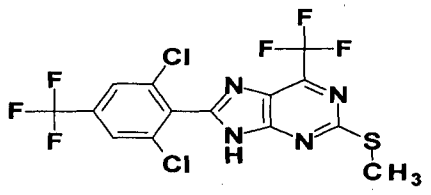
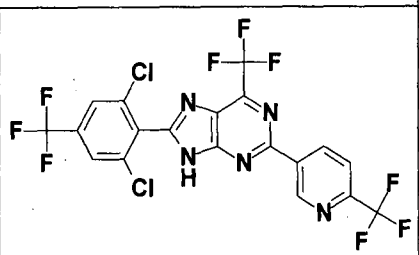
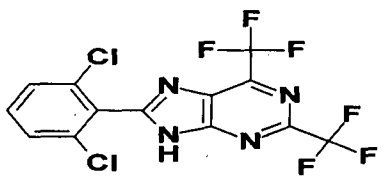
9. The purine compound of claim 7 selected from the group consisting of compounds 1–80.

No.	Compound	No.	Compound
1		41	
2		42	

No.	Compound	No.	Compound
3		43	
4		44	
5		45	
6		46	
7		47	
8		48	

No.	Compound	No.	Compound
9		49	
10		50	
11		51	
12		52	
13		53	

No.	Compound	No.	Compound
14		54	
15		55	
16		56	
17		57	
18		58	

No.	Compound	No.	Compound
19		59	
20		60	
21		61	
22		62	
23		63	
24		64	

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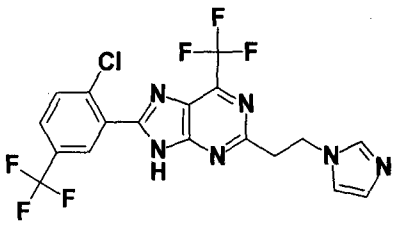
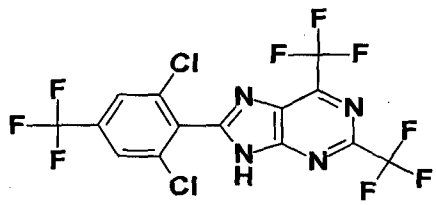
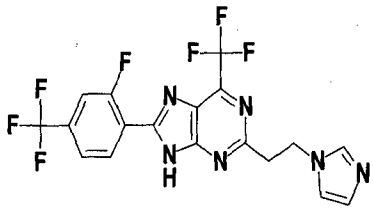
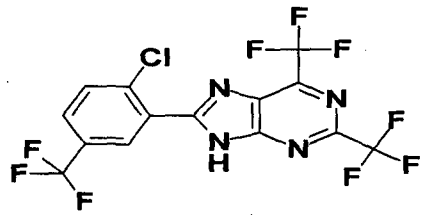
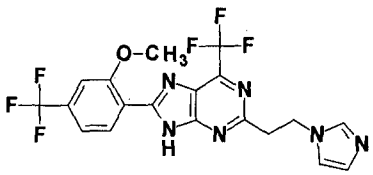
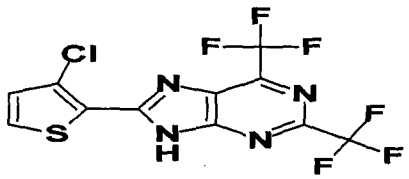
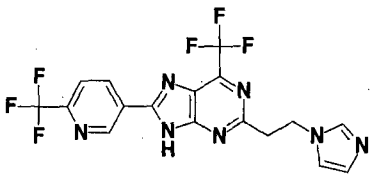
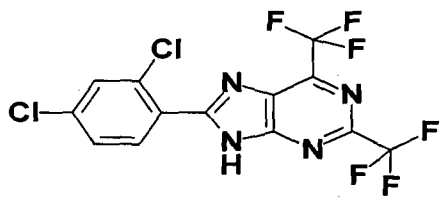
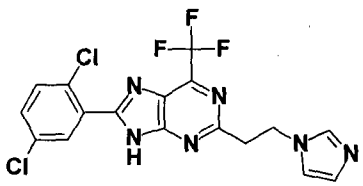
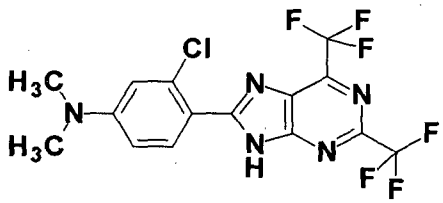
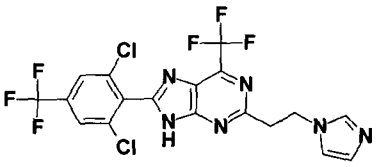
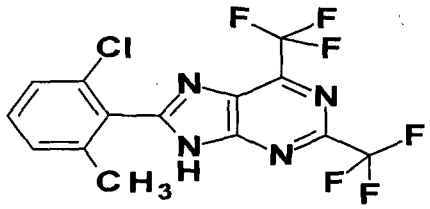
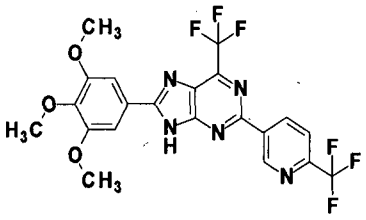
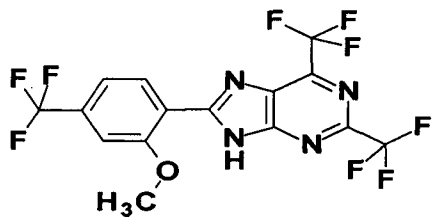
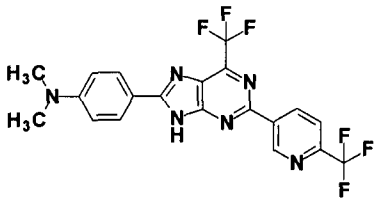
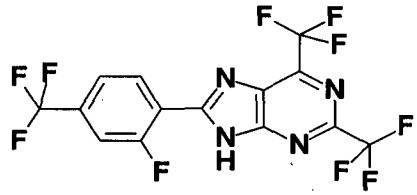
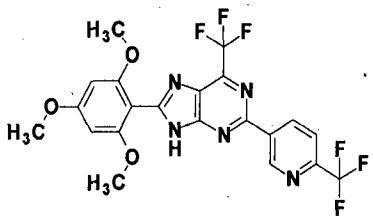
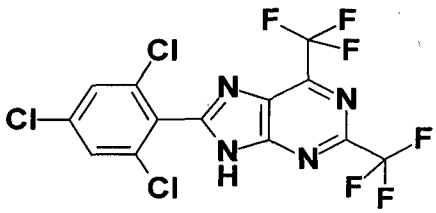
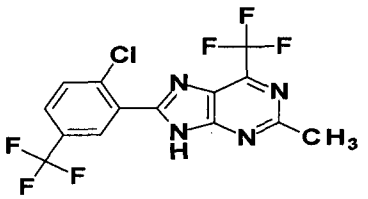
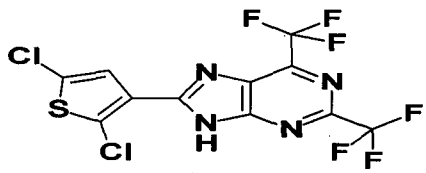
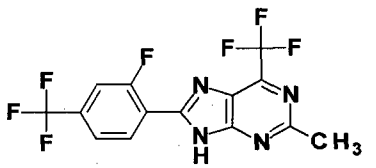
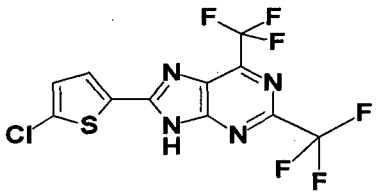
25		65	
26		66	
27		67	
28		68	
29		69	
30		70	

No.	Compound	No.	Compound
31		71	
32		72	
33		73	
34		74	
35		75	

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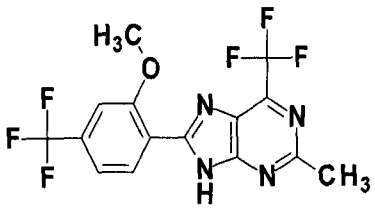
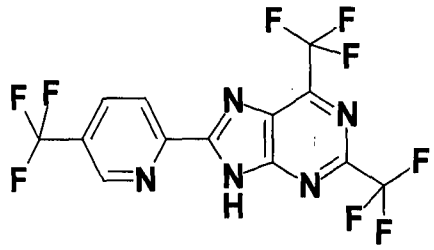
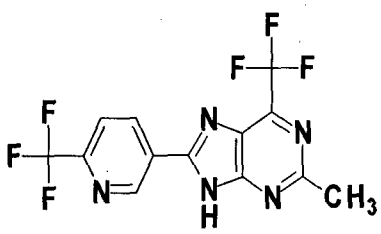
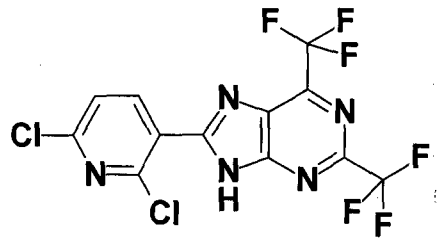
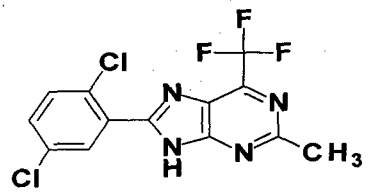
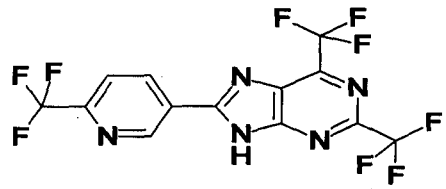
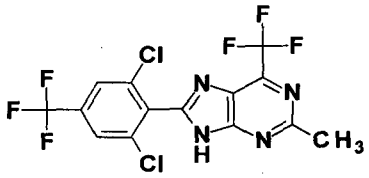
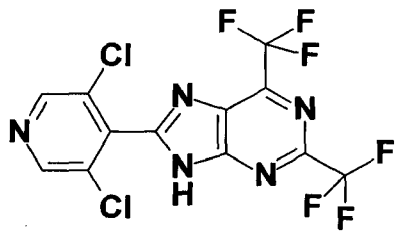
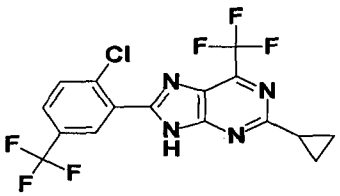
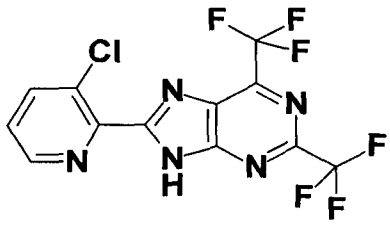
36		76	
37		77	
38		78	
39		79	
40		80	

10.–16. (Canceled)

17. An pesticidal composition, comprising a purine compound of claim 1.

18. An pesticidal composition, comprising a purine compound of claim 8.

19. An pesticidal composition, comprising a purine compound of claim 3.

20. An pesticidal composition, comprising a purine compound of claim 7 or claim 9.

21. A method of controlling insect, comprising applying an pesticidal composition near a population of insects, wherein the pesticidal composition comprises a purine compound of claim 1.

22. A method of controlling insect, comprising applying an pesticidal composition near a population of insects, wherein the pesticidal composition comprises a purine compound of claim 8.

23. A method of controlling insect, comprising applying an pesticidal composition near a population of insects, wherein the pesticidal composition comprises a purine compound of claim 3.

24. A method of controlling insect, comprising applying an pesticidal composition of claim 7 or claim 9.

STATEMENT UNDER ARTICLE 19(1) (RULE 46.4)

Applicant has amended claims 1, 3–9, 18, 20, 22 and 24, and canceled claim 2 and 10–16. The amendments to the claims have no impact on the description and the drawings.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/014719

A. CLASSIFICATION OF SUBJECT MATTER

C07D 473/40(2006.01)i, A01N 43/48(2006.01)i, A01P 7/04(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C07D 473/40; A61K 31/52; C07D 473/34; NotA vai/lable; A61K 31/522; C09K 11/06; C07D 473/16; C07D 473/00; A01N 43/48; A01P 7/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: 7H-purine, insect, dihydro-7H-purine

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2012-0080508 A (CS ELSOLAR CO., LTD.) 17 July 2012 See claims 1-10	1,2,4,5,6,8
X	US 7517888 B2 (CRISTALLI GLORIA) 14 April 2009 See claims 1-30	1,2,4,10
A		3,5-8,11-19,21-23
A	WO 2005-084401 A2 (NEUROGEN CORPORATION et al.) 15 September 2005 See claims 1-92	1-8,10-19,21-23
A	WO 2005-092892 A1 (SUMITOMO PHARMACEUTICALS CO., LTD. et al.) 06 October 2005 See claims 1-20	1-8,10-19,21-23

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 May 2014 (30.05.2014)	**30 May 2014 (30.05.2014)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea
Facsimile No. +82-42-472-7140

Authorized officer
NA, Young Min
Telephone No. +82-42-481-8466

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/014719

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 9, 20, 24
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
The claim 9 relies on reference to the description instead of definite structure expressly stated in the claim. And claims 20, 24 are referring to the claim 9.

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required addtional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2014/014719

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 10-2012-0080508 A	17/07/2012	KR 10-2013-0007511 A	18/01/2013
US 7517888 B2	14/04/2009	CA 2565037 A1	10/11/2005
		EP 1751159 A2	14/02/2007
		JP 2007-535560 A	06/12/2007
		JP 2007-535560 T	06/12/2007
		US 2005-245546 A1	03/11/2005
		WO 2005-105803 A2	10/11/2005
		WO 2005-105803 A3	09/02/2006
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		CA 2557667 A1	15/09/2005
		CN 1997644 A	11/07/2007
		CN 1997644 C0	11/07/2007
		EP 1720877 A2	15/11/2006
		EP 1720877 A4	04/11/2009
		JP 2007-526339 A	13/09/2007
		JP 2007-526339 T	13/09/2007
		US 2007-0197559 A1	23/08/2007
		WO 2005-084401 A3	17/08/2006
WO 2005-092892 A1	06/10/2005	EP 1728792 A1	06/12/2006
		EP 1728792 A4	15/12/2010
		US 2007-0225303 A1	27/09/2007