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(21) International Application Number: PCT/US92/11329 (22) International Filing Date: 30 December 1992 (30.12.92) (30) Priority data: 07/821,724 15 January 1992 (15.01.92) US (60) Parent Application or Grant (63) Related by Continuation US 07/821,724 (CIP) Filed on 15 January 1992 (15.01.92) (71) Applicant (for all designated States except US): E.I. DU PONT DE NEMOURS AND COMPANY [US/US]; 1007 Market Street, Wilmington, DE 19898 (US).		(72) Inventors; and (75) Inventors/Applicants (for US only) : DAUB, John, Powell [US/US]; 2600 Skylark Road, Wilmington, DE 19808 (US). FINKELSTEIN, Bruce, Lawrence [US/US]; 204 Valley Stream Drive, Newark, DE 19702 (US). KLEIER, Daniel, Anthony [US/US]; 31 Johnston Drive, Elkton, MD 21921 (US). (74) Agents: MAYER, Nancy, S. et al.; E.I. du Pont de Nemours and Company, Legal/Patent Records Center, 1007 Market Street, Wilmington, DE 19898 (US). (81) Designated States: AU, BB, BG, BR, CA, CS, FI, HU, JP, KP, KR, LK, MG, MN, MW, NO, NZ, PL, RO, RU, SD, UA, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, SN, TD, TG). Published <i>With international search report.</i>
(54) Title: BRIDGED HETEROCYCLIC FUNGICIDES (I) (57) Abstract Fungicidal compounds of formula (I) are disclosed.		

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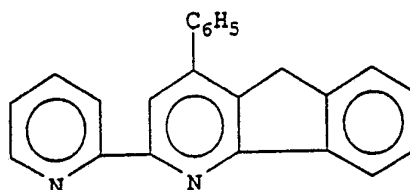
TITLE

BRIDGED HETEROCYCLIC FUNGICIDES

BACKGROUND OF THE INVENTION

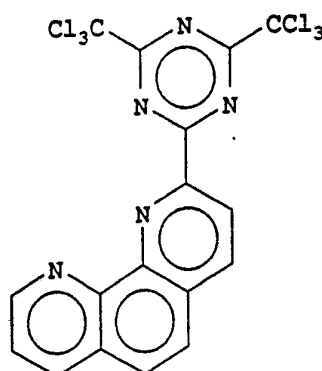
5 The disclosed invention generally is directed to the field of fungicidal compounds and compositions.

Kröhnke, F. (*Synthesis* 1976, 1, 1-24) discloses the synthesis of



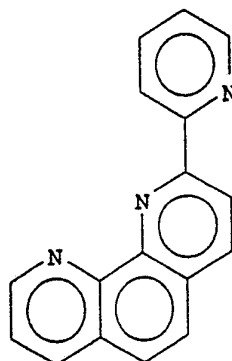
No fungicidal utility for this compound is disclosed.

10 U.S. 4,189,323 (Hoechst) discloses the compound



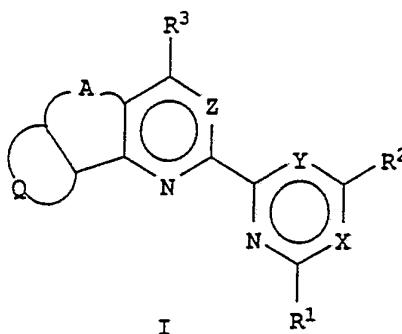
as a photoinitiator for free radical or acid-catalyzed reactions.

Haginiwa et al. (*Yakugaku Zasshi*, 1975, 95, 204-210) disclose the synthesis of



SUMMARY OF THE INVENTION

This invention comprises compounds of Formula I including all geometric and stereoisomers and agricultural compositions containing such compounds



5 wherein:

X is N or CR⁴;

Y is N or CR⁵;

Z is N or CR⁶;

10 Q is a fused benzene, naphthalene, thiophene, furan, pyrrole, pyridine or pyrimidine ring each optionally substituted with R⁷ and R⁸;

A is a bridge -G¹-G²-G³-G⁴-, wherein G¹, G², G³ or G⁴ are independently O, S(O)_p, NR⁹, CR¹⁰R¹¹, C(=O), a direct bond, or G¹-G², G²-G³ or G³-G⁴ may be taken together to form -CH=CH-; such
15 that at least one of G¹, G², G³ and G⁴ is other than a direct bond;

R¹, R², R³ and R⁴ are independently H; halogen; cyano; hydroxy; C₁-C₆ alkyl; C₁-C₄ haloalkyl; C₁-C₄ alkylthio; C₁-C₄ alkylsulfinyl; C₁-C₄ alkylsulfonyl; C₃-C₆ cycloalkyl optionally substituted with 1-2 methyl groups; C₁-C₄ alkoxy; C₁-C₄ haloalkoxy; C₂-C₄ alkoxyalkyl; C₂-C₄ alkenyl; C₂-C₄ haloalkenyl; C₂-C₄ alkenyloxy; C₂-C₄ alkynyl; C₂-C₄ alkynyloxy; NR¹²R¹³; phenyl or phenoxy optionally
20 substituted with R¹⁴; or R¹ and R⁴, R² and R⁴
25

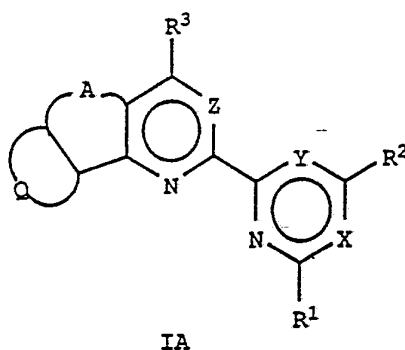
- or R² and R⁵ can be taken together to form
-(CH₂)₃-, -(CH₂)₄- or a fused phenyl ring;
R⁵ and R⁶ are independently H, halogen, C₁-C₂
alkyl or C₁-C₂ alkoxy;
- 5 R⁷ is halogen; cyano; nitro; hydroxy;
hydroxycarbonyl; C₁-C₆ alkyl; C₁-C₄
haloalkyl; C₁-C₄ alkylthio; C₁-C₄
alkylsulfinyl; C₁-C₄ alkylsulfonyl; (C₁-C₄
alkyl)₃silyl; C₃-C₆ cycloalkyl; C₂-C₅
10 alkylcarbonyl; C₂-C₄ alkenyl; C₂-C₄
alkenyloxy; C₂-C₄ alkynyl; C₂-C₄ alkynyloxy;
C₁-C₄ alkoxy; C₁-C₄ haloalkoxy; C₂-C₄
alkoxyalkyl; C₂-C₅ alkoxycarbonyl; C₂-C₄
alkoxyalkoxy; NR¹⁵R¹⁶; C(=O)NR¹⁷R¹⁸; or
15 phenyl, phenoxy or phenylthio each optionally
substituted with R¹⁹;
- R⁸ and R¹⁴ are independently 1-2 halogen, 1-2 C₁-C₃
alkyl, C₁-C₂ haloalkyl, C₁-C₂ alkoxy or C₁-C₂
haloalkoxy;
- 20 R⁹, R¹⁰ and R¹¹ are independently H or C₁-C₂ alkyl;
R¹², R¹³, R¹⁵, R¹⁶, R¹⁷, and R¹⁸ are independently H
or C₁-C₂ alkyl; or R¹² and R¹³, R¹⁵ and R¹⁶ or
R¹⁷ and R¹⁸ can be taken together with the
nitrogen to which they are attached to form a
25 piperidino, pyrrolidino or morpholino ring;
- R¹⁹ is halogen, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₁-C₂
alkoxy or C₁-C₂ haloalkoxy;
- p is 0, 1 or 2;
- or their agriculturally suitable salts or metal
30 complexes thereof;
- provided that:
- i) when any of G¹, G², G³ or G⁴ are O, then they
are not directly bonded to O or S(O)_p;
- ii) when any of G¹, G², G³ or G⁴ are S(O) or
35 S(O)₂, then they are not bonded directly to C(=O);

iii) the total number of heteroatoms in the ring containing A does not exceed two;

iv) when X, Y and Z are CH; A is CH₂; Q is fused unsubstituted benzene; and R¹ and R² are H; then R³ is not unsubstituted phenyl; and

v) the compounds are other than 2-[4,6-bis(trichloromethyl)-1,3,5-triazin-2-yl]-1,10-phenanthroline or 2-(2-pyridinyl)-1,10-phenanthroline.

This invention further comprises methods of controlling fungus disease in plants comprising treating the locus to be protected with an effective amount of a compound of Formula IA



wherein:

X is N or CR⁴;

Y is N or CR⁵;

Z is N or CR⁶;

Q is a fused benzene, naphthalene, thiophene, furan, pyrrole, pyridine or pyrimidine ring each optionally substituted with R⁷ and R⁸; A is a bridge -G¹-G²-G³-G⁴-, wherein G¹, G², G³ or G⁴ are independently O, S(O)_p, NR⁹, CR¹⁰R¹¹, C(=O), a direct bond, or G¹-G², G²-G³ or G³-G⁴ may be taken together to form -CH=CH-; such that at least one of G¹, G², G³ and G⁴ is other than a direct bond;

R¹, R², R³ and R⁴ are independently H; halogen; cyano; hydroxy; C₁-C₆ alkyl; C₁-C₄ haloalkyl;

C₁-C₄ alkylthio; C₁-C₄ alkylsulfinyl; C₁-C₄ alkylsulfonyl; C₃-C₆ cycloalkyl optionally substituted with 1-2 methyl groups; C₁-C₄ alkoxy; C₁-C₄ haloalkoxy; C₂-C₄ alkoxyalkyl; C₂-C₄ alkenyl; C₂-C₄ haloalkenyl; C₂-C₄ alkenyloxy; C₂-C₄ alkynyl; C₂-C₄ alkynyloxy; NR¹²R¹³; phenyl or phenoxy optionally substituted with R¹⁴; or R¹ and R⁴, R² and R⁴ or R² and R⁵ can be taken together to form -(CH₂)₃-, -(CH₂)₄- or a fused phenyl ring; R⁵ and R⁶ are independently H, halogen, C₁-C₂ alkyl or C₁-C₂ alkoxy; R⁷ is halogen; cyano; nitro; hydroxy; hydroxycarbonyl; C₁-C₆ alkyl; C₁-C₄ haloalkyl; C₁-C₄ alkylthio; C₁-C₄ alkylsulfinyl; C₁-C₄ alkylsulfonyl; (C₁-C₄ alkyl)₃silyl; C₃-C₆ cycloalkyl; C₂-C₅ alkylcarbonyl; C₂-C₄ alkenyl; C₂-C₄ alkenyloxy; C₂-C₄ alkynyl; C₂-C₄ alkynyloxy; C₁-C₄ alkoxy; C₁-C₄ haloalkoxy; C₂-C₄ alkoxyalkyl; C₂-C₅ alkoxycarbonyl; C₂-C₄ alkoxyalkoxy; NR¹⁵R¹⁶; C(=O)NR¹⁷R¹⁸; or phenyl, phenoxy or phenylthio each optionally substituted with R¹⁹; R⁸ and R¹⁴ are independently 1-2 halogen, 1-2 C₁-C₃ alkyl, C₁-C₂ haloalkyl, C₁-C₂ alkoxy or C₁-C₂ haloalkoxy; R⁹, R¹⁰ and R¹¹ are independently H or C₁-C₂ alkyl; R¹², R¹³, R¹⁵, R¹⁶, R¹⁷, and R¹⁸ are independently H or C₁-C₂ alkyl; or R¹² and R¹³, R¹⁵ and R¹⁶ or R¹⁷ and R¹⁸ can be taken together with the nitrogen to which they are attached to form a piperidino, pyrrolidino or morpholino ring; R¹⁹ is halogen, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₁-C₂ alkoxy or C₁-C₂ haloalkoxy;

p is 0, 1 or 2;
or their agriculturally suitable salts or metal
complexes thereof;

provided that:

5 i) when any of G^1 , G^2 , G^3 or G^4 are O, then they
are not directly bonded to O or $S(O)_p$;

ii) when any of G^1 , G^2 , G^3 or G^4 are $S(O)$ or
 $S(O)_2$, then they are not bonded directly to $C(=O)$; and

10 iii) the total number of heteroatoms in the ring
containing A does not exceed two.

In the above recitations, the term "alkyl", used
either alone or in compound words such as "alkylthio"
or "haloalkyl" denotes straight chain or branched
alkyl; e.g., methyl, ethyl, n-propyl, i-propyl,
15 n-butyl, sec-butyl, t-butyl, n-pentyl or n-hexyl.

"Alkenyl" denotes straight chain or branched
alkenes; e.g., vinyl, 1-propenyl, 2-propenyl, 3-
propenyl and the different butenyl isomers.

20 "Alkenyloxy" denotes straight chain or branched
alkenyloxy moieties. Examples of alkenyloxy include
 $H_2C=CHCH_2O$, $(CH_3)CH=CHCH_2O$, $CH_2=CH(CH_3)CH_2O$ and
 $CH_2=CHCH_2CH_2O$.

"Alkynyl" includes straight chain or branched
alkynes; e.g., ethynyl, 1-propynyl, 3-propynyl and the
25 different butynyl isomers.

"Alkynyloxy" denotes straight or branched
alkynyloxy moieties. Examples include $HC\equiv CCH_2O$ and
 $CH_3C\equiv CCH_2O$.

30 "Alkylthio" includes methylthio, ethylthio, and
the different propylthio and butylthio isomers.

"Alkylsilyl" includes $(CH_3)_2(t-C_4H_9)Si$, $(CH_3)_3Si$
and $(CH_3CH_2)_3Si$.

35 Examples of "alkylsulfinyl" include $CH_3S(O)$,
 $CH_3CH_2S(O)$, $CH_3CH_2CH_2S(O)$, $(CH_3)_2CHS(O)$ and
 $CH_3CH_2CH_2CH_2S(O)$.

Examples of "alkylsulfonyl" include $\text{CH}_3\text{S}(\text{O})_2$, $\text{CH}_3\text{CH}_2\text{S}(\text{O})_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{S}(\text{O})_2$, $(\text{CH}_3)_2\text{CHS}(\text{O})_2$ and the different butylsulfonyl isomers.

"Alkoxy" includes methoxy, ethoxy, *n*-propyloxy, isopropyloxy and the different butoxy isomers.

"Cycloalkyl" includes cyclopropyl, cyclobutyl, cyclopentyl and cyclohexyl.

The term "halogen", either alone or in compound words such as "haloalkyl", includes fluorine, chlorine, bromine or iodine. Further, when used in compound words such as "haloalkyl" said alkyl may be partially or fully substituted with halogen atoms which may be the same or different. Examples of "haloalkyl" include CF_3 , CH_2Cl , CH_2CF_3 and CF_2CF_3 . Examples of "haloalkoxy" include CF_3O , $\text{Cl}_3\text{CCH}_2\text{O}$, $\text{CF}_2\text{HCH}_2\text{CH}_2\text{O}$ and $\text{CF}_3\text{CH}_2\text{O}$.

The total number of carbon atoms in a substituent group is indicated by the " $\text{C}_i\text{-C}_j$ " prefix where *i* and *j* are numbers from 1 to 6. For example, $\text{C}_1\text{-C}_3$ alkylsulfonyl designates methylsulfonyl through propylsulfonyl; C_2 alkoxyalkoxy designates $\text{CH}_3\text{OCH}_2\text{O}$; C_3 alkoxyalkoxy designates, for example, $\text{CH}_3\text{OCH}_2\text{CH}_2\text{O}$; and C_4 alkoxyalkoxy designates the various isomers of an alkoxy group substituted with a second alkoxy group containing a total of 4 carbon atoms, examples including $\text{CH}_3\text{CH}_2\text{CH}_2\text{OCH}_2\text{O}$, and $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2\text{O}$. Examples of "alkoxyalkyl" include CH_3OCH_2 , $\text{CH}_3\text{OCH}_2\text{CH}_2$ and $\text{CH}_3\text{CH}_2\text{OCH}_2$. C_2 alkylcarbonyl designates $\text{C}(=\text{O})\text{CH}_3$ and C_4 alkylcarbonyl designates $\text{C}(=\text{O})\text{CH}_2\text{CH}_2\text{CH}_3$ and $\text{C}(=\text{O})\text{CH}(\text{CH}_3)_2$. Examples of "alkoxycarbonyl" include CO_2CH_3 , $\text{CO}_2\text{CH}_2\text{CH}_3$, $\text{CO}_2\text{CH}_2\text{CH}_2\text{CH}_3$, $\text{CO}_2\text{CH}(\text{CH}_3)_2$ and the different butoxycarbonyl isomers.

The salts of the compounds of the invention includes acid addition salts with inorganic or organic acids such as hydrochloric, nitric, sulfuric, acetic, oxalic, or 4-toluenesulphonic acids. The salts of the

compounds of the invention also include those formed with organic or inorganic bases when the compound contains an acidic group such as a carboxylic acid, phenol, or mercapto group.

5 The metal complexes of the compounds of the invention include complexes with metal salts such as copper, zinc, manganese, and iron salts. These complexes can be prepared prior to formulating the compound or can be prepared by adding the appropriate
10 metal salt to the formulation.

Preferred compounds of Formula I for reasons of greatest fungicidal activity and/or ease of synthesis are:

1.. Compounds of Formula I wherein:

15 X is N or CR⁴;

Y is N or CR⁵;

Z is N or CR⁶;

Q is a fused benzene, naphthalene, thiophene, furan, pyrrole, pyridine or pyrimidine ring
20 each optionally substituted with R⁷ and R⁸;

A is a bridge selected from the group consisting of:

-CR¹⁰R¹¹-; -G-; -(CR¹⁰R¹¹-CR¹⁰R¹¹)-;
-(G-CR¹⁰R¹¹)-; -(CH=CH)-; -[O-C(=O)]-;
25 -[NR⁹-C(=O)]-; -(CR¹⁰R¹¹-CR¹⁰R¹¹-CR¹⁰R¹¹)-;
-(G-CR¹⁰R¹¹-CR¹⁰R¹¹)-; -(CR¹⁰R¹¹-G-CR¹⁰R¹¹)-;
-(CR¹⁰R¹¹-CH=CH)-; -(O-CR¹⁰R¹¹-O)-;
-[O-C(=O)-CR¹⁰R¹¹]-; -[CR¹⁰R¹¹-O-C(=O)]-;
-[NR⁹-C(=O)-CR¹⁰R¹¹]-;
30 -[CR¹⁰R¹¹-NR⁹-C(=O)]-; -[C(=O)-CH=CH]-;
-[O-C(=O)-O]-; -[NR⁹-C(=O)-NR⁹]-;
-(CR¹⁰R¹¹-CR¹⁰R¹¹-CR¹⁰R¹¹-CR¹⁰R¹¹)-;
-(G-CR¹⁰R¹¹-CR¹⁰R¹¹-CR¹⁰R¹¹)-;
-(CR¹⁰R¹¹-G-CR¹⁰R¹¹-CR¹⁰R¹¹)-;
35 -(CR¹⁰R¹¹-CR¹⁰R¹¹-CH=CH)-;

- (CR¹⁰R¹¹-CH=CH-CR¹⁰R¹¹)-; -(CH=CH-CH=CH)-;
-(O-CR¹⁰R¹¹-O-CR¹⁰R¹¹)-;
-(O-CR¹⁰R¹¹-CR¹⁰R¹¹-O)-;
-[O-C(=O)-CR¹⁰R¹¹-CR¹⁰R¹¹]-;
5 -[CR¹⁰R¹¹-O-C(=O)-CR¹⁰R¹¹]-;
-[CR¹⁰R¹¹-CR¹⁰R¹¹-O-C(=O)]-;
-[NR⁹-C(=O)-CR¹⁰R¹¹-CR¹⁰R¹¹]-;
-[CR¹⁰R¹¹-NR⁹-C(=O)-CR¹⁰R¹¹]-; and
-[CR¹⁰R¹¹-CR¹⁰R¹¹-NR⁹-C(=O)]-;

10 such that A taken together with the
attached atoms forms a 5-8 membered ring;
and the directionality of A may be that the
left side of A is bonded to the Q ring and
the right side is bonded to the pyridyl
15 (when Z=CR⁶) or pyrimidinyl (when Z=N)
ring, or that the left side of A is bonded
to the pyridyl or pyrimidinyl ring and the
right side is bonded to Q;

G is O; S(O)_p; NR⁹; or C(=O);

20 R¹, R², R³ and R⁴ are independently H; halogen;
cyano; hydroxy; C₁-C₆ alkyl; C₁-C₄
haloalkyl; C₁-C₄ alkylthio; C₁-C₄
alkylsulfinyl; C₁-C₄ alkylsulfonyl; C₃-C₆
cycloalkyl optionally substituted with 1-2
25 methyl groups; C₁-C₄ alkoxy; C₁-C₄
haloalkoxy; C₂-C₄ alkoxyalkyl; C₂-C₄
alkenyl; C₂-C₄ haloalkenyl; C₂-C₄
alkenyloxy; C₂-C₄ alkynyl; C₂-C₄
alkynyloxy; NR¹²R¹³; phenyl or phenoxy
30 optionally substituted with R¹⁴; or R¹ and
R⁴, R² and R⁴ or R² and R⁵ can be taken
together to form -(CH₂)₃-, -(CH₂)₄- or a
fused phenyl ring;

35 R⁵ and R⁶ are independently H, halogen, C₁-C₂
alkyl or C₁-C₂ alkoxy;

5 R^7 is halogen; cyano; nitro; hydroxy; hydroxy-carbonyl; C_1 - C_6 alkyl; C_1 - C_4 haloalkyl; C_1 - C_4 alkylthio; C_1 - C_4 alkylsulfinyl; C_1 - C_4 alkylsulfonyl; $(C_1$ - C_4 alkyl) $_3$ silyl; C_3 - C_6 cycloalkyl; C_2 - C_5 alkylcarbonyl; C_2 - C_4 alkenyl; C_2 - C_4 alkenyloxy; C_2 - C_4 alkynyl; C_2 - C_4 alkynyloxy; C_1 - C_4 alkoxy; C_1 - C_4 haloalkoxy; C_2 - C_4 alkoxyalkyl; C_2 - C_5 alkoxy carbonyl; C_2 - C_4 alkoxyalkoxy; $NR^{15}R^{16}$; $C(=O)NR^{17}R^{18}$; or phenyl, phenoxy or phenylthio each optionally substituted with R^{19} ;
10 R^8 and R^{14} are independently 1-2 halogen; 1-2 C_1 - C_3 alkyl, C_1 - C_2 haloalkyl, C_1 - C_2 alkoxy or C_1 - C_2 haloalkoxy;
15 R^9 , R^{10} and R^{11} are independently H or C_1 - C_2 alkyl;
 R^{12} , R^{13} , R^{15} , R^{16} , R^{17} , and R^{18} are independently H or C_1 - C_2 alkyl; or R^{12} and R^{13} , R^{15} and R^{16} or R^{17} and R^{18} can be taken
20 together with the nitrogen to which they are attached to form a piperidino, pyrrolidino or morpholino ring;
 R^{19} is halogen, C_1 - C_2 alkyl, C_1 - C_2 haloalkyl, C_1 - C_2 alkoxy or C_1 - C_2 haloalkoxy;
25 p is 0, 1 or 2;
or their agriculturally suitable salts or metal complexes thereof.

2. Compounds of Preferred 1 wherein:

30 X is CR^4 ;
 Y is N or CH;
 Z is N or CH; and
 A is a bridge selected from the group consisting of:
35 $-(CR^{10}R^{11}-CR^{10}R^{11})-$; $-(G-CR^{10}R^{11})-$;
 $-(CH=CH)-$; $-[O-C(=O)]-$; $-[NR^9-C(=O)]-$;

$-(\text{CR}^{10}\text{R}^{11}-\text{CR}^{10}\text{R}^{11}-\text{CR}^{10}\text{R}^{11})-$;
 $-(\text{G}-\text{CR}^{10}\text{R}^{11}-\text{CR}^{10}\text{R}^{11})-$; $-(\text{CR}^{10}\text{R}^{11}-\text{G}-\text{CR}^{10}\text{R}^{11})-$;
 $-(\text{CR}^{10}\text{R}^{11}-\text{CH}=\text{CH})-$; $-(\text{O}-\text{CR}^{10}\text{R}^{11}-\text{O})-$;
 $-[\text{O}-\text{C}(=\text{O})-\text{CR}^{10}\text{R}^{11}]-$; $-[\text{CR}^{10}\text{R}^{11}-\text{O}-\text{C}(=\text{O})]-$;
 $-[\text{NR}^9-\text{C}(=\text{O})-\text{CR}^{10}\text{R}^{11}]-$;
 $-[\text{CR}^{10}\text{R}^{11}-\text{NR}^9-\text{C}(=\text{O})]-$; $-[\text{C}(=\text{O})-\text{CH}=\text{CH}]-$;
 $-[\text{O}-\text{C}(=\text{O})-\text{O}]-$; and $-[\text{NR}^9-\text{C}(=\text{O})-\text{NR}^9]-$.

3. Compounds of Preferred 2 wherein:

Q is a fused benzene, thiophene, furan or pyridine ring each optionally substituted with R^7 and R^8 ;

A is selected from the group consisting of

$-(\text{CH}_2-\text{CH}_2)-$; $-[\text{CH}_2-\text{C}(=\text{O})]-$; $-(\text{CH}=\text{CH})-$;
 $-[\text{C}(=\text{O})-\text{O}]-$; $-[\text{C}(=\text{O})-\text{NR}^9]-$; $-(\text{CH}_2-\text{CH}_2-\text{CH}_2)-$;
 $-(\text{O}-\text{CH}_2-\text{O})-$; $-(\text{CH}_2-\text{CH}_2-\text{O})-$;
 $-[\text{CH}_2-\text{CH}_2-\text{S}(\text{O})_p]-$; $-(\text{CH}_2-\text{CH}_2-\text{NR}^9)-$;
 $-(\text{CH}_2-\text{O}-\text{CH}_2)-$; $-[\text{CH}_2-\text{S}(\text{O})_p-\text{CH}_2]-$;
 $-(\text{CH}_2-\text{NR}^9-\text{CH}_2)-$; $-[\text{O}-\text{C}(=\text{O})-\text{O}]-$;

R^1 , R^2 , R^3 and R^4 are independently H, halogen, C_1 - C_4 alkyl, C_1 - C_4 haloalkyl, cyclopropyl, C_1 - C_4 alkoxy or C_2 - C_3 alkynyl; and

R^7 is halogen, cyano, C_1 - C_4 alkyl, C_1 - C_4 haloalkyl, C_1 - C_4 alkoxy, C_1 - C_4 haloalkoxy or C_2 - C_4 alkoxyalkoxy.

4. Compounds of Preferred 3 wherein:

Q is a fused benzene ring optionally substituted with R^7 and R^8 ; and

A is selected from the group consisting of

$-(\text{CH}_2-\text{CH}_2)-$; $-(\text{CH}=\text{CH})-$; $-[\text{C}(=\text{O})-\text{O}]-$;
 $-[\text{C}(=\text{O})-\text{NR}^9]-$; $-(\text{CH}_2-\text{CH}_2-\text{CH}_2)-$; $-(\text{O}-\text{CH}_2-\text{O})-$;
 $-(\text{CH}_2-\text{CH}_2-\text{O})-$; $-[\text{CH}_2-\text{CH}_2-\text{S}(\text{O})_p]-$;
 $-(\text{CH}_2-\text{CH}_2-\text{NR}^9)-$; $-(\text{CH}_2-\text{O}-\text{CH}_2)-$;
 $-[\text{CH}_2-\text{S}(\text{O})_p-\text{CH}_2]-$ and $-(\text{CH}_2-\text{NR}^9-\text{CH}_2)-$.

Specifically Preferred for greatest fungicidal

activity and/or ease of synthesis is 6,7-dihydro-2-(4-

methyl-2-pyrimidinyl)-5H-benzo[6,7]cycloheptal[1,2-b]pyridine.

Preferred methods for reasons of greatest fungicidal activity and/or ease of synthesis are:

- 5 1. A method of controlling fungus disease in plants that comprises treating the locus to be protected with an effective amount of a compound of Formula IA wherein:

X is N or CR⁴;

10 Y is N or CR⁵;

Z is N or CR⁶;

Q is a fused benzene, naphthalene, thiophene, furan, pyrrole, pyridine or pyrimidine ring each optionally substituted with R⁷ and R⁸;

15

A is a bridge selected from the group

consisting of: -CR¹⁰R¹¹-; -G-;

-(CR¹⁰R¹¹-CR¹⁰R¹¹)-; -(G-CR¹⁰R¹¹)-;

-(CH=CH)-; -[O-C(=O)]-; -[NR⁹-C(=O)]-;

20

-(CR¹⁰R¹¹-CR¹⁰R¹¹-CR¹⁰R¹¹)-;

-(G-CR¹⁰R¹¹-CR¹⁰R¹¹)-;

-(CR¹⁰R¹¹-G-CR¹⁰R¹¹)-; -(CR¹⁰R¹¹-CH=CH)-;

-(O-CR¹⁰R¹¹-O)-; -[O-C(=O)-CR¹⁰R¹¹]-;

-[CR¹⁰R¹¹-O-C(=O)]-;

25

-[NR⁹-C(=O)-CR¹⁰R¹¹]-;

-[CR¹⁰R¹¹-NR⁹-C(=O)]-; -[C(=O)-CH=CH]-;

-[O-C(=O)-O]-; -[NR⁹-C(=O)-NR⁹]-;

-(CR¹⁰R¹¹-CR¹⁰R¹¹-CR¹⁰R¹¹-CR¹⁰R¹¹)-;

-(G-CR¹⁰R¹¹-CR¹⁰R¹¹-CR¹⁰R¹¹)-;

30

-(CR¹⁰R¹¹-G-CR¹⁰R¹¹-CR¹⁰R¹¹)-;

-(CR¹⁰R¹¹-CR¹⁰R¹¹-CH=CH)-;

-(CR¹⁰R¹¹-CH=CH-CR¹⁰R¹¹)-;

-(CH=CH-CH=CH)-; -(O-CR¹⁰R¹¹-O-CR¹⁰R¹¹)-;

-(O-CR¹⁰R¹¹-CR¹⁰R¹¹-O)-;

35

-[O-C(=O)-CR¹⁰R¹¹-CR¹⁰R¹¹]-;

- 5
10
15
20
25
30
35
- [CR¹⁰R¹¹-O-C(=O)-CR¹⁰R¹¹]-;
-[CR¹⁰R¹¹-CR¹⁰R¹¹-O-C(=O)]-;
-[NR⁹-C(=O)-CR¹⁰R¹¹-CR¹⁰R¹¹]-;
-[CR¹⁰R¹¹-NR⁹-C(=O)-CR¹⁰R¹¹]-; and
-[CR¹⁰R¹¹-CR¹⁰R¹¹-NR⁹-C(=O)]-; such that
A taken together with the attached atoms
forms a 5-8 membered ring; and the
directionality of A may be that the left
side of A is bonded to the Q ring and
the right side is bonded to the pyridyl
(when Z=CR⁶) or pyrimidinyl (when Z=N)
ring, or that the left side of A is
bonded to the pyridyl or pyrimidinyl
ring and the right side is bonded to Q;
G is O; S(O)_p; NR⁹; or C(=O);
R¹, R², R³ and R⁴ are independently H;
halogen; cyano; hydroxy; C₁-C₆ alkyl;
C₁-C₄ haloalkyl; C₁-C₄ alkylthio; C₁-C₄
alkylsulfinyl; C₁-C₄ alkylsulfonyl; C₃-C₆
cycloalkyl optionally substituted with
1-2 methyl groups; C₁-C₄ alkoxy; C₁-C₄
haloalkoxy; C₂-C₄ alkoxyalkyl; C₂-C₄
alkenyl; C₂-C₄ haloalkenyl; C₂-C₄
alkenyloxy; C₂-C₄ alkynyl; C₂-C₄
alkynyloxy; NR¹²R¹³; phenyl or phenoxy
optionally substituted with R¹⁴; or R¹
and R⁴, R² and R⁴ or R² and R⁵ can be
taken together to form -(CH₂)₃-, -(CH₂)₄-
or a fused phenyl ring;
R⁵ and R⁶ are independently H, halogen, C₁-C₂
alkyl or C₁-C₂ alkoxy;
R⁷ is halogen; cyano; nitro; hydroxy;
hydroxycarbonyl; C₁-C₆ alkyl; C₁-C₄
haloalkyl; C₁-C₄ alkylthio; C₁-C₄
alkylsulfinyl; C₁-C₄ alkylsulfonyl;

- (C₁-C₄ alkyl)₃silyl; C₃-C₆ cycloalkyl;
 C₂-C₅ alkylcarbonyl; C₂-C₄ alkenyl; C₂-C₄
 alkenyloxy; C₂-C₄ alkynyl; C₂-C₄
 alkynyloxy; C₁-C₄ alkoxy; C₁-C₄
 haloalkoxy; C₂-C₄ alkoxyalkyl; C₂-C₅
 alkoxy carbonyl; C₂-C₄ alkoxyalkoxy;
 NR¹⁵R¹⁶; C(=O)NR¹⁷R¹⁸; or phenyl, phenoxy
 or phenylthio each optionally
 substituted with R¹⁹;
- R⁸ and R¹⁴ are independently 1-2 halogen, 1-2
 C₁-C₃ alkyl, C₁-C₂ haloalkyl, C₁-C₂
 alkoxy or C₁-C₂ haloalkoxy;
 R⁹, R¹⁰ and R¹¹ are independently H or C₁-C₂
 alkyl;
- R¹², R¹³, R¹⁵, R¹⁶, R¹⁷, and R¹⁸ are
 independently H or C₁-C₂ alkyl; or R¹²
 and R¹³, R¹⁵ and R¹⁶ or R¹⁷ and R¹⁸ can be
 taken together with the nitrogen to
 which they are attached to form a
 piperidino, pyrrolidino or morpholino
 ring;
- R¹⁹ is halogen, C₁-C₂ alkyl, C₁-C₂ haloalkyl,
 C₁-C₂ alkoxy or C₁-C₂ haloalkoxy;
 p is 0, 1 or 2;
- or their agriculturally suitable salts or metal
 complexes thereof.
2. A method according to Preferred 1 wherein:
 X is CR⁴;
 Y is N or CH;
 Z is N or CH; and
 A is a bridge selected from the group
 consisting of: -(CR¹⁰R¹¹-CR¹⁰R¹¹)-;
 -(G-CR¹⁰R¹¹)-; -(CH=CH)-; -[O-C(=O)]-;
 -[NR⁹-C(=O)]-;
 -(CR¹⁰R¹¹-CR¹⁰R¹¹-CR¹⁰R¹¹)-;

$-(G-CR^{10}R^{11}-CR^{10}R^{11})-$;
 $-(CR^{10}R^{11}-G-CR^{10}R^{11})-$; $-(CR^{10}R^{11}-CH=CH)-$;
 $-(O-CR^{10}R^{11}-O)-$; $-[O-C(=O)-CR^{10}R^{11}]-$;
 $-[CR^{10}R^{11}-O-C(=O)]-$;
 $-[NR^9-C(=O)-CR^{10}R^{11}]-$;
 $-[CR^{10}R^{11}-NR^9-C(=O)]-$; $-[C(=O)-CH=CH]-$;
 $-[O-C(=O)-O]-$; and $-[NR^9-C(=O)-NR^9]-$.

3. A method according to Preferred 2 wherein:
 Q is a fused benzene, thiophene, furan or
 pyridine ring each optionally
 substituted with R^7 and R^8 ;

A is selected from the group consisting of:

$-(CH_2-CH_2)-$; $-[CH_2-C(=O)]-$; $-(CH=CH)-$;
 $-[C(=O)-O]-$; $-[C(=O)-NR^9]-$;
 $-(CH_2-CH_2-CH_2)-$; $-(O-CH_2-O)-$;
 $-(CH_2-CH_2-O)-$; $-[CH_2-CH_2-S(O)_p]-$;
 $-(CH_2-CH_2-NR^9)-$; $-(CH_2-O-CH_2)-$;
 $-[CH_2-S(O)_p-CH_2]-$; $-(CH_2-NR^9-CH_2)-$;
 $-[O-C(=O)-O]-$;

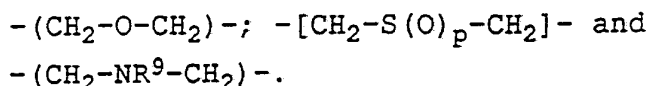
R^1 , R^2 , R^3 and R^4 are independently H,
 halogen, C_1-C_4 alkyl, C_1-C_4 haloalkyl,
 cyclopropyl, C_1-C_4 alkoxy or C_2-C_3
 alkynyl; and

R^7 is halogen, cyano, C_1-C_4 alkyl, C_1-C_4
 haloalkyl, C_1-C_4 alkoxy, C_1-C_4 haloalkoxy
 or C_2-C_4 alkoxyalkoxy.

4. A method according to Preferred 3 wherein:
 Q is a fused benzene ring optionally
 substituted with R^7 and R^8 ; and

A is selected from the group consisting of

$-(CH_2-CH_2)-$; $-(CH=CH)-$; $-[C(=O)-O]-$;
 $-[C(=O)-NR^9]-$; $-(CH_2-CH_2-CH_2)-$;
 $-(O-CH_2-O)-$; $-(CH_2-CH_2-O)-$;
 $-[CH_2-CH_2-S(O)_p]-$; $-(CH_2-CH_2-NR^9)-$;



Specifically Preferred for greatest fungicidal activity and/or ease of synthesis is a method according to Preferred 4 wherein the compound is 6,7-dihydro-2-(4-methyl-2-pyrimidinyl)-5H-benzo[6,7]cyclohepta[1,2-b]pyridine.

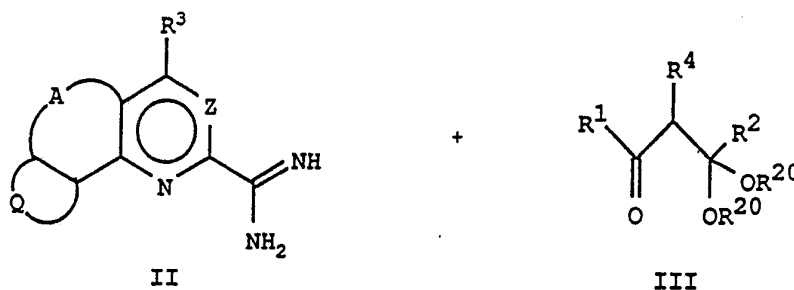
DETAILS OF THE INVENTION

One or more of the following methods, or variations obvious to one skilled in the art, can be used to prepare the compounds of the invention. The substituents in the following methods are as previously defined unless noted otherwise. One skilled in the art will recognize that these methods may require the use of protecting groups or subsequent functional group interconversions to avoid undesired side reactions with substituents which may be sensitive to the reaction conditions. One skilled in the art will also recognize that compounds of Formula I and the intermediates described below can be subjected to various electrophilic, nucleophilic, radical, organometallic, oxidation, and reduction reactions to add substituents or modify existing substituents.

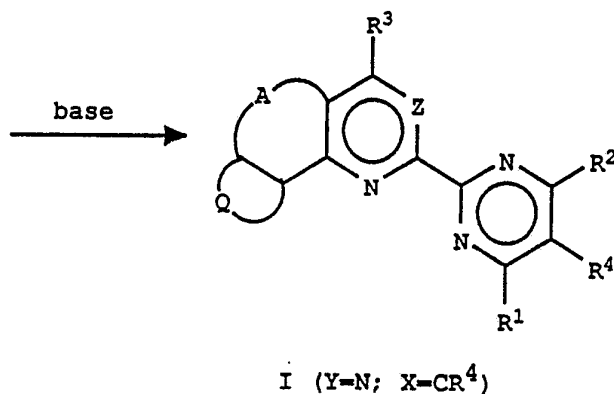
Compounds of Formula I, when Y is N and X is CR⁴, can be prepared by the reaction of amidines of Formula II with Formula III compounds in the presence of a suitable base as illustrated in Scheme 1. Typical reactions involve the combination of an amidine II or its conjugate acid salt (such as a hydrochloride) with 1 to 1.5 equivalents of a Formula III compound in an inert solvent in the presence of a catalytic amount to 2.5 equivalents of base. Typical bases include alkali metal alkoxides (such as sodium methoxide and sodium ethoxide) and organic amine bases (such as triethylamine and diethylaniline). Typical solvents

include alcohols (such as methanol and ethanol), cyclic ethers (such as tetrahydrofuran and dioxane), pyridine, and dimethylformamide. The reaction temperature typically ranges from 50°C to the reflux temperature of the particular solvent being used and the reaction is usually complete in 1 to 6 h. This method is not applicable when R¹ or R² are substituents which are attached through a heteroatom such as alkoxy and halogen. Compounds of Formula III are known in the art or can be prepared by related methods.

Scheme 1



wherein R²⁰ is C₁-C₄ alkyl;

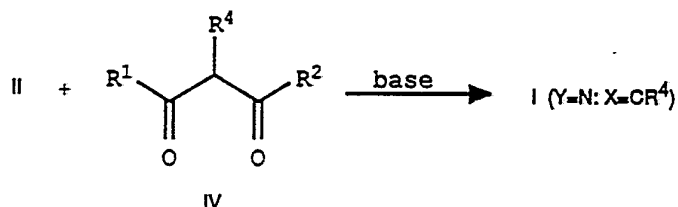


Alternatively, compounds of Formula I, when Y is N and X is CR⁴, can be prepared by the reaction of amidines of Formula II with Formula IV compounds in the presence of an optional base as illustrated in Scheme

2. Typical reactions involve the combination of an

amidine II or its conjugate acid salt (such as a hydrochloride) with 1 to 1.5 equivalents of a Formula IV compound in an inert solvent in the presence of 0 to 2.5 equivalents of base. Typical bases include alkali metal alkoxides (such as methoxide and sodium ethoxide) and organic amine bases (such as triethylamine and diethylaniline). Typical solvents include alcohols (such as methanol and ethanol), cyclic ethers (such as tetrahydrofuran), pyridine, and dimethylformamide. The reaction temperature typically ranges from 50°C to the reflux temperature of the particular solvent being used and the reaction is usually complete in 24 h. This method is not applicable when R¹ and R² are substituents which are attached through a heteroatom such as alkoxy and halogen. Compounds of Formula IV are known in the art or can be prepared by related methods (Hauser et al., Organic Reactions, 1954, 8, 59-196).

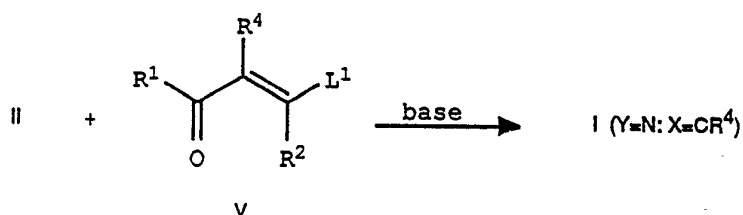
Scheme 2



Alternatively, compounds of Formula I, when Y is N and X is CR⁴, can be prepared by the reaction of amidines of Formula II with Formula V compounds where L¹ is hydrogen or a suitable leaving group such as halogen, alkoxy, alkylthio, dialkylamino, (halo)alkylsulfonyloxy, or arylsulfonyloxy in the presence of an optional base as illustrated in Scheme 3. Typical reactions involve the combination of an amidine of Formula II or its conjugate acid salt (such as a hydrochloride) with 1 to 2.5 equivalents of a Formula V

compound in an inert solvent in the presence of 0 to 2.5 equivalents of base. When L^1 is hydrogen, at least 2 equivalents of the Formula V compound are used since this reagent also serves as an oxidant for the dihydropyrimidine intermediate. Typical bases include alkali metal alkoxides (such as sodium methoxide and sodium ethoxide) and organic amine bases (such as triethylamine and diethylaniline). Typical solvents include alcohols (such as methanol and ethanol), cyclic ethers (such as tetrahydrofuran and dioxane), pyridine, and dimethylformamide. The reaction temperature typically ranges from 50°C to the reflux temperature of the particular solvent being used and the reaction is usually complete in 24 h. This method is not applicable when R^1 is a substituent which is attached through a heteroatom such as alkoxy and halogen. This method also is not applicable when R^2 is a better leaving group than L^1 since the latter would be retained in the product. Compounds of Formula V are well known in the art or can be prepared by related methods (Abdulla et al., Tetrahedron, 1979, 35, 1675-1735; Tominaga et al., Heterocycles, 1989, 29, 1409-1429; and "The Chemistry of Enones", Patai and Rappoport, Eds., Wiley, 1989).

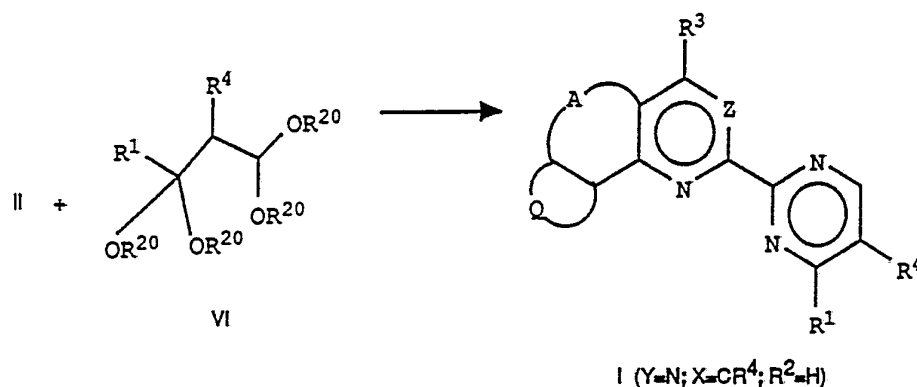
Scheme 3



Alternatively, compounds of Formula I, when Y is N, X is CR^4 , and R^2 is H, can be prepared by the reaction of amidines of Formula II with Formula VI

compounds as illustrated in Scheme 4. Typical reactions involve the combination of an amidine of Formula II or its conjugate acid salt (such as a hydrochloride) with 1 to 3 equivalents of a Formula VI compound in the absence of solvent and heating at 50 to 150°C for 1 to 6 h. This method is not applicable when R¹ is a substituent which is attached through a heteroatom such as alkoxy and halogen.

Scheme 4



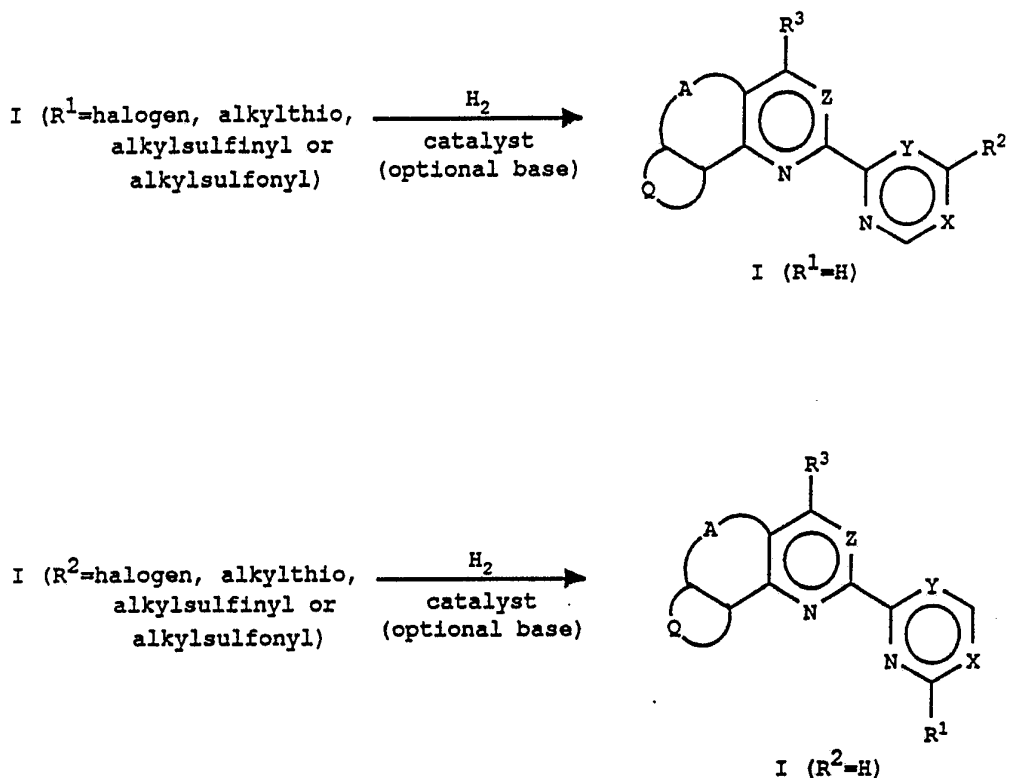
wherein R²⁰ is C₁-C₄ alkyl.

Compounds of Formula I, where R¹ or R² is hydrogen, can be prepared by reductive removal of a halogen, alkylthio, alkylsulfinyl, or alkylsulfonyl group as outlined in Scheme 5. For reductive removal of halogen, the reaction is conducted using a catalyst such as palladium on carbon under hydrogen gas in an inert solvent such as water, an alcohol (such as methanol or ethanol), ethyl acetate, or toluene at 25° to 50°C. The dehalogenation can be conducted in the presence of an equivalent of a base (such as ammonia, sodium hydroxide, sodium carbonate, or sodium acetate) to neutralize the liberated hydrogen halide.

For reductive removal of alkylthio, alkylsulfinyl, or alkylsulfonyl, the reaction is typically conducted

as above using Raney nickel as the catalyst in the absence of base and optionally under hydrogen gas.

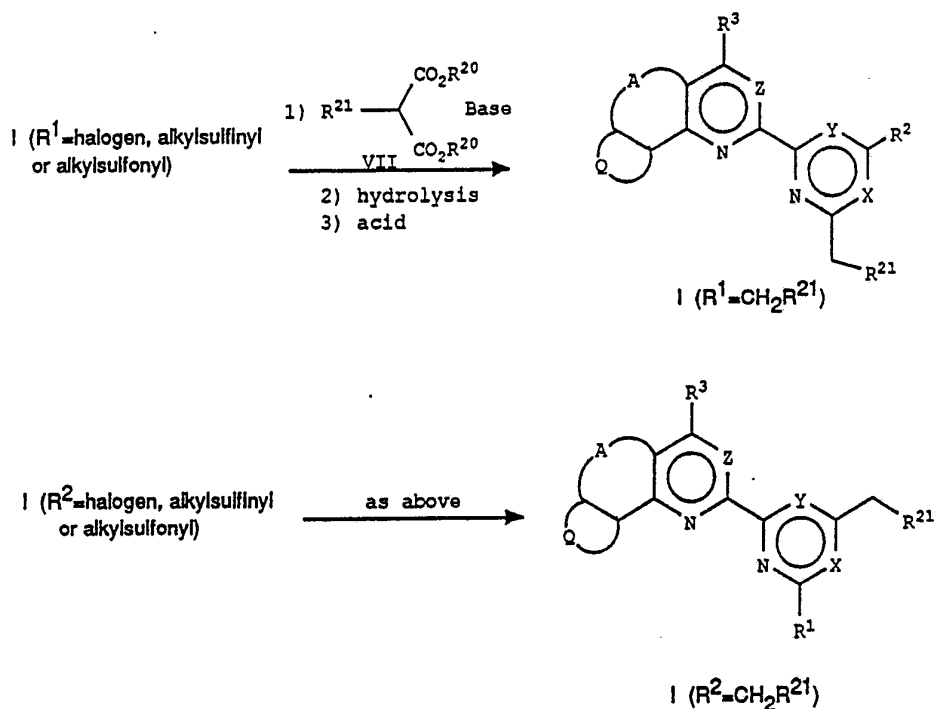
Scheme 5



Compounds of Formula I, when R^1 or R^2 are alkyl or haloalkyl, can be prepared by the reaction of compounds of Formula I, where R^1 or R^2 are leaving groups such as halogen, alkylsulfinyl, or alkylsulfonyl, with dialkyl malonates of Formula VII in the presence of base followed by hydrolysis and decarboxylation as outlined in Scheme 6. The first reaction is carried out by combining a compound of Formula I, where R^1 or R^2 are leaving groups, with 1 to 2 equivalents of a Formula VII compound in the presence of 1 to 4 equivalents of a suitable base in an inert solvent. Typical bases include alkali metal hydrides (such as sodium hydride and potassium hydride), alkyllithiums (such as butyllithium), alkali metal amides (such as lithium

diisopropylamide), and alkali metal hydroxides (such as sodium hydroxide). Typical solvents include nitriles (such as acetonitrile), ethers (such as diethyl ether and tetrahydrofuran), halohydrocarbons (such as chloroform), aromatic hydrocarbons (such as benzene and toluene), ketones (such as acetone), and dimethyl sulfoxide. The reaction temperature typically ranges from 0°C to the reflux temperature of the particular solvent being used and the reaction is usually complete in 0.5 to 24 h. The hydrolysis reaction is typically carried out in water with an optional organic cosolvent (such as methanol, ethanol, tetrahydrofuran, or dioxane) in the presence of 2 to 4 equivalents of a base, typically an alkali metal hydroxide (such as sodium hydroxide) or an alkali metal carbonate (such as sodium carbonate). The reaction temperature typically ranges from 0°C to the reflux temperature of the solvent mixture being used and the hydrolysis is usually complete after 0.2 to 24 h. The hydrolysis product (malonic acid intermediate) need not be isolated, so the decarboxylation is typically performed by adding 2.5 to 6 equivalents of acid (such as sulfuric acid, hydrochloric acid, or acetic acids) directly to the hydrolysis reaction mixture. The acidified mixture then is heated between ambient temperature and the reflux temperature of the mixture for 0.2 to 24 h to effect the decarboxylation to give a compound of Formula I where R¹ or R² are alkyl or haloalkyl. Compounds of Formula VII are well known in the art or can be prepared by related methods.

Scheme 6



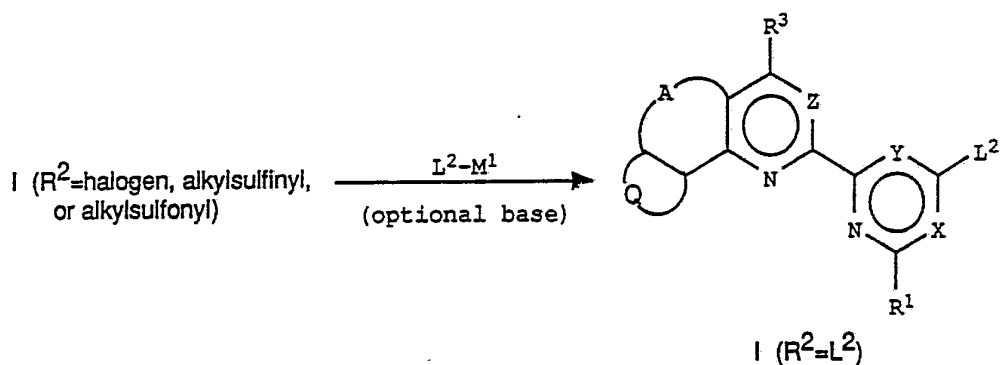
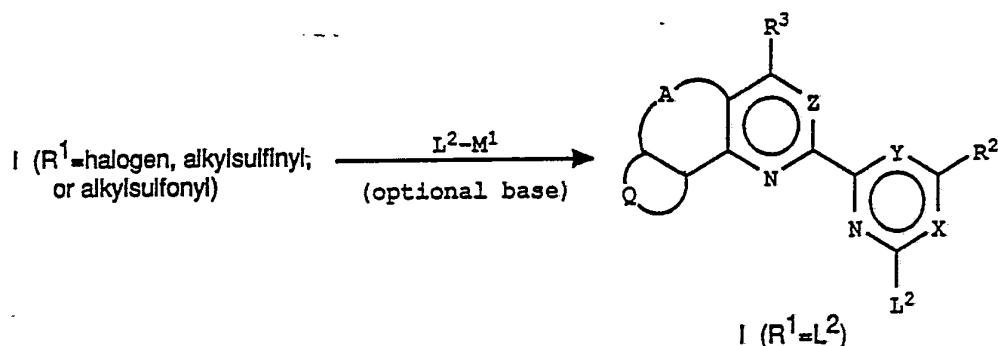
wherein

R^{20} is C_1 - C_4 alkyl; and

R^{21} is C_1 - C_5 alkyl or C_1 - C_3 haloalkyl.

Compounds of Formula I, when R^1 or R^2 are cyano, hydroxy, alkylthio, alkoxy, haloalkoxy, alkenyloxy, alkynyloxy, (di)alkylamino, or substituted phenoxy, can be prepared by the reaction of compounds of Formula I, where R^1 or R^2 are leaving groups such as halogen, alkylsulfinyl, or alkylsulfonyl, with a nucleophile L^2 - M^1 in the presence of an optional base as outlined in Scheme 7. Typical reactions involve the combination of a compound of Formula I, where R^1 or R^2 are a leaving group, with 1 to 2 equivalents of a L^2 - M^1 compound in an inert solvent. When M^1 is hydrogen, 1 to 2.2 equivalents of base are added to the reaction. Typical bases include alkali metal hydrides (such as sodium hydride), alkali metals (such as sodium), and

alkyllithiums (such as butyllithium). Typical solvents include alcohols (such as methanol and ethanol), ethers (such as diethyl ether, tetrahydrofuran, and dioxane), nitriles (such as acetonitrile), dimethylformamide, and dimethyl sulfoxide. Potentially nucleophilic solvents, such as alcohols, should be used only when they will not compete with the nucleophile L^2-M^1 . The reaction temperature typically ranges from 0°C to the reflux temperature of the particular solvent used, and the reaction is usually complete within 2 days. L^2-M^1 represent common reagents such as sodium alkoxides, alcohols, phenols, sodium cyanide, sodium hydroxide, (di)alkylamines, and the like. Catalysts (such as copper, copper(I) chloride, copper(II) chloride, and copper(II) oxide) may be added to facilitate the reaction.

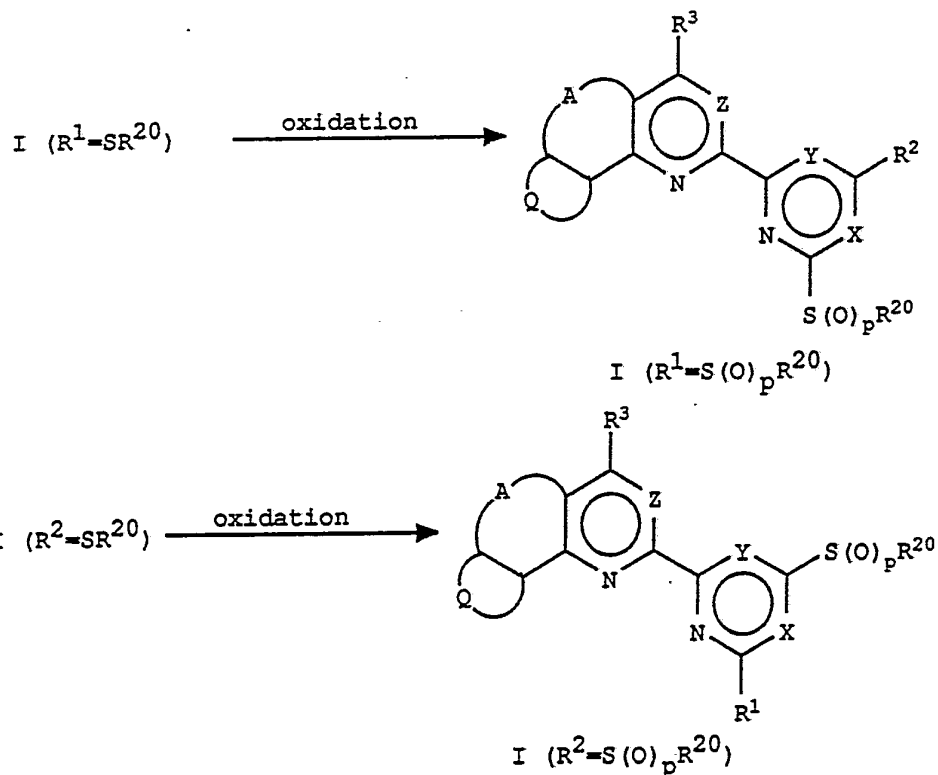
Scheme 7

wherein

L^2 is cyano, hydroxy, C_1 - C_4 alkylthio, C_1 - C_4 alkoxy, C_1 - C_4 haloalkoxy, C_2 - C_4 alkenyloxy, C_2 - C_4 alkynyloxy, $NR^{12}R^{13}$, or phenoxy substituted with R^{14} ; and M^1 is H or alkali metal.

Compounds of Formula I, when R^1 or R^2 are alkylsulfinyl or alkylsulfonyl, can be prepared by the oxidation of compounds of Formula I, where R^1 or R^2 are alkylthio, as outlined in Scheme 8. Typical reactions involve the combination of a compound of Formula I (R^1 or R^2 is alkylthio) with a suitable oxidant in an inert solvent. When R^1 or R^2 are alkylsulfinyl in the desired product I, 1 to 1.1 equivalents of oxidant are used, and when R^1 or R^2 are alkylsulfonyl in the product I, 2 to 2.2 equivalents of oxidant are used. Typical oxidants are 3-chloroperoxybenzoic acid, magnesium monoperoxyphthalate, peracetic acid, hydrogen peroxide, and the like. Typical solvents include halohydrocarbons (such as dichloromethane, 1,2-dichloroethane, and chloroform) and aromatic hydrocarbons (such as toluene). The reaction temperature typically ranges from 0°C to the reflux temperature of the particular solvent being used and the reaction is usually complete within 24 h.

Scheme 8

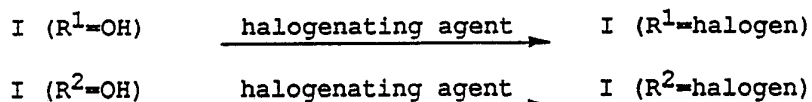


wherein R^{20} is $\text{C}_1\text{-C}_4$ alkyl.

Compounds of Formula I, when R^1 or R^2 are halogen, can be prepared by the reaction of compounds of Formula I, where R^1 or R^2 are hydroxy, with a halogenating agent such as phosphorus trichloride, phosphorus pentachloride, phosphorus tribromide, phosphorus pentabromide, phosphorus oxychloride, phosphorus oxybromide, thionyl chloride, phosgene, and the like as illustrated in Scheme 9. Typical reactions involve the combination of compounds of Formula I, when R^1 or R^2 is hydroxy, with an excess of the halogenating agent ranging from 1.1 to 10 equivalents, with 2 to 4 equivalents being preferred. The reaction can be conducted in the absence of solvent or in the presence of a suitable inert solvent including aromatic

hydrocarbons (such as benzene and toluene),
halohydrocarbons (such as dichloromethane and
chloroform), and hydrocarbons (such as hexane). The
reaction temperature can range from -10°C to 200°C with
5 25°C to 100°C being preferred. The reaction is
generally complete after 1 to 24 h.

Scheme 9

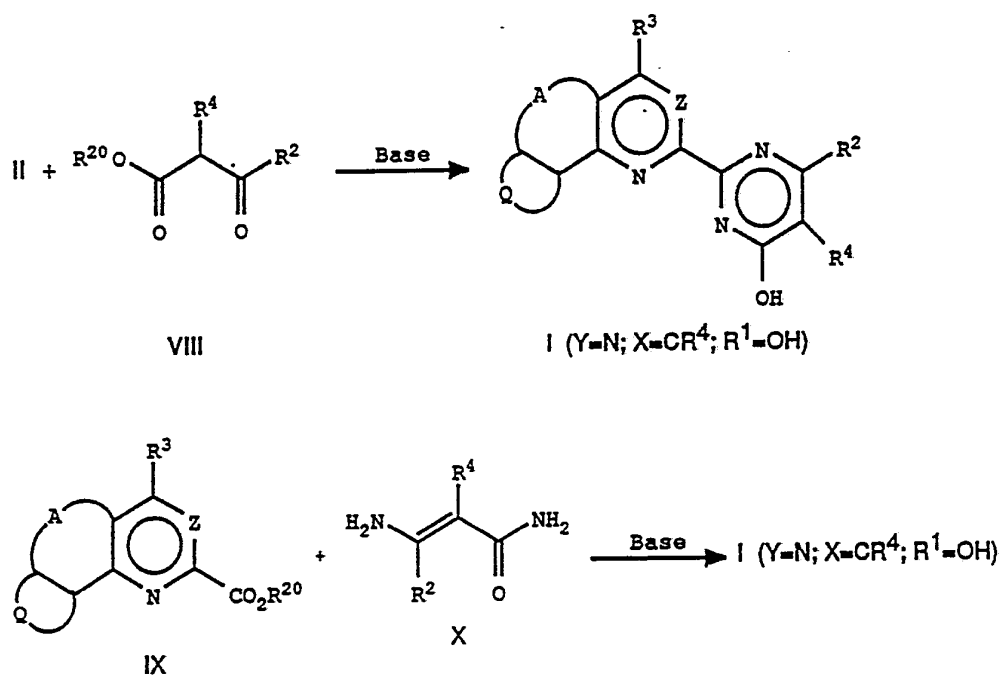


Compounds of Formula I, when Y is N, X is CR⁴, and
R¹ is hydroxy, can be prepared by the reaction of
amidines of Formula II with β-ketoesters of Formula
10 VIII in the presence of base as illustrated in Scheme
10. Typical reactions involve the combination of an
amidine II or its conjugate acid salt (such as a
hydrochloride) with 1 to 1.5 equivalents of a Formula
VIII compound in the presence of a catalytic amount to
15 1.5 equivalents of base in an inert solvent. Typical
bases include alkali metal hydroxides (such as sodium
hydroxide), alkali metal carbonates (such as potassium
carbonate), amines (such as triethylamine and
diethylaniline), and alkali metal alkoxides (such as
20 sodium methoxide and sodium ethoxide). Typical
solvents include alcohols (such as methanol and
ethanol), cyclic ethers (such as tetrahydrofuran and
dioxane), pyridine, dimethylformamide, and water. The
reaction temperature typically ranges from ambient
25 temperature to the reflux temperature of the particular
solvent being used and the reaction is usually complete
in 1 to 24 h. An example of this method is taught by
Lafferty et al. (J. Org. Chem. 1967, 32, 1591-1596).
When R² is attached through a heteroatom (such as

alkoxy), then the product usually loses R^2 giving product I wherein R^2 is hydroxy; an example of this reaction using a dialkylmalonate VIII (R^2 is alkoxy) giving a dihydroxypyrimidine also may be found in the
 5 above reference by Lafferty et al. Also illustrated in Scheme 10 is the preparation of a compound of Formula I, when Y is N, X is CR^4 , and R^1 is hydroxy, by the reaction of an ester of Formula IX with a Formula X
 10 compound as taught by Brown et al. (Aust. J. Chem. 1982, 35, 1203-1207).

Alternatively, the method of Kato et al. (Chem. Pharm. Bull. 1976, 24, 356-359) can be used on an imidate of Formula XII (see Scheme 11 for structure) to prepare these same compounds.

Scheme 10



wherein R^{20} is C_1 - C_4 alkyl.

15 Intermediates of Formulae XII, II, and IX can be prepared from compounds of Formula XI as outlined in Scheme 11. Imidates of Formula XII can be prepared by

the combination of a carbonitrile of Formula XI with 0.1 to 1 equivalent of an alkali metal alkoxide (preferably sodium methoxide or sodium ethoxide) in an alcoholic solvent (preferably methanol or ethanol).

- 5 The reaction temperature can range from 0°C to 50°C (preferably ambient temperature) and the reaction is usually complete after 1 to 48 h. The reaction is typically worked up by neutralizing with an acid (such as acetic acid), concentrating the reaction mixture, 10 dissolving in an appropriate solvent (such as ether), filtering off the salt by-product (e.g., sodium acetate), and concentrating the filtrate to give the imidate XII which is usually used without purification.

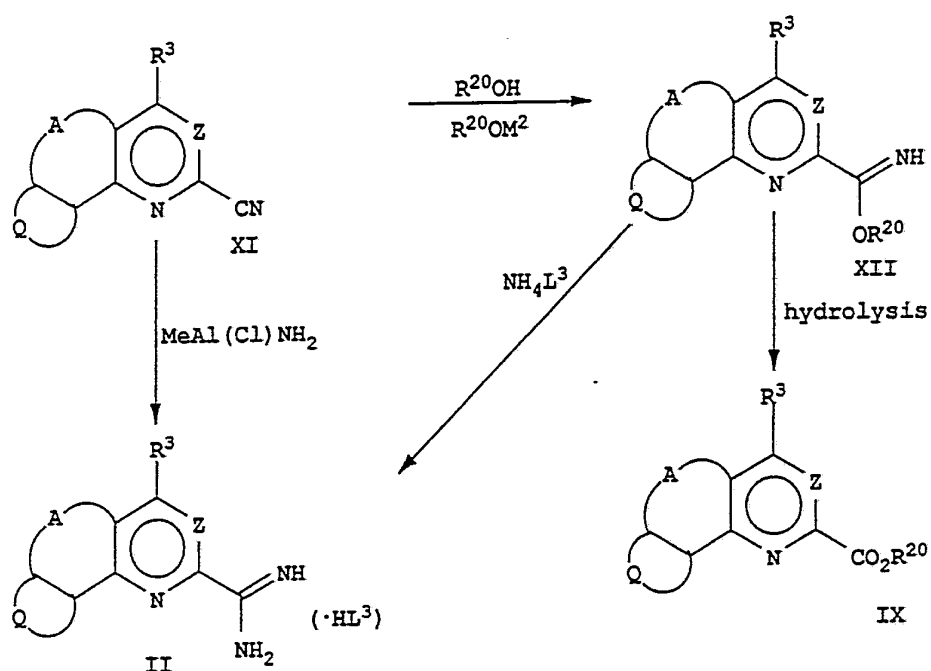
- The intermediate amidines of Formula II can be 15 prepared by the reaction of an imidate of Formula XII with 1.0 to 1.1 equivalents of an ammonium salt (such as ammonium chloride, ammonium bromide, ammonium acetate, and ammonium formate) in an alcohol (preferably methanol or ethanol) or an alcohol-water 20 mixture.

- The reaction temperature can range from ambient temperature to the reflux temperature of the particular solvent being used and the reaction is usually complete after 30 min to 5 h. The reaction mixture is 25 concentrated to give the amidine salt (HL³) which is purified by recrystallization or trituration. The amidine salts can be used in the previously described reactions or can be first converted to their conjugate bases.

- 30 Alternatively, amidines of Formula II can be prepared directly from carbonitriles XI by the reagent MeAl(Cl)NH₂ as described by Garigipati (Tetrahedron Lett., 1990, 31, 1969-1972).

- The esters of Formula IX can be prepared from 35 imidates of Formula XII by aqueous hydrolysis with an

optional organic cosolvent. Typical reactions involve the combination of an imideate XII with an excess of acid (such as sulfuric acid or hydrochloric acid) in an optional organic cosolvent (such as methanol, ethanol, tetrahydrofuran, and dioxane). The reaction temperature can range from 0°C to the reflux temperature of the particular solvent being used (preferably 0°C to ambient temperature) and the reaction is usually complete within 6 h.

Scheme 11

wherein

R^{20} is $\text{C}_1\text{-C}_4$ alkyl,

M^2 is an alkali metal, and

L^3 is a counterion such as Cl , Br , OAc , or OCHO .

10 Intermediates of Formula XI can be prepared from *N*-oxides of Formula XIV by the method of Fife (*J. Org. Chem.*, 1983, **48**, 1375-1377; review: *Heterocycles* 1984, **22**, 2375-2394) as illustrated in Scheme 12. There are several other modifications of the Reissert-Henze

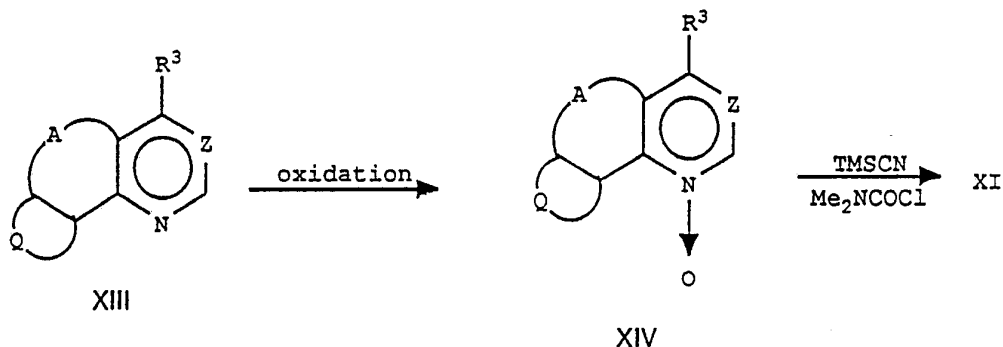
reaction which are useful on pyridine and pyrimidine *N*-oxides as discussed by Sakamoto et al. (Chem. Pharm. Bull. 1985, 33, 565-571) and Yamanaka et al.

(Heterocycles 1990, 31, 923-967), so no further

5 detailed discussion of these methods will be presented.

The *N*-oxide intermediates of Formula XIV can be prepared by oxidation of compounds of Formula XIII with 1 to 1.2 equivalents of a suitable oxidizing reagent such as 3-chloroperoxybenzoic acid, magnesium
10 monoperoxyphthalate, peracetic acid, hydrogen peroxide, and the like. Typical solvents include halohydrocarbons (such as dichloromethane, 1,2-dichloroethane, and chloroform) and aromatic hydrocarbons (such as benzene and toluene). The
15 reaction temperature can range from 0°C to the reflux temperature of the particular solvent being used and the reaction is usually complete in 24 h. When Z is N, a mixture of *N*-oxides may be formed; both of these regioisomeric *N*-oxides can be used for the subsequent
20 Fife cyanation to intermediates XI.

Scheme 12



Numerous compounds of Formula XIII are known in the art or can be prepared by related methods. Alternatively, these compounds of Formula XIII, when Z is CR⁶, can be prepared using one of several pyridine

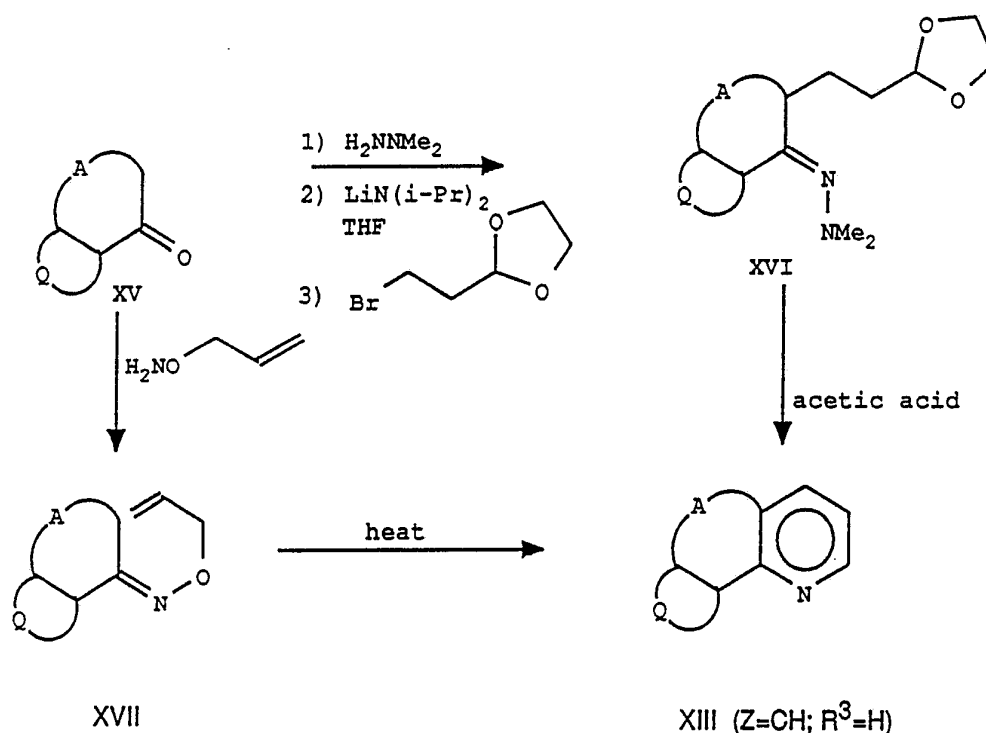
annulation procedures known in the art. Two such procedures are outlined in Scheme 13.

The method of Chelucci et al. (J. Heterocyclic Chem. 1988, 25, 1761-1765) involves the alkylation of a
5 *N,N*-dimethylhydrazone anion with 2-(2-bromoethyl)-1,3-dioxolane to give intermediate XVI which cyclizes in refluxing acetic acid to the annulated pyridine XIII (Z is CH; R³ is H). An effective, safer modification of Chelucci's method substitutes 1,3-dimethyl-3,4,5,6-
10 tetrahydro-2(1*H*)-pyrimidinone (DMPU) for the toxic, cancer suspect agent hexamethylphosphoramide (HMPA) as cosolvent in the alkylation reaction.

The method of Kusumi et al. (Synthesis 1979, 221-223), and Koyama et al. (Chem. Pharm. Bull. 1983, 31, 2601-2606) proceeds through *O*-allyloximes XVII which, upon pyrolysis at 180°C to 200°C, cyclize to the annulated pyridine XIII (Z is CH; R³ is H).
Alternative pyridoannulation methods are discussed in publications by Bell et al. (J. Am. Chem. Soc. 1991, 20 113, 6283-6284), Thummel (Tetrahedron 1991, 34, 6851-6886), Westerwelle et al. (Chem. Ber. 1991, 124, 571-576), Potts et al. (J. Org. Chem. 1982, 3027-3038), Ciufolini et al. (J. Am. Chem. Soc. 1991, 113, 8016-8024 and J. Chem. Soc., Chem. Commun. 1988, 1230-1231),
25 and Kröhnke (Synth. 1976, 1-24).

The starting ketones of Formula XV are known in the art or can be obtained by methods analogous to known procedures. Formula XV compounds includes indanones, tetralones, benzosuberones, chromanones and
30 homologs, thiochromanones and homologs, isochromanones, benzofuran-3-ones, and others.

Scheme 13

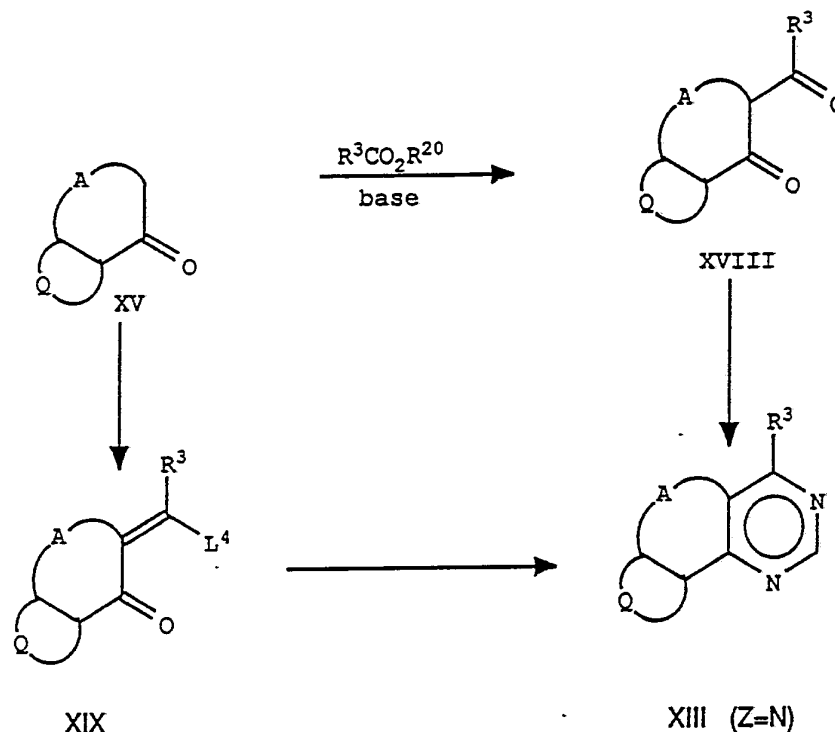


Intermediates of Formula XIII, when Z is N, can be prepared from ketones of Formula XV as outlined in Scheme 14. Formula XV compounds can be converted to acylated derivatives XVIII using methods well known in the art (Hauser et al., Organic Reactions 1954, 8, 59-196). These, in turn, can be converted to the pyrimidines XIII by reaction with formamide as taught by Brederick et al. (Chem. Ber. 1957, 90, 942-952), formamidine, or thiourea followed by Raney nickel desulfurization as taught by Foster et al. (Org. Syn. Coll. Vol. 1963, 4, 638-640).

Alternatively, ketones of Formula XV can be converted to compounds of Formula XIX, where L^4 is a leaving group, by methods known in the art. Intermediates of Formula XIX can be converted into the intermediate pyrimidines XIII ($\text{Z}=\text{N}$) by reaction with

thiourea followed by Raney nickel desulfurization or with formamidine.

Scheme 14



wherein

R^{20} is $\text{C}_1\text{-C}_4$ alkyl; and

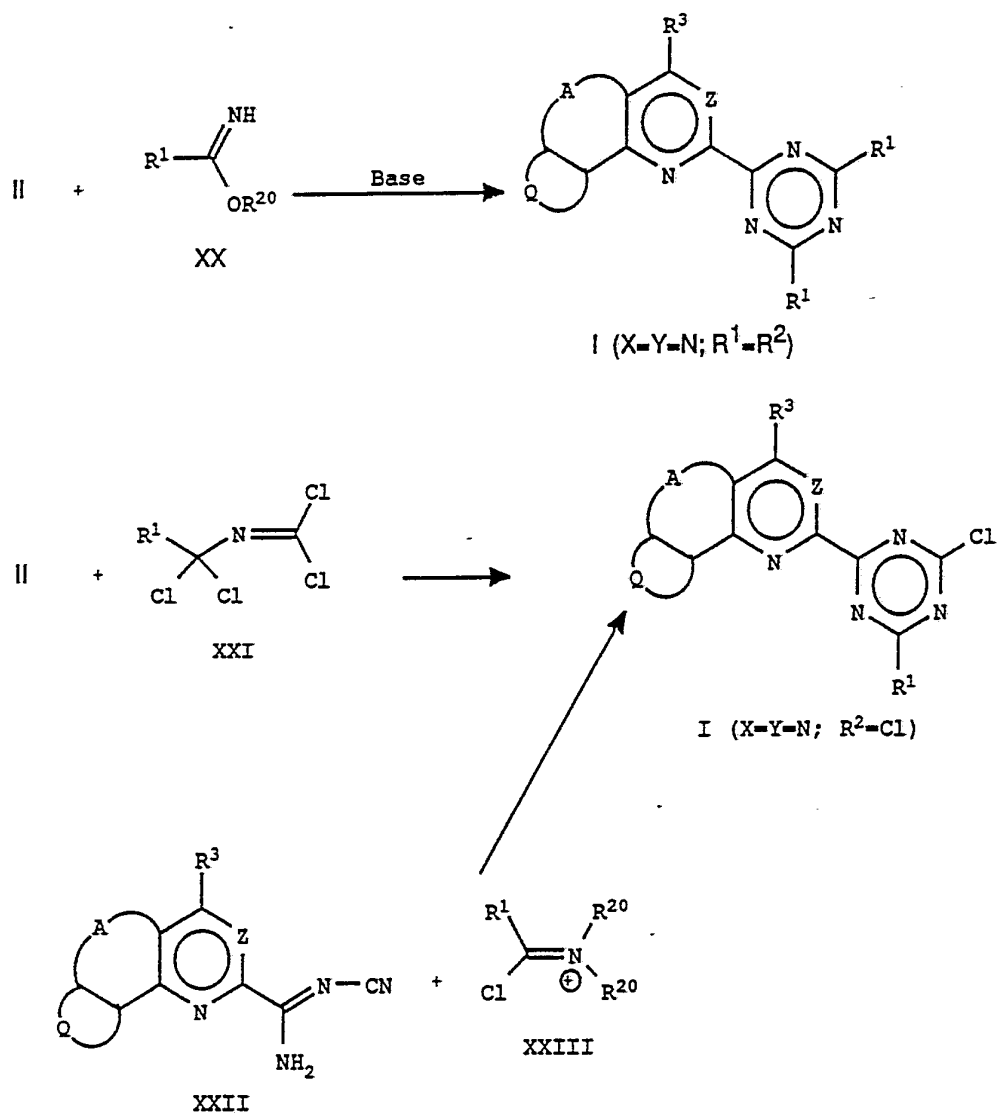
L^4 is a leaving group such as halogen, alkoxy, alkylthio, (di)alkylamino, (halo)alkylsulfonyloxy, and arylsulfonyloxy.

Compounds of Formula I, when X and Y are nitrogen, can be prepared as outlined in Scheme 15. Amidines of Formula II can be converted to compounds of Formula I (X=Y=N; $\text{R}^1=\text{R}^2$) by reaction with imidates of Formula XX as taught by Schaeffer (*J. Org. Chem.* 1962, 27, 3608-3613). This method is not applicable when R^1 is a substituent which is attached through a heteroatom such as halogen and alkoxy.

Also shown in Scheme 15 is the preparation of compounds of Formula I, when X and Y are nitrogen and

R² is chlorine, by the reaction of amidines of Formula II with compounds of Formula XXI as taught by Schmelzer et al. (Angew. Chem. Int. Ed. Engl. 1966, 5, 960-961) or by the reaction of N-cyanoamidines of Formula XXII with chloromethyleneiminium salts as taught by Harris (Aust. J. Chem. 1981, 34, 623-634 and Synth. 1980, 841-842). N-cyanoamidines of Formula XXII can be prepared by the reaction of imidates of Formula XII with cyanamide as taught by Huffman et al. (J. Org. Chem. 1963, 28, 1812-1816). Additionally, the method of Bader (J. Org. Chem. 1965, 30, 707-11) can be used to prepare other compounds of Formula I (X=Y=N).

Scheme 15

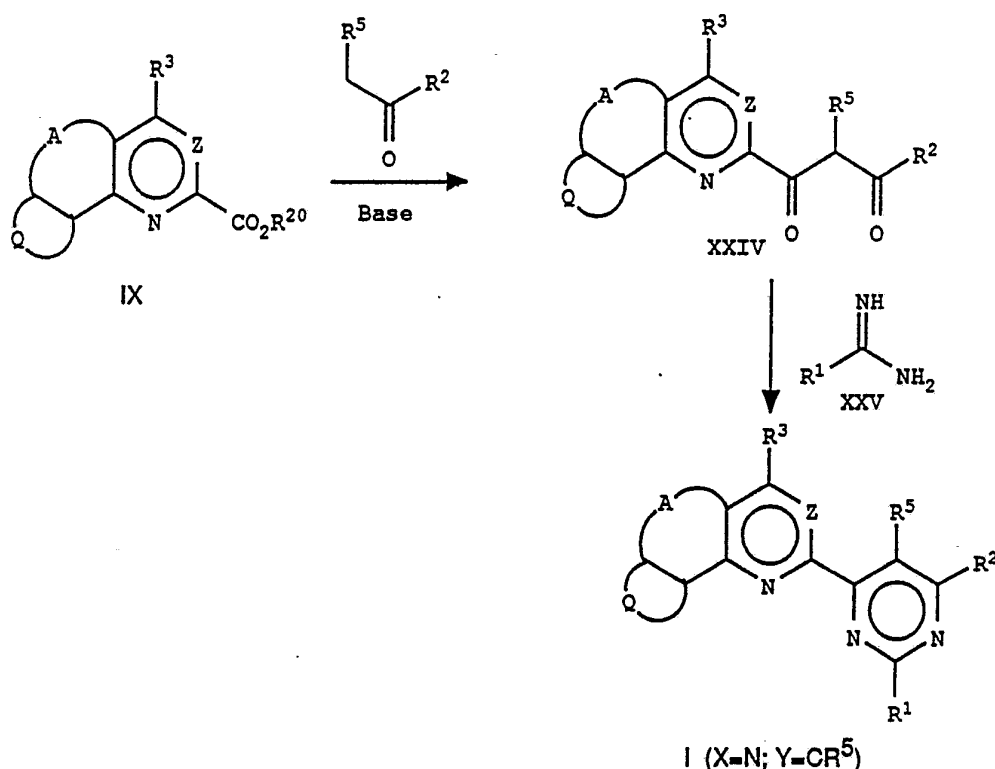


wherein R²⁰ is C₁-C₄ alkyl.

Compounds of Formula I, when X is N and Y is CR⁵, can be prepared from esters of Formula IX as outlined in Scheme 16. Claisen-like condensations between esters and ketones (Hauser et al., Organic Reactions 1954, 8, 59-196) and Claisen condensations between two different esters (Hauser et al., Organic Reactions 1942, 1, 266-302) to give 1,3-dicarbonyl compounds such as intermediates of Formula XXIV are well known in the

art. The reaction between intermediates of Formula XXIV and amidines of Formula XXV can be carried out as previously discussed for Scheme 2. Formula XXV compounds include amidines, thiourea, urea, O-alkylisoureas, and S-alkylisothioureas. Also, when R² is a leaving group such as alkoxy in Formula XXIV, then R² will be hydroxy in the product which can be converted to several other substituents as described in previous schemes.

Scheme 16

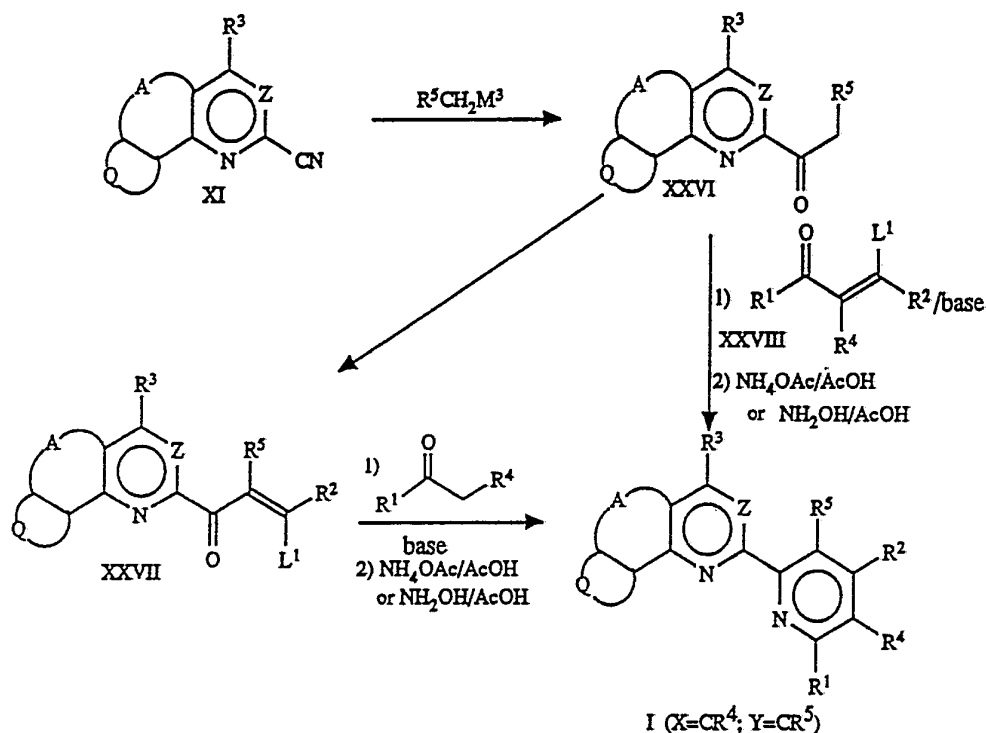


wherein R²⁰ is C₁-C₄ alkyl.

10 Compounds of Formula I, when X and Y are CR⁴ and
 CR⁵, respectively, can be prepared from intermediate
 carbonitriles of Formula XI as outlined in Scheme 17.
 The addition of organometallic reagents to nitriles to
 give ketones represented by Formula XXVI is well known
 15 in the art. Ketones of Formula XXVI can be converted

to intermediates of Formula XXVII by methods well known in the art. Michael-type reactions of intermediate XXVII with a ketone followed by cyclization with ammonium acetate (when L^1 is a leaving group) or hydroxylamine (when L^1 is hydrogen) affords pyridines of Formula I ($X=CR^4$, $Y=CR^5$); examples of these methods are discussed by Jameson et al. (Tetrahedron Lett. 1991, 32, 1999-2002), Potts et al. (J. Am. Chem. Soc. 1981, 103, 3585-3586), and Jones (Comprehensive Heterocyclic Chemistry Vol. 2, 395-510, Katritzky and Rees, Eds., Pergamon). Similar Michael-type reactions between ketones of Formula XXVI with Formula XXVIII compounds provides, after cyclization, pyridines of Formula I ($X=CR^4$, $Y=CR^5$).

Scheme 17



wherein

M^3 is alkali or alkaline earth metal; and

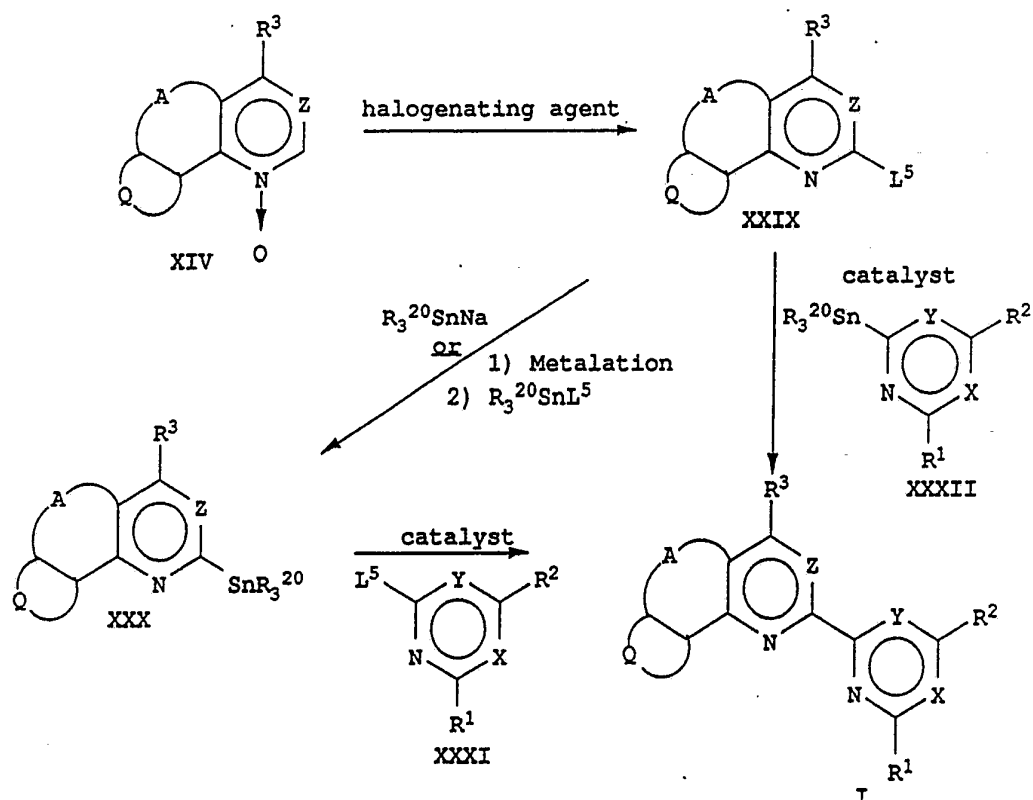
L¹ is hydrogen or a leaving group such as halogen, alkoxy, alkylthio, (di)alkylamino, (halo)alkylsulfonyloxy, and arylsulfonyloxy.

Alternatively, compounds of Formula I can be prepared by transition-metal catalyzed aryl coupling reactions as illustrated in Scheme 18. Intermediates of Formula XXIX, when L⁵ is halogen, can be prepared by the reaction of N-oxide intermediates of Formula XIV with a halogenating agent such as phosphorus pentachloride, phosphorus oxychloride, phosphorus oxybromide, and the like. Typical reaction conditions are analogous to those discussed for Scheme 9. Aryltin intermediates of Formula XXX can be prepared from Formula XXIX compounds by the displacement of L⁵ with a trialkylstannylsodium reagent as taught by Wursthorn et al. (J. Am. Chem. Soc. 1978, 100, 2779-2789) or, when Z is CR⁶, by metal-halogen exchange with an alkyllithium (such as butyllithium) and reaction with a trialkyltin halide (such as tributyltin chloride). Palladium-catalyzed coupling of intermediate stannanes of Formula XXX with compounds of Formula XXXI, where L⁵ is halogen, then provides compounds of Formula I.

Typical palladium catalysts include tetrakis(triphenylphosphine)palladium(0) and bis(triphenylphosphine)palladium(II) chloride. Typical solvents include aromatic hydrocarbons (such as benzene and toluene), cyclic ethers (such as tetrahydrofuran and dioxane), and dimethylformamide. Related coupling reactions are known in the art as discussed by Solberg et al. (Acta Chem. Scand. 1989, 43, 62-68), Undheim et al. (Heterocycles 1990, 30, 1155-1193), Gronowitz et al. (Chem. Scripta 1986, 26, 305-309), Fu et al. (Tetrahedron Lett. 1990, 31, 1665-8), Bailey (Tetrahedron Lett. 1986, 27, 4407-4410), and Heck (in

Palladium Reagents in Organic Syntheses, 179-321, Academic 1985).

Alternatively, compounds of Formula I can be prepared by similar palladium-catalyzed couplings of intermediates of Formula XXIX with arylstannanes of Formula XXXII as illustrated in Scheme 18. Compounds of Formula XXXI are well known in the art or can be prepared by analogous methods and compounds of Formula XXXII can be prepared from these compounds by displacing L^5 with a trialkyltin sodium reagent. One skilled in the art will recognize that there are numerous methods for aryl coupling reactions as discussed, for example, by Mitchell et al. (Tetrahedron Lett. 1991, 32, 2273-2276), Oae et al. (Acc. Chem. Res. 1991, 24, 202-208 and Adv. Heterocyclic Chem. 1990, 48, 1-63), Tamao et al. (The Chemistry of the Metal-Carbon Bond Vol. 4, 819-887, Hartley, Ed., Wiley), and Strekowski et al. (J. Heterocyclic Chem. 1990, 27, 1393-1400).

Scheme 18

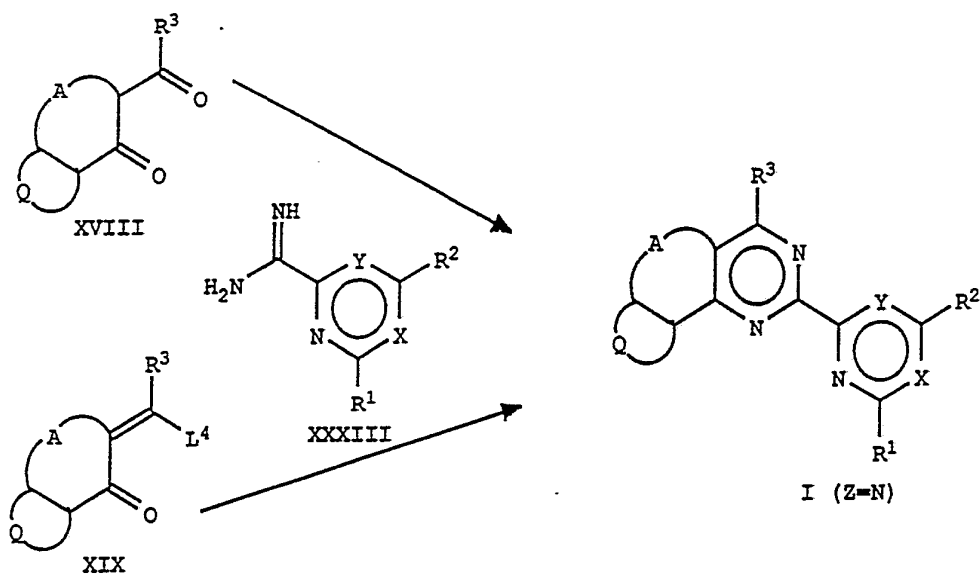
wherein

L^5 is a leaving group such as halogen; and

R^{20} is $\text{C}_1\text{-C}_4$ alkyl.

- Compounds of Formula I, when Z is nitrogen, can be prepared by the reaction of compounds of Formulae XVIII or XIX with amidines of Formula XXXIII (Scheme 19). Typical reaction conditions are those discussed for
- 5 Scheme 2 and Scheme 3, respectively. Amidines of Formula XXXIII can be prepared from the corresponding nitriles, which are known in the art, using the methods previously discussed in Scheme 11.

Scheme 19

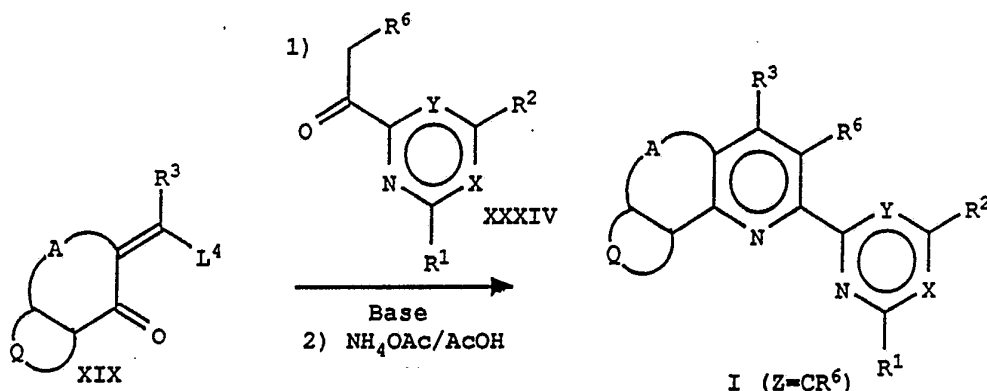


wherein

L⁴ is a leaving group such as halogen, alkoxy, alkylthio, (di)alkylamino, (halo)alkylsulfonyloxy, and arylsulfonyloxy.

Compounds of Formula I, when Z is CR⁶, can be prepared from intermediates of Formula XIX by a Michael-type reaction with a Formula XXXIV compound followed by cyclization as illustrated in Scheme 20.

- 5 Refer to the discussion for Scheme 17 for further details and references for this method. Intermediates of Formula XXXIV are known in the art or can be prepared by analogous methods.

Scheme 20

wherein

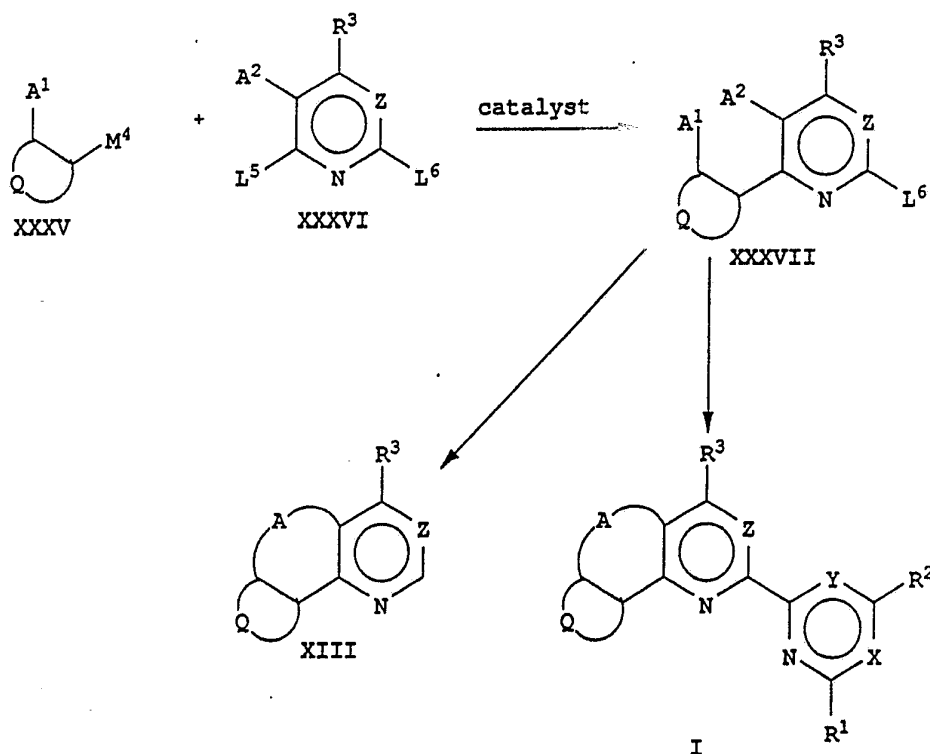
L⁴ is a leaving group such as halogen, alkoxy, alkylthio, (di)alkylamino, (halo)alkylsulfonyloxy, and arylsulfonyloxy.

Compounds of Formula I and intermediates of Formula XIII can be prepared using the general strategies outlined in Schemes 21 and 22. In Scheme 21, an organometallic compound of Formula XXXV is coupled to a heterocyclic halide of Formula XXXVI in the presence of a catalyst (such as a suitable palladium or nickel catalyst) following procedures well known in the art (refer to references given in the discussion for Scheme 18). Compounds of Formula XXXV are arylboronic acids, arylstannanes, arylzincs, aryl Grignards, and the like, which are well known in the art. Also, compounds of Formula XXXVI are halopyridines and halopyrimidines which are well known in the art or can be prepared by related methods.

Groups A¹ and A² are chosen so that a bond or bonds can be made between them to construct the particular bridge A. There are numerous synthetic methods for effecting cyclizations to compounds of Formula I and intermediates of Formula XIII including, but not

limited to, lactonizations, lactamizations, etherifications, Friedel-Crafts reactions, low-valent titanium carbonyl couplings (McMurray reaction), Wittig reactions, acetal formations, and condensations. For example, when A^1 is hydroxy and A^2 is CH_2CO_2H , lactonization using an activating agent (such as 1,3-dicyclohexylcarbodiimide) gives compounds of Formulae XIII and I where A is $-OC(O)CH_2-$. Similarly, when A^1 is hydroxy and A^2 is CH_2Br , etherification by treatment with base gives compounds where A is $-OCH_2-$; when A^1 and A^2 are $CH_2C(O)H$, the McMurray reaction gives compounds where A is $-CH_2CH=CHCH_2-$; and when A^1 and A^2 are hydroxy, acetal formation with 2,2-dimethoxypropane gives compounds where A is $-OC(Me)_2O-$. A specific example of the strategy in Scheme 21 is reported by Fu et al. (J. Org. Chem. 1991, 56, 1683-1685) using a palladium-catalyzed coupling between arylboronates and arylhalides followed by an anionic Friedel-Crafts equivalent giving an intermediate of Formula XIII where Q is benzene ring, A is $-C(O)-$, R^3 is H, and Z is CH. The roles of the two aryl intermediates XXXV and XXXVI can be reversed, i.e., coupling of an aryl halide derivative analogous to XXXV with a heteroaromatic metal derivative analogous to XXXVI will give the same intermediates of Formula XXXVII.

Scheme 21

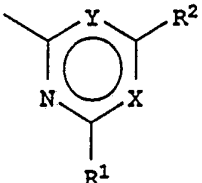


wherein

M⁴ is a metallic group such as Sn(R²⁰)₃, B(OH)₂, B(OR²⁰)₂,

ZnCl, ZnBr, MgCl, MgBr, and the like,

L⁵ is a leaving group such as halogen,

L⁶ is hydrogen or ; and

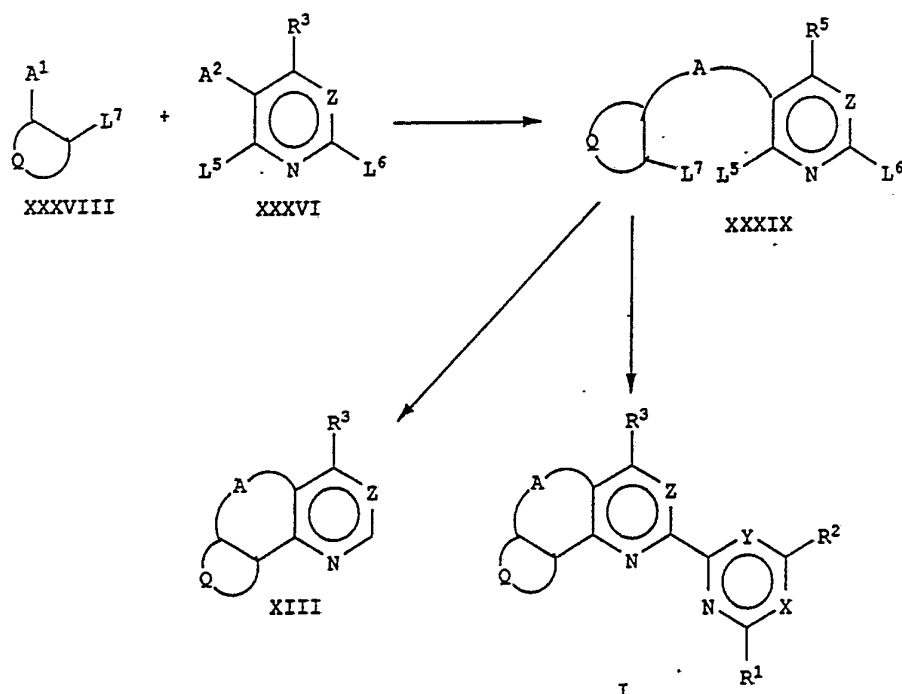
A¹ and A² are suitable groups for creating bonds between them to construct bridge A.

Scheme 22 illustrates the strategy where the bridge A is first constructed using methods similar to those discussed for Scheme 21. Suitable synthetic methods include, but are not limited to,

5 esterifications, etherifications, amide formations,

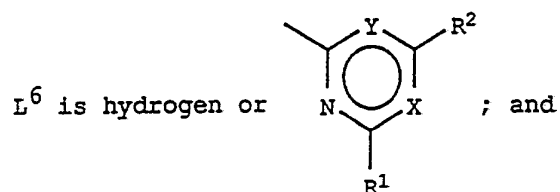
Wittig reactions, and the like. The intermediate XXXIX can be converted by an intramolecular Ullman or related aryl coupling to compounds of Formula I or intermediates of Formula XIII. Compounds of Formulae
 5 XXXVIII and XXXVI are aryl and heteroaryl halides which are known in the art or can be prepared by analogous procedures. Examples of this strategy can be found in papers by Rebek et al. (*J. Am. Chem. Soc.* 1985, 107, 7487-7493) and Botteghi et al. (*Synth. Commun.* 1991,
 10 21, 1819-1823).

Scheme 22



wherein

L⁵ and L⁷ are independently leaving groups such as halogen,



A¹ and A² are suitable groups for creating bonds between them to construct bridge A.

The metal complexes of the compounds of the invention include complexes with copper, zinc, iron, magnesium or manganese cations. These complexes can be made by combining the compound with the metal salt, either in aprotic solvents such as ether or tetrahydrofuran or they can be generated in protic solvents such as methanol or mixtures of such solvents. The complex may crystallize and precipitate from solution or the complex is crystallized as the solvent is removed.

Without further elaboration, it is believed that one skilled in the art using the preceding description can utilize the present invention to its fullest extent. The following examples are, therefore, to be construed as merely illustrative, and not limiting of the disclosure in any way whatsoever.

EXAMPLES

EXAMPLE 1

6,7-Dihydro-2-(4-methyl-2-pyrimidinyl)-
5H-benzo[6,7]-cyclohepta[1,2-b]pyridine

Step A: 6,7,8,9-Tetrahydro-5H-benzocyclohepten-5-one
dimethylhydrazone

To a stirred solution of 1-benzosuberone (25.00 g, 156.0 mmol) in ethanol (39 mL) under a nitrogen atmosphere is added *N,N*-dimethylhydrazine (37.51 g, 624.1 mmol) and the resulting mixture is heated under reflux overnight. After cooling to room temperature, the reaction mixture is concentrated under reduced pressure. The residue is dissolved in ethanol and reconcentrated; this is repeated once more with ethanol and twice more with dichloromethane to yield 32.65 g of

the crude title hydrazone. Chromatography of this material on silica gel (1000 mL) with 1:25 ethyl acetate-hexane affords the title compound (28.36 g, 90%) as a yellow oil which is a mixture of syn and anti isomers: R_f 0.05 (silica gel, 1:25 ethyl acetate-hexane); 200 MHz 1H NMR ($CDCl_3$) major isomer δ 1.75 (m, 4H), 2.61 (s, 6H), 2.76 (m, 4H), 7.1 (dd, 1H), 7.2 (m, 2H), 7.5 (dd, 1H) and minor isomer δ 1.85 (m, 4H), 2.38 (s, 6H), 2.45 (m, 2H), 2.7 (m, 2H), 7.2-7.3 (m, 4H).

10

Step B: 6-[2-(1,3-Dioxolan-2-yl)ethyl]-6,7,8,9-tetrahydro-5H-benzocyclohepten-5-one dimethylhydrazone

To a stirred solution of lithium diisopropylamide [prepare by the addition of *n*-butyllithium (4.35 mL, 10.87 mmol of a 2.5 M solution in hexanes) to a stirred solution of diisopropylamine (1.66 mL, 11.86 mmol) in anhydrous tetrahydrofuran (11.6 mL) under a nitrogen atmosphere cooled to 0°C] is added a solution of the product of Step A (2.000 g, 9.886 mmol) in tetrahydrofuran (5 mL) over 15 min maintaining the temperature below 5°C. The resulting solution is maintained at 0°C for 2 h and is then cooled to -78°C. To this solution is added a solution of 2-(2-bromoethyl)-1,3-dioxolane (1.28 mL, 10.9 mmol) in 1,3-dimethyl-3,4,5,6-tetrahydro-2(1H)-pyrimidinone (1.32 mL) over 15 min. at a rate such that the temperature of the reaction stays below -65°C, the mixture is then kept at -78°C for 1 h. The reaction mixture is allowed to come to room temperature and is left at room temperature overnight. The reaction mixture is slowly quenched with water and is then poured into water (250 mL). The resulting mixture is extracted three times with diethyl ether. After drying (Na_2SO_4), the combined organic extracts are

concentrated under reduced pressure and chromatography of the residue on silica gel (300 mL) with 1:4 ethyl acetate-hexane affords the title compound (2.765 g, 92.5%) as a yellow oil which is essentially a single
5 geometric isomer: R_f 0.04 (silica gel, 1:4 ethyl acetate-hexane); 200 MHz 1H NMR ($CDCl_3$) δ 1.35 (m, 2H), 1.52 (m, 2H), 1.81 (m, 2H), 1.91 (m, 2H), 2.56 (s, 6H), 2.75 (m, 2H), 3.77 (m, 3H), 3.9 (m, 2H), 4.69 (t, 1H), 7.05 (m, 1H), 7.15-7.25 (m, 3H).

10

Step C: 6,7-Dihydro-5H-benzo[6,7]cyclohepta[1,2-b]pyridine

A stirred solution of the title compound from Step B (31.23 g, 103.3 mmol) in glacial acetic acid (207 mL)
15 under a nitrogen atmosphere is heated under reflux for 2 h. The reaction mixture is allowed to cool to room temperature and is concentrated under reduced pressure. The residue is dissolved in *n*-heptane and concentrated under reduced pressure several times to azeotrope off
20 residual acetic acid. The residue is dissolved in 1 N aqueous HCl (800 mL) and extracted with four 200 mL portions of diethyl ether to remove undesired by-products. The aqueous layer is then basified to pH 9 with 1 N aqueous NaOH. The basic aqueous layer is
25 extracted with three 200 mL portions of diethyl ether and these combined extracts are dried ($MgSO_4$) and concentrated under reduced pressure. Chromatography of the residue on silica gel (1200 mL) with dichloromethane affords the title compound (12.675 g,
30 63%) as a golden-brown oil: R_f 0.50 (silica gel, 1:1 ethyl acetate-hexane); 200 MHz 1H NMR ($CDCl_3$) δ 2.20 (pentet, 2H), 2.50 (t, 2H), 2.54 (t, 2H), 7.2 (m, 2H), 7.37 (m, 2H), 7.54 (d, 1H), 7.7 (d, 1H), 8.61 (dd, 1H).

Step D: 6,7-Dihydro-5H-benzo[6,7]cyclohepta[1,2-b]pyridine 1-oxide

To a stirred solution of the product of Step C (10.17 g, 52.08 mmol) in 1,2-dichloroethane (130 mL) under a nitrogen atmosphere at room temperature is added portionwise 3-chloroperoxybenzoic acid (50-60% commercial, 19.77 g, 57.29 mmol) and the reaction is allowed to stir overnight at room temperature. The reaction is quenched by the addition of 1.5 mL of dimethylsulfide and, after 1.5 h, is washed with saturated aqueous Na₂CO₃ (800 mL). The aqueous wash is extracted with five 200 mL portions of dichloromethane. After drying (MgSO₄), the combined organic layers are concentrated under reduced pressure and chromatography of the residue on silica gel (1000 mL) with 1:40 methanol-dichloromethane affords the title compound (10.45 g, 95%) as a white solid melting at 84-87°C: R_f 0.12 (silica gel, 1:20 methanol-dichloromethane); 400 MHz ¹H NMR (CDCl₃) δ 2.1-2.2 (m, 3H), 2.45 (m, 1H), 2.6 (m, 2H), 7.15 (m, 2H), 7.27 (m, 1H), 7.37 (m, 2H), 8.05 (m, 1H), 8.3 (t, 1H).

Step E: 6,7-Dihydro-5H-benz[6,7]cyclohepta[1,2-b]pyridine-2-carbonitrile

To a stirred solution of the product of Step D (8.955 g, 42.40 mmol) in anhydrous dichloromethane (85 mL) under a nitrogen atmosphere at room temperature is added first trimethylsilyl cyanide (6.22 mL, 4.63 g, 46.6 mmol) over 10 min and then, after 15 min, is added dimethylcarbonyl chloride (4.1 mL, 4.8 g, 44.5 mmol) over 10 min. After 2 days at room temperature, the reaction is diluted with saturated aqueous NaHCO₃ (800 mL) and the layers are separated. The aqueous layer is extracted with three 200 mL portions of dichloromethane. After drying (MgSO₄), the combined

organic layers are concentrated under reduced pressure and chromatography of the residue on silica gel (900 mL) with 1:20 ethyl acetate-hexane affords the title compound (8.257 g, 88%) as a white solid melting at 65.5-66.5°C: R_f 0.07 (silica gel, 1:20 ethyl acetate-hexane); 400 MHz ^1H NMR (CDCl_3) δ 2.28 (pentet, 2H), 2.54 (t, 2H), 2.57 (t, 2H), 7.25 (m, 1H), 7.4 (m, 2H), 7.6 (d, 1H), 7.68 (d, 1H), 7.73 (m, 1H).

10 Step F: Methyl 6,7-dihydro-5H-benzo[6,7]cyclohepta-[1,2-b]pyridine-2-carboximidate

To a stirred solution of the product of Step E (8.25 g, 37.45 mmol) in methanol (75 mL) under a nitrogen atmosphere at room temperature is added a solution of sodium methoxide (3.0 mL of commercial 25 wt. % solution in methanol, 13.11 mmol) and the reaction is allowed to stir at room temperature overnight. The reaction is quenched by adding glacial acetic acid (0.75 mL, 787 mg, 13.1 mmol) and is then concentrated under reduced pressure. The residue is triturated with diethyl ether and filtered. The filtrate is concentrated under reduced pressure to afford the crude title compound (11.4 g) as a light yellow oily solid melting at 91.5-98°C: R_f 0.25 (silica gel, 1:30 methanol-dichloromethane); 400 MHz ^1H NMR (CDCl_3) δ 2.26 (pentet, 2H), 2.55 (t, 4H), 4.03 (s, 3H), 7.26 (d, 1H), 7.39 (t, 1H), 7.43 (t, 1H), 7.63 (d, 1H), 7.74 (d, 1H), 7.78 (d, 1H).

30 Step G: 6,7-Dihydro-5H-benzo[6,7]cyclohepta[1,2-b]pyridine-2-carboximidamide hydrochloride

To a solution of the crude imidate from Step F (37.45 mmol) in absolute ethanol (48.3 mL) under a nitrogen atmosphere at room temperature is added a solution of ammonium chloride (2.003 g, 37.45 mmol) in

water (18.3 mL) and the resulting mixture is heated under reflux for 3 h. The reaction mixture is allowed to cool, concentrated under reduced pressure and, finally, concentrated *in vacuo*. The resulting solid is
5 triturated with acetone (50 mL) and filtered to afford the title compound (8.185 g, 80%) as a white solid which does not melt below 250°C: R_f 0.02 (silica gel, 1:30 methanol-dichloromethane); 400 MHz ^1H NMR ($\text{Me}_2\text{SO}-d_6$) δ 2.24 (pentet, 2H), 2.49 (t, 2H), 2.56 (t, 2H), 7.37 (m, 1H), 7.45 (m, 2H), 7.87 (m, 1H), 8.09 (d, 1H), 8.23 (d, 1H), 9.44 (s, 2H), 9.55 (s, 2H).
10

The acetone filtrate is concentrated under reduced pressure and triturated with dichloromethane (10 mL) to afford additional title compound as a white solid
15 (695 mg, 7%).

Step H: 6,7-Dihydro-2-(4-methyl-2-pyrimidinyl)-5H-benzo[6,7]cyclohepta[1,2-b]pyridine

To a stirred solution of the product from Step G
20 (2.507 g, 9.158 mmol) in methanol (92 mL) under a nitrogen atmosphere at room temperature is added first a solution of sodium methoxide (3.14 mL of commercial 25 wt. % solution in methanol, 13.74 mmol) and then acetylacetaldehyde dimethyl acetal (1.83 mL, 1.815 g, 25 13.74 mmol). The resulting solution is heated under reflux for 2 h, allowed to cool to room temperature, and then concentrated under reduced pressure. The residue is dissolved in dichloromethane and reconcentrated under reduced pressure (twice) to remove
30 residual methanol. Chromatography of the residue on silica gel (280 mL) with 1:50 methanol-dichloromethane affords the title compound (2.55 g, 97%) as a yellow solid melting at 161.5-164.5°C contaminated with acetylacetaldehyde dimethyl acetal (4% by weight).
35 This solid is recrystallized from 1-chlorobutane

(45 mL)/hexane (25 mL) to give pure title compound (1.990 g, 76%) as a cream-colored granular solid melting at 166-166.5°C: R_f 0.25 (silica gel, 1:20 methanol-dichloromethane); 200 MHz 1H NMR ($CDCl_3$) δ

5 2.26 (pentet, 2H), 2.56 (t, 2h), 2.58 (t, 2H), 2.65 (s, 3H), 7.15 (d, 1H), 7.22 (dd, 1H), 7.34 (dt, 1H), 7.41 (dt, 1H), 7.70 (d, 1H), 7.91 (dd, 1H), 8.36 (d, 1H), 8.77 (d, 1H).

The mother liquor is concentrated under reduced pressure and the residue is triturated with hexane (8 mL)/1-chlorobutane (2 mL) to afford additional title compound (265 mg, 10%) as a tan solid.

EXAMPLE 2

15 6,7-Dihydro-2-(4-methyl-2-pyrimidinyl)-5H-benzo[6,7]cyclohepta[1,2-b]pyridine,
complex with zinc chloride

To a stirred solution of 6,7-dihydro-2-(4-methyl-2-pyrimidinyl)-5H-benzo[6,7]-cyclohepta[1,2-b]pyridine (150 mg, 0.52 mmol) in anhydrous tetrahydrofuran (8 mL) under a nitrogen atmosphere at room temperature is added a 1 M solution of zinc chloride in diethyl ether (0.468 mL, 63.8 mg, 0.468 mmol). During the addition a precipitate forms. After 2 h at room temperature, the reaction mixture is concentrated under reduced pressure. The resulting orange solid is triturated with tetrahydrofuran and concentrated under reduced pressure four successive times to yield the title complex (0.242 g) as an orange solid which does not melt below 250°C: IR (KBr) 1578, 1396, 774 cm^{-1} .

EXAMPLE 32-(4,6-Dimethyl-2-pyrimidinyl)-6,7-dihydro-5H-
benzo[6,7]cyclohepta[1,2-b]pyridine5 Step A: 2-[(Dimethylamino)methylenel]-2,3,4,5-
tetrahydro-1H-benzocyclohepten-1-one

A stirred solution of 1-benzosuberone (14.01 mL, 15.00 g, 93.62 mmol) in *N,N*-dimethylformamide dimethyl acetal (24.88 mL, 22.31 g, 187.2 mmol) under a nitrogen
10 atmosphere is heated under reflux for 26 h. The reaction mixture is allowed to cool to room temperature, concentrated under reduced pressure, and finally concentrated *in vacuo*. The resulting yellow-orange solid is triturated with hexane (65 mL) and
15 filtered to afford the title compound (18.60 g, 92%) as a light yellow solid melting at 88.5-89.5°C: *R*_f 0.06 (silica gel, eluting first with 1:4 ethyl acetate-hexane and then with 1:2 ethyl acetate-hexane); 200 MHz ¹H NMR (CDCl₃) δ 1.85 (pentet, 2H), 2.34 (t, 2H), 2.76 (t, 2H), 3.13 (s, 6H), 7.11 (dd, 1H), 7.31 (m, 2H),
20 7.65 (dd, 1H), 7.77 (s, 1H).

Step B: 2-(4,6-Dimethyl-2-pyrimidinyl)-6,7-dihydro-
5H-benzo[6,7]cyclohepta[1,2-b]pyridine

25 To a stirred solution of potassium *tert*-butoxide (316 mg, 2.82 mmol) in anhydrous tetrahydrofuran (7 mL) under a nitrogen atmosphere at room temperature is added 1-(4,6-dimethyl-2-pyrimidinyl)-ethanone (212 mg, 1.41 mmol). After 2 h at room temperature, the product
30 of Step A (304 mg, 1.41 mmol) is added in one portion and the reaction is allowed to stir overnight at room temperature. Ammonium acetate (1.087 g, 14.10 mmol) and then glacial acetic acid (3.5 mL) are added to the reaction. The reaction is heated under a distillation
35 head and the tetrahydrofuran is distilled off over 4 h.

After cooling to room temperature, the reaction is concentrated under reduced pressure. The residue is diluted with saturated aqueous sodium carbonate such that the resulting mixture is basic (pH 10), and
5 extracted twice with chloroform. After drying (MgSO_4), the combined organic extracts are concentrated under reduced pressure and chromatography of the residue on silica gel (50 mL) eluting first with 1:4 ethyl acetate-hexane and then with 1:3 ethyl acetate-hexane
10 affords the title compound (335 mg, 78%) as a tan solid melting at 120.5-123°C: R_f 0.27 (silica gel, 1:1 ethyl acetate-hexane); 400 MHz ^1H NMR (CDCl_3) δ 2.26 (pentet, 2H), 2.57 (m, 4H), 2.60 (s, 6H), 7.03 (s, 1H), 7.22 (d, 1H), 7.34 (t, 1H), 7.41 (t, 1H), 7.69 (d, 1H), 7.95 (d,
15 1H), 8.32 (d, 1H).

EXAMPLE 4

6,7-Dihydro-2-(2-pyridinyl)-5H-benzo[6,7]cyclohepta[1,2-b]pyridine

To a stirred solution of potassium *tert*-butoxide
20 (1.042 g, 9.290 mmol) in anhydrous tetrahydrofuran (23.2 mL) under a nitrogen atmosphere at room temperature is added 2-acetylpyridine (0.52 mL, 563 mg, 4.64 mmol). After 2 h at room temperature, the product of Step A in Example 3 (1.00 g, 4.64 mmol) is added in
25 one portion and the reaction is allowed to stir overnight at room temperature. Ammonium acetate (3.58 g, 46.45 mmol) and then glacial acetic acid (11.6 mL) are added to the reaction. The reaction is heated under a distillation head and the
30 tetrahydrofuran is distilled off over 2 h. After cooling to room temperature, the reaction is concentrated under reduced pressure. The residue is diluted with water and a little chloroform, solid sodium carbonate is added until the aqueous layer is
35 basic (pH 10), and the mixture is then extracted with

three portions of chloroform. After drying (MgSO_4), the combined organic extracts are concentrated under reduced pressure and chromatography of the residue on silica gel (140 mL) with chloroform affords the title compound (750 mg, 59%) as a dark brown oil: R_f 0.08 (silica gel, chloroform); 400 MHz ^1H NMR (CDCl_3) δ 2.27 (pentet, 2H), 2.56 (t, 2H), 2.59 (t, 2H), 7.29 (m, 2H), 7.38 (t, 1H), 7.44 (t, 1H), 7.68 (d, 1H), 7.81 (t, 1H), 7.87 (d, 1H), 8.32 (d, 1H), 8.57 (d, 1H), 8.68 (d, 1H). Further elution afford additional title compound (245 mg, 13% corrected for impurities) which is 65% pure by weight.

EXAMPLE 5

6,7-Dihydro-2-(6-methyl-2-pyridinyl)-5H-benzo[6,7]cyclohepta[1,2-b]pyridine

To a stirred solution of 6,7-dihydro-2-(2-pyridinyl)-5H-benzo[6,7]cyclohepta[1,2-b]pyridine (250 mg, 0.918 mmol) in anhydrous diethyl ether (4.6 mL) under a nitrogen atmosphere cooled to 0°C is added a 1.4 M solution of methyllithium in diethyl ether (0.66 mL, 20 mg, 0.92 mmol) over 10 min. The reaction is allowed to warm to room temperature and, after 1 h it is heated under reflux overnight. After cooling to room temperature, the reaction is quenched by the slow addition of water. The layers are separated and the aqueous layer is extracted twice with diethyl ether. After drying (MgSO_4), the combined organic layers are concentrated under reduced pressure. To a stirred solution of the residue in acetone at room temperature under a nitrogen atmosphere is added a saturated solution of potassium permanganate in acetone until a violet color persists, and then this mixture is filtered through Celite®. The filtrate is concentrated under reduced pressure and chromatography of the residue on silica gel (50 mL) with 1:50 ethyl acetate-

hexane affords first the title compound (10 mg, 4%) as a white solid melting at 144-145°C: R_f 0.34 (silica gel, 1:10 ethyl acetate-hexane); 400 MHz 1H NMR ($CDCl_3$) δ 2.27 (pentet, 2H), 2.57 (m, 4H), 2.64 (s, 3H), 7.16 (d, 1H), 7.29 (m, 1H), 7.38 (m, 1H), 7.44 (m, 1H), 7.69 (m, 2H), 7.87 (d, 1H), 8.35 (m, 2H).

Further elution affords the starting material (title compound from Example 4, 125 mg, 50%) as a white solid melting at 72-73.5°C.

10

EXAMPLE 66,7-Dihydro-2-(6-methyl-2-pyridinyl)-5H-benzo[6,7]cyclohepta[1,2-d]pyrimidine

To a stirred mixture of 2-(4,6-dimethyl-2-pyrimidinyl)-6,7-dihydro-5H-benzo[6,7]cyclohepta[1,2-b]pyridine (1.311 g, 6.090 mmol) and the hydrochloride salt of 6-methyl-2-pyridine carboximidamide (1.045 g, 6.090 mmol) in absolute ethanol (15.2 mL) at room temperature under a nitrogen atmosphere is added triethylamine (1.70 mL, 1.23 g, 12.2 mmol) and then the mixture is heated under reflux overnight. After cooling to room temperature, the reaction is concentrated under reduced pressure. The residue is diluted with dichloromethane (80 mL) and washed successively with saturated aqueous sodium hydrogen carbonate (25 mL) and water (25 mL). Each of these aqueous layer are extracted with dichloromethane. After drying ($MgSO_4$), the combined organic layers are concentrated under reduced pressure and chromatography of the residue on silica gel (350 mL) with ethyl acetate affords impure title compound (1.17 g) as a yellow solid. Chromatography of this material on silica gel (100 mL) with 1:1 ethyl acetate-dichloromethane and then rechromatography on neutral activity I alumina (100 mL) eluting first with 1:1 dichloromethane-hexane, then with dichloromethane, and

finally with 1:1 ethylacetate-dichloromethane affords pure title compound (565 mg, 32%) as a white solid melting at 151-153°C: R_f 0.17 (silica gel, 1:20 methanol-dichloromethane); 200 MHz 1H NMR ($CDCl_3$) δ 2.31 (pentet, 2H), 2.57 (t, 2H), 2.60 (t, 2H), 2.74 (s, 3H), 7.27 (m, 2H), 7.45 (m, 2H), 7.73 (t, 1H), 7.90 (m, 1H), 8.42 (d, 1H), 8.78 (s, 1H).

EXAMPLE 7

8-Bromo-6,7-dihydro-2-(4-methyl-2-pyrimidinyl)-
10 5H-benzo[6,7]cyclohepta[1,2-b]pyridine and
10-bromo-6,7-dihydro-2-(4-methyl-2-pyrimidinyl)-
5H-benzo[6,7]cyclohepta(1,2b]pyridine

Step A: 8-Bromo-6,7-dihydro-5H-benzo[6,7]cyclohepta-
15 [1,2-b]pyridine and 10-bromo-6,7-dihydro-5H-
benzo[6,7]cyclohepta[1,2-b]pyridine

To a stirred solution of 6,7-dihydro-5H-benzo[6,7]cyclohepta[1,2-b]pyridine (60.00 g, 307.3 mmol) in trifluoroacetic acid (1025 mL) under a
20 nitrogen atmosphere at room temperature is added portionwise N-bromosuccinimide (60.159 g, 338.00 mmol) and the reaction is allowed to stir for four days at room temperature. The reaction mixture is concentrated under reduced pressure and the residue is diluted with
25 1N aqueous sodium hydroxide. The resulting basic aqueous mixture is extracted with three portions of ethyl acetate. After drying ($MgSO_4$), the combined organic extracts are concentrated under reduced pressure and chromatography of the residue on silica
30 gel (1200 mL) with 1:3 dichloromethane-hexane affords first the 10-bromo isomer (31.015 g, 37%) as a light brown oil: R_f 0.43 (silica gel, dichloromethane); 400 MHz 1H NMR ($CDCl_3$) δ 2.23 (pentet, 2H), 2.49 (t, 4H), 7.12 (d, 1H), 7.21 (dd, 1H), 7.46 (dd, 1H), 7.55
35 (dd, 1H), 7.87 (d, 1H), 8.61 (dd, 1H).

Further elution with 1:3 dichloromethane-hexane and then with dichloromethane affords mixtures of the 8-bromo isomer, 10-bromo isomer, and unreacted starting material (total of 33.00 g representing approximately 5 7.68 g of the 10-bromo isomer, 17.58 g of the 8-bromo isomer, and 7.74 g of unreacted starting material).
Rechromatography of some of the mixed fractions on silica gel with 1:20 ethyl acetate-hexane or 1:1 dichloromethane-hexane affords the 8-bromo isomer 10 (8.35 g, 10%, contaminated with a small amount of unreacted starting material): R_f 0.33 (silica gel, dichloromethane); 400 MHz, 1H NMR (C_6D_6) δ 1.82 (pentet, 2H), 2.01 (t, 2H), 2.58 (t, 2H), 6.66 (t, 1H), 6.83 (t, 1H), 6.89 (d, 1H), 7.41 (d, 1H), 7.87 (d, 1H), 15 8.53 (d, 1H).

Step B: 8-Bromo-6,7-dihydro-2-(4-methyl-2-pyrimidinyl)-5H-benzo[6,7]cyclohepta[1,2-b]pyridine

20 Following the synthetic methods taught in Example 1 (Steps D through H), a portion of the 8-bromo isomer from Step A is converted into the title compound contaminated with 7% of 6,7-dihydro-2-(4-methyl-2-pyrimidinyl)-5H-benzo[6,7]cyclohepta[1,2-b]pyridine) 25 which is obtained as a yellow solid melting at 112-116°C: R_f 0.07 (silica gel, 1:1 ethyl acetate-hexane); 400 MHz 1H NMR ($CDCl_3$) δ 2.25 (pentet, 2H), 2.56 (t, 2H), 2.66 (s, 3H), 2.78 (t, 2H), 7.17 (d, 1H), 7.24 (t, 1H), 7.61 (d, 1H), 7.72 (d, 1H), 7.83 (d, 1H), 30 8.40 (d, 1H), 8.77 (d, 1H).

Step C: 10-Bromo-6,7-dihydro-2-(4-methyl)-2-pyrimidinyl)-5H-benzo[6,7]cyclohepta[1,2-b]pyridine

Following the synthetic methods taught in Example 1 (Steps D through H), a portion of the 10-bromo isomer from Step A is converted into the title compound which is obtained as yellow oily solid melting at 137-138°C: R_f 0.10 (silica gel, 1:2 ethyl acetate-hexane); 400 MHz 1H NMR ($CDCl_3$) δ 2.25 (pentet, 2H), 2.51 (t, 2H), 2.58 (t, 2H), 2.67 (s, 3H), 7.10 (d, 1H), 7.18 (d, 1H), 7.46 (d, 1H), 7.72 (d, 1H), 8.05 (s, 1H), 8.40 (d, 1H), 8.78 (d, 1H).

Examples of compounds of the invention are shown in Tables 1-9. These compounds readily can be converted to their conjugate acid salts or metal complexes. Abbreviations are as follows:

t- is <u>tertiary</u>	c-Pr is <u>cyclo</u> -propyl
sec- is <u>secondary</u>	TMS is trimethylsilyl
n- is <u>normal</u>	CO ₂ H is hydroxycarbonyl
NHET is ethylamino	n-Pr is <u>normal</u> -propyl
SPh is phenylthio	t-Bu is <u>tertiary</u> -butyl
i-Pr is isopropyl	O-n-Bu is <u>normal</u> -butoxy
O-i-Pr is isopropoxy	n-Bu is <u>normal</u> -butyl
Bu is butyl	n-Hex is <u>normal</u> -hexyl
Hex is hexyl	sec-Bu is <u>secondary</u> -butyl
CN is cyano	S-i-Pr is isopropylthio
OPh is phenoxy	CO ₂ Me is methoxycarbonyl
c-Hex is <u>cyclo</u> -hexyl	S(O)Me is methylsulfinyl
NO ₂ is nitro	S(O) ₂ Me is methylsulfonyl
SEt is ethylthio	S(O) ₂ Et is ethylsulfonyl
SMe is methylthio	S(O) ₂ -n-Bu is <u>normal</u> -butylsulfonyl
OH is hydroxy	TBS is <u>tertiary</u> -butyldimethylsilyl
OMe is methoxy	Et is ethyl
i- is <u>iso</u>	OEt is ethoxy

Ph is phenyl

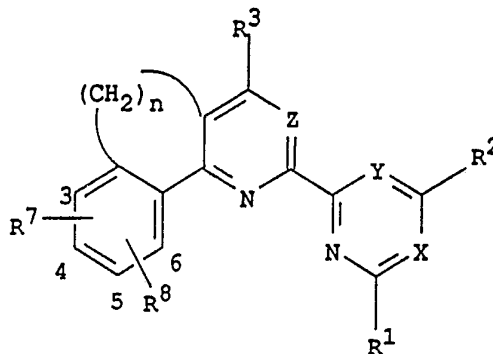
Pr is propyl

c- is cycloNMe₂ is dimethylamino

Me is methyl

NEt₂ is diethylamino

Ac is acetyl

Table 1R¹ is Me; R², R³, R⁷ and R⁸ are H

X	Y	Z	n	X	Y	Z	n
N	CH	CH	1	CH	N	COEt	3
N	CH	CH	2	CH	N	CF	1
N	CH	CH	3	CH	N	CF	2
N	CH	N	2	CH	N	CF	3
N	CH	N	3	CH	CH	CMe	2
N	CH	N	4	CH	CH	CMe	3
N	CH	CMe	3	CH	CH	CF	2
N	CH	CF	3	CH	CH	CF	3
CH	N	CEt	3	CH	CH	COEt	3
CH	N	COMe	3	CH	CH	CEt	3
CH	N	CCl	3	CH	CH	CBr	3
CH	N	CBr	3	CH	CH	COMe	3

R¹ and R² are Me; R³, R⁷ and R⁸ are H

X	Y	Z	n	X	Y	Z	n
N	N	CH	2	CH	COEt	N	3
N	N	CH	3	CH	CF	N	2
N	N	N	3	CH	CF	N	3
N	N	N	4	CH	CMe	N	4

N	CH	CH	2	CH	CF	CH	3
N	CH	CH	3	CH	CMe	CH	3
N	CH	N	3	CH	COMe	CH	3
N	CH	N	4	CH	CEt	CH	3
CH	CCl	N	3	CH	COEt	CH	3
CH	CBr	N	3	CH	Cl	CH	2
CH	CEt	N	3	CH	CMe	CF	3
CH	COMe	N	3	CH	CMe	CMe	3

X and Y are CH; Z is N; R³, R⁷ and R⁸ are H

R ¹	R ²	n	R ¹	R ²	n
H	H	2	α -Pr	Me	1
H	H	3	α -Pr	Me	2
H	H	4	α -Pr	Me	3
H	Me	2	α -Pr	Me	4
H	Me	3	Me	F	1
H	Me	4	Me	Cl	2
H	OMe	2	Me	Br	3
H	SMe	3	Me	CN	4
H	Cl	4	Me	Et	1
H	OEt	3	Me	OH	2
H	Ph	3	H	n-Hex	3
Me	H	1	H	t-Bu	4
Me	H	2	H	CF ₃	2
Me	H	3	Me	SMe	3
Me	H	4	Me	S(O) ₂ -n-Bu	2
Me	Me	1	Me	2-Me- α -Pr	3
Me	Me	2	α -Hex	H	2
Me	Me	3	Me	OMe	3
Me	Me	4	Me	OCH ₂ CF ₃	2
Me	OMe	2	Me	OCH ₂ OMe	3
Me	OMe	3	Me	CH=CHMe	2
Me	OMe	4	OCH ₂ CH=CH ₂	H	3
Et	H	2	OH	Me	2
Et	H	3	n-Bu	NMe ₂	3

Et	H	4	C=C-Me	H	2
CF ₃	H	3	Me	OPh	3
i-Pr	H	3	Ph	OCH ₂ C≡CH	2
n-Bu	H	3	Me	1-piperidinyl	3
α-Hex	H	3	CH=CCl ₂	H	2
Ph	H	2	NH ₂ Et	H	3
t-Bu	H	3	Me	4-CF ₃ -Ph	3
OMe	H	3	CH ₂ CH ₂ OMe	S(O)Me	3
SMe	H	2	CH ₂ C≡CH	H	3

X, Y and Z are CH; R³, R⁷ and R⁸ are H

R ¹	R ²	n	R ¹	R ²	n
H	H	2	α-Pr	Me	1
H	H	3	α-Pr	Me	2
H	H	4	α-Pr	Me	3
H	Me	2	α-Pr	Me	4
H	Me	3	Me	F	1
H	Me	4	Me	Cl	2
H	OMe	2	Me	Br	3
H	SMe	3	Me	CN	4
H	Cl	4	Me	Et	1
H	OEt	3	Me	OH	2
H	Ph	3	H	n-Hex	3
Me	H	1	H	t-Bu	4
Me	H	2	H	CF ₃	2
Me	H	3	Me	SMe	3
Me	H	4	Me	S(O) ₂ -n-Bu	2
Me	Me	1	Me	2-Me-α-Pr	3
Me	Me	2	α-Hex	H	2
Me	Me	3	Me	OMe	3
Me	Me	4	Me	OCH ₂ CF ₃	2
Me	OMe	2	Me	OCH ₂ OMe	3
Me	OMe	3	Me	CH=CHMe	2
Me	OMe	4	OCH ₂ CH=CH ₂	H	3
Et	H	2	OH	Me	2

Et	H	3	n-Bu	NMe ₂	3
Et	H	4	C≡C-Me	H	2
CF ₃	H	3	Me	OPh	3
i-Pr	H	3	Ph	OCH ₂ C≡CH	2
n-Bu	H	3	Me	1-piperidinyl	3
α-Hex	H	3	CH=CCl ₂	H	2
Ph	H	2	NHEt	H	3
t-Bu	H	3	Me	4-CF ₃ -Ph	3
OMe	H	3	CH ₂ CH ₂ OMe	S(O)Me	3
SMe	H	2	CH ₂ C≡CH	H	3

X and Z are CH; Y is N; R³, R⁷ and R⁸ are H

R ¹	R ²	n	R ¹	R ²	n
H	H	2	α-Pr	Me	1
H	H	3	α-Pr	Me	2
H	H	4	α-Pr	Me	3
H	α-Pr	2	α-Pr	Me	4
H	α-Pr	3	Me	F	1
H	α-Pr	4	Me	Cl	2
H	OMe	2	Me	Br	3
H	SMe	3	Me	CN	4
H	Cl	4	Me	Et	1
H	OEt	3	Me	OH	2
H	Ph	3	H	n-Hex	3
Me	H	1	H	t-Bu	4
Me	H	2	H	CF ₃	2
Me	H	3	Me	SMe	3
Me	H	4	Me	S(O) ₂ -n-Bu	2
Me	Me	1	Me	2-Me-α-Pr	3
Me	Me	2	α-Hex	H	2
Me	Me	3	Me	OMe	3
Me	Me	4	Me	OCH ₂ CF ₃	2
Me	OMe	2	Me	OCH ₂ OMe	3
Me	OMe	3	Me	CH=CHMe	2
Me	OMe	4	OCH ₂ CH=CH ₂	H	3

Et	H	2	OH	Me	2
Et	H	3	n-Bu	NMe ₂	3
Et	H	4	C≡C-Me	H	2
CF ₃	H	3	Me	OPh	3
i-Pr	H	3	Ph	OCH ₂ C≡CH	2
n-Bu	H	3	Me	1-piperidinyl	3
α-Hex	H	3	CH=CCl ₂	H	2
Ph	H	2	NHEt	H	3
t-Bu	H	3	Me	4-CF ₃ -Ph	3
OMe	H	3	CH ₂ CH ₂ OMe	S(O)Me	3
SMe	H	2	CH ₂ C≡CH	H	3

X is CH; Y and Z are N; R³, R⁷ and R⁸ are H

R ¹	R ²	n	R ¹	R ²	n
H	H	2	α-Pr	Me	1
H	H	3	α-Pr	Me	2
H	H	4	α-Pr	Me	3
H	α-Pr	2	α-Pr	Me	4
H	α-Pr	3	Me	F	1
H	α-Pr	4	Me	Cl	2
H	OMe	2	Me	Br	3
H	SMe	3	Me	CN	4
H	Cl	4	Me	Et	1
H	OEt	3	Me	OH	2
H	Ph	3	H	n-Hex	3
Me	H	1	H	t-Bu	4
Me	H	2	H	CF ₃	2
Me	H	3	Me	SMe	3
Me	H	4	Me	S(O) ₂ -n-Bu	2
Me	Me	1	Me	2-Me-α-Pr	3
Me	Me	2	α-Hex	H	2
Me	Me	3	Me	OMe	3
Me	Me	4	Me	OCH ₂ CF ₃	2
Me	OMe	2	Me	OCH ₂ OMe	3
Me	OMe	3	Me	CH=CHMe	2

Me	OMe	4	OCH ₂ CH=CH ₂	H	3
Et	H	2	OH	Me	2
Et	H	3	n-Bu	NMe ₂	3
Et	H	4	C≡C-Me	H	2
CF ₃	H	3	Me	OPh	3
i-Pr	H	3	Ph	OCH ₂ C≡CH	2
n-Bu	H	3	Me	1-piperidinyl	3
α-Hex	H	3	CH=CCl ₂	H	2
Ph	H	2	NHEt	H	3
t-Bu	H	3	Me	4-CF ₃ -Ph	3
OMe	H	3	CH ₂ CH ₂ OMe	S(O)Me	3
SMe	H	2	CH ₂ C≡CH	H	3

X is CR⁴; R¹ is Me; R², R³, R⁷ and R⁸ are H

X	Z	R ⁴	n	X	Z	R ⁴	n
N	CH	F	1	CH	N	CH ₂ OEt	3
N	CH	Cl	2	CH	N	vinyl	3
N	CH	Br	3	CH	CH	CH=CF ₂	3
N	CH	I	4	CH	CH	OCH ₂ CH=CH ₂	3
N	CH	CN	2	CH	CH	C≡C-Me	3
N	CH	OH	3	CH	CH	OCH ₂ C≡C-Me	3
N	CH	Me	4	CH	CH	NH ₂	3
N	CH	i-Pr	2	CH	CH	4-CF ₃ Ph	3
N	CH	n-Bu	3	CH	CH	OPh	3
N	N	CH ₂ Cl	4	N	CH	F	3
N	N	n-C ₄ F ₉	2	CH	N	F	3
N	N	S-sec-Bu	3	CH	CH	F	3
CH	N	S(O)Me	2	N	CH	Cl	3
CH	N	S(O) ₂ Et	3	CH	N	Cl	3
CH	N	α-Pr	2	N	CH	Me	3
CH	N	O-i-Pr	3	CH	N	Me	3
CH	N	OCH ₂ CF ₃	2				

X is CH; R¹ and R² are Me; R⁷ and R⁸ are H

X	Z	R ³	n	X	Z	R ³	n
N	CH	F	1	CH	N	C≡CH	3
N	CH	Cl	2	CH	N	OCH ₂ C≡C-Me	3
N	CH	CN	3	CH	CH	4-morpholinyl	3
N	CH	OH	4	CH	CH	NEt ₂	3
N	CH	Me	2	CH	CH	2-Me-Ph	3
N	CH	n-Pr	3	CH	CH	4-OCF ₂ CF ₂ H-Ph	3
N	CH	CF ₃	4	CH	CH	O-3-F-Ph	3
N	CH	SEt	2	N	CH	Me	3
N	CH	S(O) ₂ Me	3	CH	N	Me	3
N	N	2-Me- <u>g</u> -Pr	4	CH	CH	Me	3
N	N	O-n-Bu	2	N	CH	OMe	3
N	N	OMe	3	CH	N	OMe	3
CH	N	OCHF ₂	2	N	CH	SMe	3
CH	N	CH ₂ OMe	3	CH	N	SMe	3
CH	N	CH=CHMe	2	N	CH	OCHF ₂	3
CH	N	CH=CCl ₂	3	CH	N	OCHF ₂	3
CH	N	OCH(Me)CH=CH ₂	2				

X and Y are CH; Z is N; R³ and R⁸ are H

R ¹	R ²	R ⁷	n	R ¹	R ²	R ⁷	n
Me	H	6-F	1	Me	Me	3-OCH ₂ C≡CH	3
Me	H	4-Cl	2	Me	Me	4-OMe	2
Me	H	5-CN	3	Me	Me	3-O-i-Pr	3
Me	H	5-NO ₂	4	Me	Me	4-OCF ₂	3
Me	H	4-OH	1	Me	Me	5-CH ₂ OEt	3
Me	H	5-CO ₂ H	2	H	H	4-CO ₂ Me	3
Me	H	4-Me	3	H	H	6-OCH ₂ OMe	3
Me	H	3-n-Hex	4	H	H	4-NHEt	3
Me	H	4-CH ₂ CF ₃	2	H	H	5-C(=O)NMe ₂	3
Me	H	4-S-i-Pr	3	H	Me	4-Ph	3
Me	H	5-S(O) ₂ Et	4	H	Me	5-(4-F-Ph)	3
Me	Me	4-TMS	2	H	CF ₃	4-OPh	3
Me	Me	4- <u>g</u> -Hex	3	<u>g</u> -Pr	H	5-SPh	3

Me	Me	4-Ac	4	Me	H	3-Me	3
Me	Me	5-CH ₂ CH=CH ₂	2	Me	H	5-Me	3
Me	Me	4-OCH ₂ CH=CHMe	3	Me	H	6-Me	3
Me	Me	4-C≡C-Me	2				

X and Y are CH; Z is N; R¹ is Me; R³ is H

R ²	R ⁷	R ⁸	n	R ²	R ⁷	R ⁸	n
H	3-F	6-F	2	Me	6-Me	5-Me	3
H	5-Cl	4-Cl	3	Me	4-OMe	5-Me	3
H	5-Me	4-Br	4	Me	4-OCF ₃	5-Me	3
H	4-Me	5-Me	2	Me	3-Cl	5-Cl	3
H	4-Me	5-Me	3	Me	3-F	5-F	3
H	4-Me	5-Me	4	H	4-F	H	3
H	5-F	4-Et	2	H	4-Cl	H	3
H	6-OMe	4-Et	3	H	4- <u>i</u> -Pr	H	3
H	4-Me	3- <u>n</u> -Pr	4	H	4-OCF ₃	H	3
H	5-Cl	4-CF ₃	2	H	4-OMe	H	3
H	3-Br	4-CH ₂ CF ₃	3	H	4-Et	H	3
Me	5-OMe	4-OMe	2	H	4- <u>t</u> -Bu	H	3
Me	4-F	5-OEt	3	H	4-TMS	H	3
Me	5-Cl	4-OCHF ₂	2	H	4-TBS	H	3
Me	4-F	5-Me	3	H	4-I	H	3
Me	3-F	5-Me	2	H	4-OEt	H	3
Me	3-Me	5-Me	3				

X, Y and Z are CH; R³ and R⁸ are H

R ¹	R ²	R ⁷	n	R ¹	R ²	R ⁷	n
Me	H	6-F	1	Me	Me	3-OCH ₂ C≡CH	3
Me	H	4-Cl	2	Me	Me	4-OMe	2
Me	H	5-CN	3	Me	Me	3-O- <u>i</u> -Pr	3
Me	H	5-NO ₂	4	Me	Me	4-OCF ₂	3
Me	H	4-OH	1	Me	Me	5-CH ₂ OEt	3
Me	H	5-CO ₂ H	2	H	H	4-CO ₂ Me	3
Me	H	4-Me	3	H	H	6-OCH ₂ OMe	3
Me	H	3- <u>n</u> -Hex	4	H	H	4-NHEt	3

Me	H	4-CH ₂ CF ₃	2	H	H	5-C(=O)NMe ₂	3
Me	H	4-S- <u>1</u> -Pr	3	H	Me	4-Ph	3
Me	H	5-S(O) ₂ Et	4	H	Me	5-(4-F-Ph)	3
Me	Me	4-TMS	2	H	CF ₃	4-OPh	3
Me	Me	4- <u>2</u> -Hex	3	<u>2</u> -Pr	H	5-SPh	3
Me	Me	4-Ac	4	Me	H	3-Me	3
Me	Me	5-CH ₂ CH=CH ₂	2	Me	H	5-Me	3
Me	Me	4-OCH ₂ CH=CHMe	3	Me	H	6-Me	3
Me	Me	4-C≡C-Me	2				

X, Y and Z are CH; R¹ is Me; R³ is H

R ²	R ⁷	R ⁸	n	R ²	R ⁷	R ⁸	n
H	3-F	6-F	2	Me	6-Me	5-Me	3
H	5-Cl	4-Cl	3	Me	4-OMe	5-Me	3
H	5-Me	4-Br	4	Me	4-OCF ₃	5-Me	3
H	4-Me	5-Me	2	Me	3-Cl	5-Cl	3
H	4-Me	5-Me	3	Me	3-F	5-F	3
H	4-Me	5-Me	4	H	4-F	H	3
H	5-F	4-Et	2	H	4-Cl	H	3
H	6-OMe	4-Et	3	H	4- <u>1</u> -Pr	H	3
H	4-Me	3-n-Pr	4	H	4-OCF ₃	H	3
H	5-Cl	4-CF ₃	2	H	4-OMe	H	3
H	3-Br	4-CH ₂ CF ₃	3	H	4-Et	H	3
Me	5-OMe	4-OMe	2	H	4- <u>1</u> -Bu	H	3
Me	4-F	5-OEt	3	H	4-TMS	H	3
Me	5-Cl	4-OCHF ₂	2	H	4-TBS	H	3
Me	4-F	5-Me	3	H	4-I	H	3
Me	3-F	5-Me	2	H	4-OEt	H	3
Me	3-Me	5-Me	3				

X and Z are CH; Y is N; R³ and R⁸ are H

R ¹	R ²	R ⁷	n	R ¹	R ²	R ⁷	n
Me	H	6-F	1	Me	Me	3-OCH ₂ C≡CH	3
Me	H	4-Cl	2	Me	Me	4-OMe	2
Me	H	5-CN	3	Me	Me	3-O- <u>1</u> -Pr	3

Me	H	5-NO ₂	4	Me	Me	4-OCF ₂	3
Me	H	4-OH	1	Me	Me	5-CH ₂ OEt	3
Me	H	5-CO ₂ H	2	H	H	4-CO ₂ Me	3
Me	H	4-Me	3	H	H	6-OCH ₂ OMe	3
Me	H	3-n-Hex	4	H	H	4-NHEt	3
Me	H	4-CH ₂ CF ₃	2	H	H	5-C(=O)NMe ₂	3
Me	H	4-S-i-Pr	3	H	Me	4-Ph	3
Me	H	5-S(O) ₂ Et	4	H	Me	5-(4-F-Ph)	3
Me	Me	4-TMS	2	H	CF ₃	4-OPh	3
Me	Me	4- <u>g</u> -Hex	3	<u>g</u> -Pr	H	5-SPh	3
Me	Me	4-Ac	4	Me	H	3-Me	3
Me	Me	5-CH ₂ CH=CH ₂	2	Me	H	5-Me	3
Me	Me	4-OCH ₂ CH=CHMe	3	Me	H	6-Me	3
Me	Me	4-C≡C-Me	2				

X and Z are CH; Y is N; R¹ is Me; R³ is H

R ²	R ⁷	R ⁸	n	R ²	R ⁷	R ⁸	n
H	3-F	6-F	2	Me	6-Me	5-Me	3
H	5-Cl	4-Cl	3	Me	4-OMe	5-Me	3
H	5-Me	4-Br	4	Me	4-OCF ₃	5-Me	3
H	4-Me	5-Me	2	Me	3-Cl	5-Cl	3
H	4-Me	5-Me	3	Me	3-F	5-F	3
H	4-Me	5-Me	4	H	4-F	H	3
H	5-F	4-Et	2	H	4-Cl	H	3
H	6-OMe	4-Et	3	H	4-i-Pr	H	3
H	4-Me	3-n-Pr	4	H	4-OCF ₃	H	3
H	5-Cl	4-CF ₃	2	H	4-OMe	H	3
H	3-Br	4-CH ₂ CF ₃	3	H	4-Et	H	3
Me	5-OMe	4-OMe	2	H	4-t-Bu	H	3
Me	4-F	5-OEt	3	H	4-TMS	H	3
Me	5-Cl	4-OCHF ₂	2	H	4-TBS	H	3
Me	4-F	5-Me	3	H	4-I	H	3
Me	3-F	5-Me	2	H	4-OEt	H	3
Me	3-Me	5-Me	3				

R^2, R^3, R^7 and R^8 are H; X is CR^4

Y	Z	R^1-R^4	n	Y	Z	R^1-R^4	n
N	CH	$-(CH_2)_3-$	2	CH	CH	$-(CH_2)_4-$	2
N	CH	$-(CH_2)_3-$	3	CH	CH	$-(CH_2)_4-$	3
N	CH	$-(CH_2)_3-$	4	CH	CH	$-(CH_2)_4-$	4
CH	N	$-(CH_2)_3-$	2	N	N	$-(CH_2)_4-$	2
CH	N	$-(CH_2)_3-$	3	N	N	$-(CH_2)_4-$	3
CH	N	$-(CH_2)_3-$	4	N	CH	$-CH=CH-CH=CH-$	1
CH	CH	$-(CH_2)_3-$	2	N	CH	$-CH=CH-CH=CH-$	2
CH	CH	$-(CH_2)_3-$	3	N	CH	$-CH=CH-CH=CH-$	3
CH	CH	$-(CH_2)_3-$	4	CH	N	$-CH=CH-CH=CH-$	2
N	N	$-(CH_2)_3-$	2	CH	N	$-CH=CH-CH=CH-$	3
N	N	$-(CH_2)_3-$	3	CH	N	$-CH=CH-CH=CH-$	4
N	CH	$-(CH_2)_4-$	1	CH	CH	$-CH=CH-CH=CH-$	2
N	CH	$-(CH_2)_4-$	2	CH	CH	$-CH=CH-CH=CH-$	3
N	CH	$-(CH_2)_4-$	3	CH	CH	$-CH=CH-CH=CH-$	4
CH	N	$-(CH_2)_4-$	2	N	N	$-CH=CH-CH=CH-$	2
CH	N	$-(CH_2)_4-$	3	N	N	$-CH=CH-CH=CH-$	3
CH	N	$-(CH_2)_4-$	4				

R^1 is Me; R^3, R^7 and R^8 are H; X is CR^4

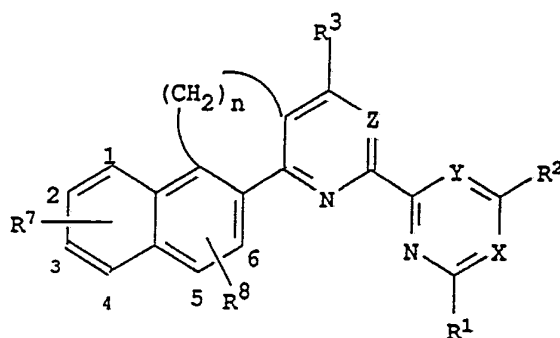
Y	Z	R^2-R^4	n	Y	Z	R^2-R^4	n
N	CH	$-(CH_2)_3-$	2	CH	N	$-(CH_2)_4-$	3
N	CH	$-(CH_2)_3-$	3	CH	CH	$-(CH_2)_4-$	2
CH	N	$-(CH_2)_3-$	2	CH	CH	$-(CH_2)_4-$	3
CH	N	$-(CH_2)_3-$	3	N	CH	$-CH=CH-CH=CH-$	2
CH	CH	$-(CH_2)_3-$	2	N	CH	$-CH=CH-CH=CH-$	3
CH	CH	$-(CH_2)_3-$	3	N	CH	$-CH=CH-CH=CH-$	4
N	CH	$-(CH_2)_4-$	2	CH	N	$-CH=CH-CH=CH-$	2
N	CH	$-(CH_2)_4-$	3	CH	N	$-CH=CH-CH=CH-$	3
CH	N	$-(CH_2)_4-$	2	CH	N	$-CH=CH-CH=CH-$	4

R^1 is Me; R^3, R^7 and R^8 are H; Y is CR^5

X	Z	R^2-R^5	n	X	Z	R^2-R^5	n
CH	N	$-(CH_2)_3-$	2	N	CH	$-(CH_2)_3-$	2

CH	N	-(CH ₂) ₃ -	3	N	CH	-CH=CH-CH=CH-	3
CH	N	-CH=CH-CH=CH-	2	N	CH	-CH=CH-CH=CH-	4
CH	N	-CH=CH-CH=CH-	3	N	N	-CH=CH-CH=CH-	2
CH	CH	-CH=CH-CH=CH-	2	N	N	-CH=CH-CH=CH-	3
CH	CH	-CH=CH-CH=CH-	3				

Table 2



R¹ is Me; R², R³, R⁷ and R⁸ are H

X	Y	Z	n	X	Y	Z	n
N	CH	CH	1	CH	N	COEt	3
N	CH	CH	2	CH	N	CF	1
N	CH	CH	3	CH	N	CF	2
N	CH	N	2	CH	N	CF	3
N	CH	N	3	CH	CH	CMe	2
N	CH	N	4	CH	CH	CMe	3
N	CH	CMe	3	CH	CH	CF	2
N	CH	CF	3	CH	CH	CF	3
CH	N	CEt	3	CH	CH	COEt	3
CH	N	COMe	3	CH	CH	CEt	3
CH	N	CCl	3	CH	CH	CBr	3
CH	N	CBr	3	CH	CH	COMe	3

R¹ and R² are Me; R³, R⁷ and R⁸ are H

X	Y	Z	n	X	Y	Z	n
N	N	CH	2	CH	COEt	N	3

N	N	CH	3	CH	CF	N	2
N	N	N	3	CH	CF	N	3
N	N	N	4	CH	CMe	N	4
N	CH	CH	2	CH	CF	CH	3
N	CH	CH	3	CH	CMe	CH	3
N	CH	N	3	CH	COMe	CH	3
N	CH	N	4	CH	CEt	CH	3
CH	CCl	N	3	CH	COEt	CH	3
CH	CBr	N	3	CH	CI	CH	2
CH	CEt	N	3	CH	CMe	CF	3
CH	COMe	N	3	CH	CMe	CMe	3

X and Y are CH; Z is N; R³, R⁷ and R⁸ are H

R ¹	R ²	n	R ¹	R ²	n
H	H	2	α -Pr	Me	1
H	H	3	α -Pr	Me	2
H	H	4	α -Pr	Me	3
H	Me	2	α -Pr	Me	4
H	Me	3	Me	F	1
H	Me	4	Me	Cl	2
H	OMe	2	Me	Br	3
H	SMe	3	Me	CN	4
H	Cl	4	Me	Et	1
H	OEt	3	Me	OH	2
H	Ph	3	H	n-Hex	3
Me	H	1	H	t-Bu	4
Me	H	2	H	CF ₃	2
Me	H	3	Me	SMe	3
Me	H	4	Me	S(O) ₂ -n-Bu	2
Me	Me	1	Me	2-Me- α -Pr	3
Me	Me	2	α -Hex	H	2
Me	Me	3	Me	OMe	3
Me	Me	4	Me	OCH ₂ CF ₃	2
Me	OMe	2	Me	OCH ₂ OMe	3
Me	OMe	3	Me	CH=CHMe	2

Me	OMe	4	OCH ₂ CH=CH ₂	H	3
Et	H	2	OH	Me	2
Et	H	3	n-Bu	NMe ₂	3
Et	H	4	C≡C-Me	H	2
CF ₃	H	3	Me	OPh	3
i-Pr	H	3	Ph	OCH ₂ C≡CH	2
n-Bu	H	3	Me	1-piperidinyl	3
α-Hex	H	3	CH=CCl ₂	H	2
Ph	H	2	NHEt	H	3
t-Bu	H	3	Me	4-CF ₃ -Ph	3
OMe	H	3	CH ₂ CH ₂ OMe	S(O)Me	3
SMe	H	2	CH ₂ C≡CH	H	3

X, Y and Z are CH; R³, R⁷ and R⁸ are H

R ¹	R ²	n	R ¹	R ²	n
H	H	2	α-Pr	Me	1
H	H	3	α-Pr	Me	2
H	H	4	α-Pr	Me	3
H	Me	2	α-Pr	Me	4
H	Me	3	Me	F	1
H	Me	4	Me	Cl	2
H	OMe	2	Me	Br	3
H	SMe	3	Me	CN	4
H	Cl	4	Me	Et	1
H	OEt	3	Me	OH	2
H	Ph	3	H	n-Hex	3
Me	H	1	H	t-Bu	4
Me	H	2	H	CF ₃	2
Me	H	3	Me	SMe	3
Me	H	4	Me	S(O) ₂ -n-Bu	2
Me	Me	1	Me	2-Me-α-Pr	3
Me	Me	2	α-Hex	H	2
Me	Me	3	Me	OMe	3
Me	Me	4	Me	OCH ₂ CF ₃	2
Me	OMe	2	Me	OCH ₂ OMe	3

Me	OMe	3	Me	CH=CHMe	2
Me	OMe	4	OCH ₂ CH=CH ₂	H	3
Et	H	2	OH	Me	2
Et	H	3	n-Bu	NMe ₂	3
Et	H	4	C≡C-Me	H	2
CF ₃	H	3	Me	OPh	3
i-Pr	H	3	Ph	OCH ₂ C≡CH	2
n-Bu	H	3	Me	1-piperidinyl	3
α-Hex	H	3	CH=CCl ₂	H	2
Ph	H	2	NHEt	H	3
t-Bu	H	3	Me	4-CF ₃ -Ph	3
OMe	H	3	CH ₂ CH ₂ OMe	S(O)Me	3
SMe	H	2	CH ₂ C≡CH	H	3

X and Z are CH; Y is N; R³, R⁷ and R⁸ are H

R ¹	R ²	n	R ¹	R ²	n
H	H	2	α-Pr	Me	1
H	H	3	α-Pr	Me	2
H	H	4	α-Pr	Me	3
H	α-Pr	2	α-Pr	Me	4
H	α-Pr	3	Me	F	1
H	α-Pr	4	Me	Cl	2
H	OMe	2	Me	Br	3
H	SMe	3	Me	CN	4
H	Cl	4	Me	Et	1
H	OEt	3	Me	OH	2
H	Ph	3	H	n-Hex	3
Me	H	1	H	t-Bu	4
Me	H	2	H	CF ₃	2
Me	H	3	Me	SMe	3
Me	H	4	Me	S(O) ₂ -n-Bu	2
Me	Me	1	Me	2-Me-α-Pr	3
Me	Me	2	α-Hex	H	2
Me	Me	3	Me	OMe	3
Me	Me	4	Me	OCH ₂ CF ₃	2

Me	OMe	2
Me	OMe	3
Me	OMe	4
Et	H	2
Et	H	3
Et	H	4
CF ₃	H	3
i-Pr	H	3
n-Bu	H	3
α-Hex	H	3
Ph	H	2
t-Bu	H	3
OMe	H	3
SMe	H	2

Me	OCH ₂ OMe	3
Me	CH=CHMe	2
OCH ₂ CH=CH ₂	H	3
OH	Me	2
n-Bu	NMe ₂	3
C≡C-Me	H	2
Me	OPh	3
Ph	OCH ₂ C≡CH	2
Me	1-piperidinyl	3
CH=CCl ₂	H	2
NHEt	H	3
Me	4-CF ₃ -Ph	3
CH ₂ CH ₂ OMe	S(O)Me	3
CH ₂ C≡CH	H	3

X is CR⁴; R¹ is Me; R², R³, R⁷ and R⁸ are H

Y	Z	R ⁴	n	Y	Z	R ⁴	n
N	CH	F	1	CH	N	CH ₂ OEt	3
N	CH	Cl	2	CH	N	vinyl	3
N	CH	Br	3	CH	CH	CH=CF ₂	3
N	CH	I	4	CH	CH	OCH ₂ CH=CH ₂	3
N	CH	CN	2	CH	CH	C≡C-Me	3
N	CH	OH	3	CH	CH	OCH ₂ C≡C-Me	3
N	CH	Me	4	CH	CH	NH ₂	3
N	CH	i-Pr	2	CH	CH	4-CF ₃ Ph	3
N	CH	n-Bu	3	CH	CH	OPh	3
N	N	CH ₂ Cl	4	N	CH	F	3
N	N	n-C ₄ F ₉	2	CH	N	F	3
N	N	S- <u>sec</u> -Bu	3	CH	CH	F	3
CH	N	S(O)Me	2	N	CH	Cl	3
CH	N	S(O) ₂ Et	3	CH	N	Cl	3
CH	N	α-Pr	2	N	CH	Me	3
CH	N	O-i-Pr	3	CH	N	Me	3
CH	N	OCH ₂ CF ₃	2				

X is CH; R¹ and R² are Me; R⁷ and R⁸ are H

X	Z	R ³	n	X	Z	R ³	n
N	CH	F	1	CH	N	C≡CH	3
N	CH	Cl	2	CH	N	OCH ₂ C≡C-Me	3
N	CH	CN	3	CH	CH	4-morpholinyl	3
N	CH	OH	4	CH	CH	NEt ₂	3
N	CH	Me	2	CH	CH	2-Me-Ph	3
N	CH	n-Pr	3	CH	CH	4-OCF ₂ CF ₂ H-Ph	3
N	CH	CF ₃	4	CH	CH	O-3-F-Ph	3
N	CH	SEt	2	N	CH	Me	3
N	CH	S(O) ₂ Me	3	CH	N	Me	3
N	N	2-Me- <i>g</i> -Pr	4	CH	CH	Me	3
N	N	O-n-Bu	2	N	CH	OMe	3
N	N	OMe	3	CH	N	OMe	3
CH	N	OCHF ₂	2	N	CH	SMe	3
CH	N	CH ₂ OMe	3	CH	N	SMe	3
CH	N	CH=CHMe	2	N	CH	OCHF ₂	3
CH	N	CH=CCl ₂	3	CH	N	OCHF ₂	3
CH	N	OCH(Me)CH=CH ₂	2				

X and Z are CH; Y is N; R³ and R⁸ are H

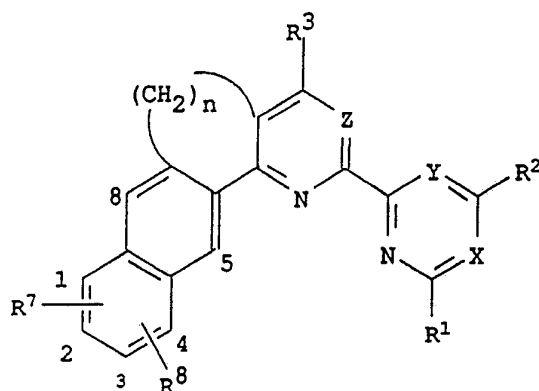
R ¹	R ²	R ⁷	n	R ¹	R ²	R ⁷	n
Me	H	6-F	1	Me	Me	3-OCH ₂ C≡CH	3
Me	H	4-Cl	2	Me	Me	4-OMe	2
Me	H	5-CN	3	Me	Me	3-O-i-Pr	3
Me	H	5-NO ₂	4	Me	Me	4-OCF ₂	3
Me	H	4-OH	1	Me	Me	5-CH ₂ OEt	3
Me	H	5-CO ₂ H	2	H	H	4-CO ₂ Me	3
Me	H	4-Me	3	H	H	6-OCH ₂ OMe	3
Me	H	3-n-Hex	4	H	H	4-NHEt	3
Me	H	4-CH ₂ CF ₃	2	H	H	5-C(=O)NMe ₂	3
Me	H	4-S-i-Pr	3	H	Me	4-Ph	3
Me	H	5-S(O) ₂ Et	4	H	Me	5-(4-F-Ph)	3
Me	Me	4-TMS	2	H	CF ₃	4-OPh	3
Me	Me	4- <i>g</i> -Hex	3	<i>g</i> -Pr	H	5-SPh	3

Me	Me	4-Ac	4	Me	H	3-Me	3
Me	Me	5-CH ₂ CH=CH ₂	2	Me	H	5-Me	3
Me	Me	4-OCH ₂ CH=CHMe	3	Me	H	6-Me	3
Me	Me	4-C≡C-Me	2				

X and Z are CH; Y is N; R¹ is Me; R³ is H

R ²	R ⁷	R ⁸	n	R ²	R ⁷	R ⁸	n
H	3-F	6-F	2	Me	6-Me	5-Me	3
H	5-Cl	4-Cl	3	Me	4-OMe	5-Me	3
H	5-Me	4-Br	4	Me	4-OCF ₃	5-Me	3
H	4-Me	5-Me	2	Me	3-Cl	5-Cl	3
H	4-Me	5-Me	3	Me	3-F	5-F	3
H	4-Me	5-Me	4	H	4-F	H	3
H	5-F	4-Et	2	H	4-Cl	H	3
H	6-OMe	4-Et	3	H	4-i-Pr	H	3
H	4-Me	3-n-Pr	4	H	4-OCF ₃	H	3
H	5-Cl	4-CF ₃	2	H	4-OMe	H	3
H	3-Br	4-CH ₂ CF ₃	3	H	4-Et	H	3
Me	5-OMe	4-OMe	2	H	4-t-Bu	H	3
Me	4-F	5-OEt	3	H	4-TMS	H	3
Me	5-Cl	4-OCHF ₂	2	H	4-TBS	H	3
Me	4-F	5-Me	3	H	4-I	H	3
Me	3-F	5-Me	2	H	4-OEt	H	3
Me	3-Me	5-Me	3				

Table 3



R^1 is Me; R^2 , R^3 , R^7 and R^8 are H

X	Y	Z	n	X	Y	Z	n
N	CH	CH	1	CH	N	COEt	3
N	CH	CH	2	CH	N	CF	1
N	CH	CH	3	CH	N	CF	2
N	CH	N	2	CH	N	CF	3
N	CH	N	3	CH	CH	CMe	2
N	CH	N	4	CH	CH	CMe	3
N	CH	CMe	3	CH	CH	CF	2
N	CH	CF	3	CH	CH	CF	3
CH	N	CEt	3	CH	CH	COEt	3
CH	N	COMe	3	CH	CH	CEt	3
CH	N	CCl	3	CH	CH	CBr	3
CH	N	CBr	3	CH	CH	COMe	3

R^1 and R^2 are Me; R^3 , R^7 and R^8 are H

X	Y	Z	n	X	Y	Z	n
N	N	CH	2	CH	COEt	N	3
N	N	CH	3	CH	CF	N	2
N	N	N	3	CH	CF	N	3
N	N	N	4	CH	CMe	N	4
N	CH	CH	2	CH	CF	CH	3
N	CH	CH	3	CH	CMe	CH	3
N	CH	N	3	CH	COMe	CH	3

N	CH	N	4	CH	CEt	CH	3
CH	CCl	N	3	CH	COEt	CH	3
CH	CBr	N	3	CH	Cl	CH	2
CH	CEt	N	3	CH	CMe	CF	3
CH	COMe	N	3	CH	CMe	CMe	3

X and Y are CH; Z is N; R³, R⁷ and R⁸ are H

R ¹	R ²	n	R ¹	R ²	n
H	H	2	α -Pr	Me	1
H	H	3	α -Pr	Me	2
H	H	4	α -Pr	Me	3
H	Me	2	α -Pr	Me	4
H	Me	3	Me	F	1
H	Me	4	Me	Cl	2
H	OMe	2	Me	Br	3
H	SMe	3	Me	CN	4
H	Cl	4	Me	Et	1
H	OEt	3	Me	OH	2
H	Ph	3	H	n-Hex	3
Me	H	1	H	i-Bu	4
Me	H	2	H	CF ₃	2
Me	H	3	Me	SMe	3
Me	H	4	Me	S(O) ₂ -n-Bu	2
Me	Me	1	Me	2-Me- α -Pr	3
Me	Me	2	α -Hex	H	2
Me	Me	3	Me	OMe	3
Me	Me	4	Me	OCH ₂ CF ₃	2
Me	OMe	2	Me	OCH ₂ OMe	3
Me	OMe	3	Me	CH=CHMe	2
Me	OMe	4	OCH ₂ CH=CH ₂	H	3
Et	H	2	OH	Me	2
Et	H	3	n-Bu	NMe ₂	3
Et	H	4	C $\equiv$ C-Me	H	2
CF ₃	H	3	Me	OPh	3
i-Pr	H	3	Ph	OCH ₂ C $\equiv$ CH	2

n-Bu	H	3	Me	1-piperidinyl	3
α -Hex	H	3	CH=CCl ₂	H	2
Ph	H	2	NHEt	H	3
t-Bu	H	3	Me	4-CF ₃ -Ph	3
OMe	H	3	CH ₂ CH ₂ OMe	S(O)Me	3
SMe	H	2	CH ₂ C $\equiv$ CH	H	

X and Z are CH; Y is N; R³, R⁷ and R⁸ are H

R ¹	R ²	n	R ¹	R ²	n
H	H	2	α -Pr	Me	1
H	H	3	α -Pr	Me	2
H	H	4	α -Pr	Me	3
H	α -Pr	2	α -Pr	Me	4
H	α -Pr	3	Me	F	1
H	α -Pr	4	Me	Cl	2
H	OMe	2	Me	Br	3
H	SMe	3	Me	CN	4
H	Cl	4	Me	Et	1
H	OEt	3	Me	OH	2
H	Ph	3	H	n-Hex	3
Me	H	1	H	t-Bu	4
Me	H	2	H	CF ₃	2
Me	H	3	Me	SMe	3
Me	H	4	Me	S(O) ₂ -n-Bu	2
Me	Me	1	Me	2-Me- α -Pr	3
Me	Me	2	α -Hex	H	2
Me	Me	3	Me	OMe	3
Me	Me	4	Me	OCH ₂ CF ₃	2
Me	OMe	2	Me	OCH ₂ OMe	3
Me	OMe	3	Me	CH=CHMe	2
Me	OMe	4	OCH ₂ CH=CH ₂	H	3
Et	H	2	OH	Me	2
Et	H	3	n-Bu	NMe ₂	3
Et	H	4	C $\equiv$ C-Me	H	2
CF ₃	H	3	Me	OPh	3

i-Pr	H	3	Ph	OCH ₂ C≡CH	2
n-Bu	H	3	Me	1-piperidinyl	3
o-Hex	H	3	CH=CCl ₂	H	2
Ph	H	2	NHEt	H	3
t-Bu	H	3	Me	4-CF ₃ -Ph	3
OMe	H	3	CH ₂ CH ₂ OMe	S(O)Me	3
SMe	H	2	CH ₂ C≡CH	H	3

X is CR⁴; R¹ is Me; R², R³, R⁷ and R⁸ are H

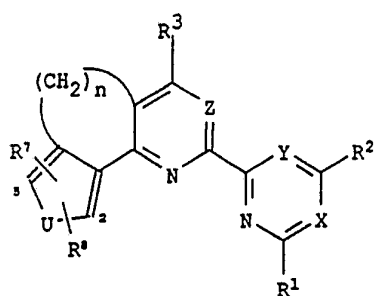
Y	Z	R ⁴	n	Y	Z	R ⁴	n
N	CH	F	1	CH	N	CH ₂ OEt	3
N	CH	Cl	2	CH	N	vinyl	3
N	CH	Br	3	CH	CH	CH=CF ₂	3
N	CH	I	4	CH	CH	OCH ₂ CH=CH ₂	3
N	CH	CN	2	CH	CH	C≡C-Me	3
N	CH	OH	3	CH	CH	OCH ₂ C≡C-Me	3
N	CH	Me	4	CH	CH	NH ₂	3
N	CH	i-Pr	2	CH	CH	4-CF ₃ Ph	3
N	CH	n-Bu	3	CH	CH	OPh	3
N	N	CH ₂ Cl	4	N	CH	F	3
N	N	n-C ₄ F ₉	2	CH	N	F	3
N	N	S-sec-Bu	3	CH	CH	F	3
CH	N	S(O)Me	2	N	CH	Cl	3
CH	N	S(O) ₂ Et	3	CH	N	Cl	3
CH	N	o-Pr	2	N	CH	Me	3
CH	N	O-i-Pr	3	CH	N	Me	3
CH	N	OCH ₂ CF ₃	2				

X is CH; R¹ and R² are Me; R⁷ and R⁸ are H

X	Z	R ³	n	X	Z	R ³	n
N	CH	F	1	CH	N	C≡CH	3
N	CH	Cl	2	CH	N	OCH ₂ C≡C-Me	3
N	CH	CN	3	CH	CH	4-morpholinyl	3
N	CH	OH	4	CH	CH	NEt ₂	3
N	CH	Me	2	CH	CH	2-Me-Ph	3

N	CH	n-Pr	3	CH	CH	4-OCF ₂ CF ₂ H-Ph	3
N	CH	CF ₃	4	CH	CH	O-3-F-Ph	3
N	CH	SEt	2	N	CH	Me	3
N	CH	S(O) ₂ Me	3	CH	N	Me	3
N	N	2-Me-n-Pr	4	CH	CH	Me	3
N	N	O-n-Bu	2	N	CH	OMe	3
N	N	OMe	3	CH	N	OMe	3
CH	N	OCHF ₂	2	N	CH	SMe	3
CH	N	CH ₂ OMe	3	CH	N	SMe	3
CH	N	CH=CHMe	2	N	CH	OCHF ₂	3
CH	N	CH=CCl ₂	3	CH	N	OCHF ₂	3
CH	N	OCH(Me)CH=CH ₂	2				

Table 4



wherein U is S, O, or N.

R¹ is Me; R², R³, R⁷ and R⁸ are H; U is S

X	Y	Z	n
N	CH	CH	1
N	CH	CH	2
N	CH	CH	3
N	CH	N	2
N	CH	N	3
N	CH	N	4
N	CH	CMe	3
N	CH	CF	3
CH	N	CEt	3
CH	N	COMe	3
CH	N	CCl	3

R¹ and R² are Me; R³, R⁷ and R⁸ are H; U is O

X	Y	Z	n
N	N	CH	2
N	N	CH	3
N	N	N	3
N	N	N	4
N	CH	CH	2
N	CH	CH	3
N	CH	N	3
N	CH	N	4
CH	CCl	N	3
CH	CBr	N	3
CH	CEt	N	3

CH	N	CBr	3
CH	N	COEt	3
CH	N	CF	1
CH	N	CF	2
CH	N	CF	3
CH	CH	CMe	2
CH	CH	CMe	3
CH	CH	CF	2
CH	CH	CF	3
CH	CH	COEt	3
CH	CH	CEt	3
CH	CH	CBr	3
CH	CH	COMe	3

CH	COMe	N	3
CH	COEt	N	3
CH	CF	N	2
CH	CF	N	3
CH	CMe	N	4
CH	CF	CH	3
CH	CMe	CH	3
CH	COMe	CH	3
CH	CEt	CH	3
CH	COEt	CH	3
CH	CI	CH	2
CH	CMe	CF	3
CH	CMe	CMe	3

X and Y are CH; Z is N; R³ and R⁸ are H; R⁷ is 5-Me; U is S;

R ¹	R ²	n
H	H	2
H	H	3
H	H	4
H	Me	2
H	Me	3
H	Me	4
H	OMe	2
H	SMe	3
H	Cl	4
H	OEt	3
H	Ph	3
Me	H	1
Me	H	2
Me	H	3
Me	H	4
Me	Me	1
Me	Me	2

R ¹	R ²	n
Me	Me	3
Me	Me	4
Me	OMe	2
Me	OMe	3
Me	OMe	4
Et	H	2
Et	H	3
Et	H	4
CF ₃	H	3
i-Pr	H	3
n-Bu	H	3
o-Hex	H	3
Ph	H	2
t-Bu	H	3
OMe	H	3
SMe	H	2

X and Y are CH; Z is N; R³, R⁷ and R⁸ are H; U is O

R ¹	R ²	n	R ¹	R ²	n
<i>q</i> -Pr	Me	1	Me	OMe	3
<i>q</i> -Pr	Me	2	Me	OCH ₂ CF ₃	2
<i>q</i> -Pr	Me	3	Me	OCH ₂ OMe	3
<i>q</i> -Pr	Me	4	Me	CH=CHMe	2
Me	F	1	OCH ₂ CH=CH ₂	H	3
Me	Cl	2	OH	Me	2
Me	Br	3	<i>n</i> -Bu	NMe ₂	3
Me	CN	4	C≡C-Me	H	2
Me	Et	1	Me	OPh	3
Me	OH	2	Ph	OCH ₂ C≡CH	2
H	<i>n</i> -Hex	3	Me	1-piperidinyl	3
H	<i>t</i> -Bu	4	CH=CCl ₂	H	2
H	CF ₃	2	NHEt	H	3
Me	SMe	3	Me	4-CF ₃ -Ph	3
Me	S(O) ₂ - <i>n</i> -Bu	2	CH ₂ CH ₂ OMe	S(O)Me	3
Me	2-Me- <i>q</i> -Pr	3	CH ₂ C≡CH	H	3
<i>q</i> -Hex	H	2			

X, Y and Z are CH; R³ and R⁸ are H; R⁷ is 5-Me; U is O

R ¹	R ²	n	R ¹	R ²	n
H	H	2	Me	Me	3
H	H	3	Me	Me	4
H	H	4	Me	OMe	2
H	Me	2	Me	OMe	3
H	Me	3	Me	OMe	4
H	Me	4	Et	H	2
H	OMe	2	Et	H	3
H	SMe	3	Et	H	4
H	Cl	4	CF ₃	H	3
H	OEt	3	<i>i</i> -Pr	H	3
H	Ph	3	<i>n</i> -Bu	H	3
Me	H	1	<i>q</i> -Hex	H	3
Me	H	2	Ph	H	2

Me	H	3	t-Bu	H	3
Me	H	4	OMe	H	3
Me	Me	1	SMe	H	2
Me	Me	2			

X, Y and Z are CH; R³ and R⁷ are H; R⁸ is Me; U is NR⁸

R ¹	R ²	n	R ¹	R ²	n
Q-Pr	Me	1	Me	OMe	3
Q-Pr	Me	2	Me	OCH ₂ CF ₃	2
Q-Pr	Me	3	Me	OCH ₂ OMe	3
Q-Pr	Me	4	Me	CH=CHMe	2
Me	F	1	OCH ₂ CH=CH ₂	H	3
Me	Cl	2	OH	Me	2
Me	Br	3	n-Bu	NMe ₂	3
Me	CN	4	C≡C-Me	H	2
Me	Et	1	Me	OPh	3
Me	OH	2	Ph	OCH ₂ C≡CH	2
H	n-Hex	3	Me	1-piperidinyl	3
H	t-Bu	4	CH=CCl ₂	H	2
H	CF ₃	2	NHEt	H	3
Me	SMe	3	Me	4-CF ₃ -Ph	3
Me	S(O) ₂ -n-Bu	2	CH ₂ CH ₂ OMe	S(O)Me	3
Me	2-Me-Q-Pr	3	CH ₂ C≡CH	H	3
Q-Hex	H	2			

X and Z are CH; Y is N; R³ and R⁸ are H; R⁷ is 5-Me; U is O

R ¹	R ²	n	R ¹	R ²	n
H	H	2	Me	Me	3
H	H	3	Me	Me	4
H	H	4	Me	OMe	2
H	Q-Pr	2	Me	OMe	3
H	Q-Pr	3	Me	OMe	4
H	Q-Pr	4	Et	H	2
H	OMe	2	Et	H	3
H	SMe	3	Et	H	4

H	Cl	4	CF ₃	H	3
H	OE _t	3	<i>i</i> -Pr	H	3
H	Ph	3	<i>n</i> -Bu	H	3
Me	H	1	<i>o</i> -Hex	H	3
Me	H	2	Ph	H	2
Me	H	3	<i>t</i> -Bu	H	3
Me	H	4	OMe	H	3
Me	Me	1	SMe	H	2
Me	Me	2			

X and Z are CH; Y is N; R³, R⁷ and R⁸ are H; U is S

R ¹	R ²	n	R ¹	R ²	n
<i>o</i> -Pr	Me	1	Me	OMe	3
<i>o</i> -Pr	Me	2	Me	OCH ₂ CF ₃	2
<i>o</i> -Pr	Me	3	Me	OCH ₂ OMe	3
<i>o</i> -Pr	Me	4	Me	CH=CHMe	2
Me	F	1	OCH ₂ CH=CH ₂	H	3
Me	Cl	2	OH	Me	2
Me	Br	3	<i>n</i> -Bu	NMe ₂	3
Me	CN	4	C≡C-Me	H	2
Me	Et	1	Me	OPh	3
Me	OH	2	Ph	OCH ₂ C≡CH	2
H	<i>n</i> -Hex	3	Me	1-piperidinyl	3
H	<i>t</i> -Bu	4	CH=CCl ₂	H	2
H	CF ₃	2	NHEt	H	3
Me	SMe	3	Me	4-CF ₃ -Ph	3
Me	S(O) ₂ - <i>n</i> -Bu	2	CH ₂ CH ₂ OMe	S(O)Me	3
Me	2-Me- <i>o</i> -Pr	3	CH ₂ C≡CH	H	3
<i>o</i> -Hex	H	2			

X is CR⁴; R¹ is Me; R², R³, R⁷ and R⁸ are H; U is NH

Y	Z	R ⁴	n	Y	Z	R ⁴	n
N	CH	F	1	CH	N	CH ₂ OE _t	3
N	CH	Cl	2	CH	N	vinyl	3
N	CH	Br	3	CH	CH	CH=CF ₂	3

N	CH	I	4	CH	CH	OCH ₂ CH=CH ₂	3
N	CH	CN	2	CH	CH	C≡C-Me	3
N	CH	OH	3	CH	CH	OCH ₂ C≡C-Me	3
N	CH	Me	4	CH	CH	NH ₂	3
N	CH	<i>i</i> -Pr	2	CH	CH	4-CF ₃ Ph	3
N	CH	<i>n</i> -Bu	3	CH	CH	OPh	3
N	N	CH ₂ Cl	4	N	CH	F	3
N	N	<i>n</i> -C ₄ F ₉	2	CH	N	F	3
N	N	<i>S</i> - <i>sec</i> -Bu	3	CH	CH	F	3
CH	N	S(O)Me	2	N	CH	Cl	3
CH	N	S(O) ₂ Et	3	CH	N	Cl	3
CH	N	<i>α</i> -Pr	2	N	CH	Me	3
CH	N	O- <i>i</i> -Pr	3	CH	N	Me	3
CH	N	OCH ₂ CF ₃	2				

X is CH; R¹ and R² are Me; R⁷ and R⁸ are H; U is S

X	Z	R ³	n	X	Z	R ³	n
N	CH	F	1	CH	N	C≡CH	3
N	CH	Cl	2	CH	N	OCH ₂ C≡C-Me	3
N	CH	CN	3	CH	CH	4-morpholinyl	3
N	CH	OH	4	CH	CH	NEt ₂	3
N	CH	Me	2	CH	CH	2-Me-Ph	3
N	CH	<i>n</i> -Pr	3	CH	CH	4-OCF ₂ CF ₂ H-Ph	3
N	CH	CF ₃	4	CH	CH	O-3-F-Ph	3
N	CH	SEt	2	N	CH	Me	3
N	CH	S(O) ₂ Me	3	CH	N	Me	3
N	N	2-Me- <i>α</i> -Pr	4	CH	CH	Me	3
N	N	O- <i>n</i> -Bu	2	N	CH	OMe	3
N	N	OMe	3	CH	N	OMe	3
CH	N	OCHF ₂	2	N	CH	SMe	3
CH	N	CH ₂ OMe	3	CH	N	SMe	3
CH	N	CH=CHMe	2	N	CH	OCHF ₂	3
CH	N	CH=CCl ₂	3	CH	N	OCHF ₂	3
CH	N	OCH(Me)CH=CH ₂	2				

R^2, R^3, R^7 and R^8 are H; X is CR^4 ; U is S

Y	Z	R^1-R^4	n	Y	Z	R^1-R^4	n
N	CH	$-(CH_2)_3-$	2	CH	CH	$-(CH_2)_4-$	2
N	CH	$-(CH_2)_3-$	3	CH	CH	$-(CH_2)_4-$	3
N	CH	$-(CH_2)_3-$	4	CH	CH	$-(CH_2)_4-$	4
CH	N	$-(CH_2)_3-$	2	N	N	$-(CH_2)_4-$	2
CH	N	$-(CH_2)_3-$	3	N	N	$-(CH_2)_4-$	3
CH	N	$-(CH_2)_3-$	4	N	CH	$-CH=CH-CH=CH-$	1
CH	CH	$-(CH_2)_3-$	2	N	CH	$-CH=CH-CH=CH-$	2
CH	CH	$-(CH_2)_3-$	3	N	CH	$-CH=CH-CH=CH-$	3
CH	CH	$-(CH_2)_3-$	4	CH	N	$-CH=CH-CH=CH-$	2
N	N	$-(CH_2)_3-$	2	CH	N	$-CH=CH-CH=CH-$	3
N	N	$-(CH_2)_3-$	3	CH	N	$-CH=CH-CH=CH-$	4
N	CH	$-(CH_2)_4-$	1	CH	CH	$-CH=CH-CH=CH-$	2
N	CH	$-(CH_2)_4-$	2	CH	CH	$-CH=CH-CH=CH-$	3
N	CH	$-(CH_2)_4-$	3	CH	CH	$-CH=CH-CH=CH-$	4
CH	N	$-(CH_2)_4-$	2	N	N	$-CH=CH-CH=CH-$	2
CH	N	$-(CH_2)_4-$	3	N	N	$-CH=CH-CH=CH-$	3
CH	N	$-(CH_2)_4-$	4				

R^1 is Me; R^3, R^7 and R^8 are H; X is CR^4 ; U is O

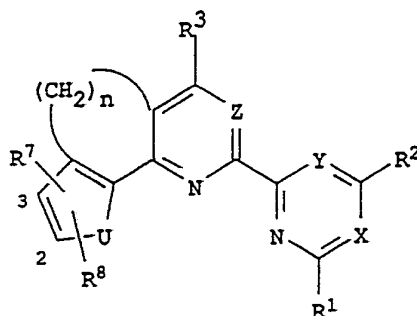
Y	Z	R^2-R^4	n	Y	Z	R^2-R^4	n
N	CH	$-(CH_2)_3-$	2	CH	N	$-(CH_2)_4-$	3
N	CH	$-(CH_2)_3-$	3	CH	CH	$-(CH_2)_4-$	2
CH	N	$-(CH_2)_3-$	2	CH	CH	$-(CH_2)_4-$	3
CH	N	$-(CH_2)_3-$	3	N	CH	$-CH=CH-CH=CH-$	2
CH	CH	$-(CH_2)_3-$	2	N	CH	$-CH=CH-CH=CH-$	3
CH	CH	$-(CH_2)_3-$	3	N	CH	$-CH=CH-CH=CH-$	4
N	CH	$-(CH_2)_4-$	2	CH	N	$-CH=CH-CH=CH-$	2
N	CH	$-(CH_2)_4-$	3	CH	N	$-CH=CH-CH=CH-$	3
CH	N	$-(CH_2)_4-$	2	CH	N	$-CH=CH-CH=CH-$	4

R^1 is Me; R^3 and R^8 are H; Y is CR^5 ; U is NR^7 ; R^7 is Me

X	Z	R^2-R^5	n	X	Z	R^2-R^5	n
CH	N	$-(CH_2)_3-$	2	N	CH	$-(CH_2)_3-$	2

CH	N	-(CH ₂) ₃ -	3	N	CH	-CH=CH-CH=CH-	3
CH	N	-CH=CH-CH=CH-	2	N	CH	-CH=CH-CH=CH-	4
CH	N	-CH=CH-CH=CH-	3	N	N	-CH=CH-CH=CH-	2
CH	CH	-CH=CH-CH=CH-	2	N	N	-CH=CH-CH=CH-	3
CH	CH	-CH=CH-CH=CH-	3				

Table 5



wherein U is S, O or N.

R¹ is Me; R², R³, R⁷ and R⁸
are H; U is O

X	Y	Z	n
N	CH	CH	1
N	CH	CH	2
N	CH	CH	3
N	CH	N	2
N	CH	N	3
N	CH	N	4
N	CH	CMe	3
N	CH	CF	3
CH	N	CEt	3
CH	N	COMe	3
CH	N	CCl	3
CH	N	CBr	3
CH	N	COEt	3
CH	N	CF	1
CH	N	CF	2
CH	N	CF	3
CH	CH	CMe	2
CH	CH	CMe	3

R¹ and R² are Me; R³, R⁷ and
R⁸ are H; U is S

X	Y	Z	n
N	N	CH	2
N	N	CH	3
N	N	N	3
N	N	N	4
N	CH	CH	2
N	CH	CH	3
N	CH	N	3
N	CH	N	4
CH	CCl	N	3
CH	CBr	N	3
CH	CEt	N	3
CH	COMe	N	3
CH	COEt	N	3
CH	CF	N	2
CH	CF	N	3
CH	CMe	N	4
CH	CF	CH	3
CH	CMe	CH	3

CH	CH	CF	2	CH	COMe	CH	3
CH	CH	CF	3	CH	CEt	CH	3
CH	CH	COEt	3	CH	COEt	CH	3
CH	CH	CEt	3	CH	CI	CH	2
CH	CH	CBr	3	CH	CMe	CF	3
CH	CH	COMe	3	CH	CMe	CMe	3

X, Y and Z are CH; R³ and R⁸ are H; R⁷ is 2-Me; U is S

R ¹	R ²	n	R ¹	R ²	n
H	H	2	Me	Me	3
H	H	3	Me	Me	4
H	H	4	Me	OMe	2
H	Me	2	Me	OMe	3
H	Me	3	Me	OMe	4
H	Me	4	Et	H	2
H	OMe	2	Et	H	3
H	SMe	3	Et	H	4
H	Cl	4	CF ₃	H	3
H	OEt	3	i-Pr	H	3
H	Ph	3	n-Bu	H	3
Me	H	1	α-Hex	H	3
Me	H	2	Ph	H	2
Me	H	3	t-Bu	H	3
Me	H	4	OMe	H	3
Me	Me	1	SMe	H	2
Me	Me	2			

X, Y and Z are CH; R³ and R⁸ are H; R⁷ is 2-Me; U is O

R ¹	R ²	n	R ¹	R ²	n
α-Pr	Me	1	Me	OMe	3
α-Pr	Me	2	Me	OCH ₂ CF ₃	2
α-Pr	Me	3	Me	OCH ₂ OMe	3
α-Pr	Me	4	Me	CH=CHMe	2
Me	F	1	OCH ₂ CH=CH ₂	H	3
Me	Cl	2	OH	Me	2

Me	Br	3	n-Bu	NMe ₂	3
Me	CN	4	C≡C-Me	H	2
Me	Et	1	Me	OPh	3
Me	OH	2	Ph	OCH ₂ C≡CH	2
H	n-Hex	3	Me	1-piperidiny1	3
H	t-Bu	4	CH=CCl ₂	H	2
H	CF ₃	2	NHEt	H	3
Me	SMe	3	Me	4-CF ₃ -Ph	3
Me	S(O) ₂ -n-Bu	2	CH ₂ CH ₂ OMe	S(O)Me	3
Me	2-Me- α -Pr	3	CH ₂ C≡CH	H	3
α -Hex	H	2			

X and Z are CH; Y is N; R³ and R⁸ are H; R⁷ is Me; U is NR⁷

R ¹	R ²	n	R ¹	R ²	n
H	H	2	Me	Me	3
H	H	3	Me	Me	4
H	H	4	Me	OMe	2
H	α -Pr	2	Me	OMe	3
H	α -Pr	3	Me	OMe	4
H	α -Pr	4	Et	H	2
H	OMe	2	Et	H	3
H	SMe	3	Et	H	4
H	Cl	4	CF ₃	H	3
H	OEt	3	i-Pr	H	3
H	Ph	3	n-Bu	H	3
Me	H	1	α -Hex	H	3
Me	H	2	Ph	H	2
Me	H	3	t-Bu	H	3
Me	H	4	OMe	H	3
Me	Me	1	SMe	H	2
Me	Me	2			

X and Z are CH; Y is N; R³, R⁷ and R⁸ are H; U is O

R ¹	R ²	n	R ¹	R ²	n
α -Pr	Me	1	Me	OMe	3

α -Pr	Me	2	Me	OCH ₂ CF ₃	2
α -Pr	Me	3	Me	OCH ₂ OMe	3
α -Pr	Me	4	Me	CH=CHMe	2
Me	F	1	OCH ₂ CH=CH ₂	H	3
Me	Cl	2	OH	Me	2
Me	Br	3	<i>n</i> -Bu	NMe ₂	3
Me	CN	4	C=C-Me	H	2
Me	Et	1	Me	OPh	3
Me	OH	2	Ph	OCH ₂ C $\equiv$ CH	2
H	<i>n</i> -Hex	3	Me	1-piperidinyl	3
H	<i>i</i> -Bu	4	CH=CCl ₂	H	2
H	CF ₃	2	NHEt	H	3
Me	SMe	3	Me	4-CF ₃ -Ph	3
Me	S(O) ₂ - <i>n</i> -Bu	2	CH ₂ CH ₂ OMe	S(O)Me	3
Me	2-Me- α -Pr	3	CH ₂ C $\equiv$ CH	H	3
α -Hex	H	2			

X is CR⁴; R¹ is Me; R², R³, R⁷ and R⁸ are H; U is S

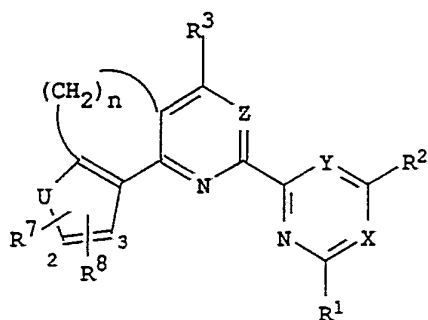
Y	Z	R ⁴	n	Y	Z	R ⁴	n
N	CH	F	1	CH	N	CH ₂ OEt	3
N	CH	Cl	2	CH	N	vinyl	3
N	CH	Br	3	CH	CH	CH=CF ₂	3
N	CH	I	4	CH	CH	OCH ₂ CH=CH ₂	3
N	CH	CN	2	CH	CH	C=C-Me	3
N	CH	OH	3	CH	CH	OCH ₂ C $\equiv$ C-Me	3
N	CH	Me	4	CH	CH	NH ₂	3
N	CH	<i>i</i> -Pr	2	CH	CH	4-CF ₃ Ph	3
N	CH	<i>n</i> -Bu	3	CH	CH	OPh	3
N	N	CH ₂ Cl	4	N	CH	F	3
N	N	<i>n</i> -C ₄ F ₉	2	CH	N	F	3
N	N	S- <i>sec</i> -Bu	3	CH	CH	F	3
CH	N	S(O)Me	2	N	CH	Cl	3
CH	N	S(O) ₂ Et	3	CH	N	Cl	3
CH	N	α -Pr	2	N	CH	Me	3

CH	N	O-i-Pr	3	CH	N	Me	3
CH	N	OCH ₂ CF ₃	2				

X is CH; R¹ and R² are Me; R⁷ is H; R⁸ is Et; U is O

X	Z	R ³	n	X	Z	R ³	n
N	CH	F	1	CH	N	C=CH	3
N	CH	Cl	2	CH	N	OCH ₂ C≡C-Me	3
N	CH	CN	3	CH	CH	4-morpholinyl	3
N	CH	OH	4	CH	CH	NEt ₂	3
N	CH	Me	2	CH	CH	2-Me-Ph	3
N	CH	n-Pr	3	CH	CH	4-OCF ₂ CF ₂ H-Ph	3
N	CH	CF ₃	4	CH	CH	O-3-F-Ph	3
N	CH	SEt	2	N	CH	Me	3
N	CH	S(O) ₂ Me	3	CH	N	Me	3
N	N	2-Me-G-Pr	4	CH	CH	Me	3
N	N	O-n-Bu	2	N	CH	OMe	3
N	N	OMe	3	CH	N	OMe	3
CH	N	OCHF ₂	2	N	CH	SMe	3
CH	N	CH ₂ OMe	3	CH	N	SMe	3
CH	N	CH=CHMe	2	N	CH	OCHF ₂	3
CH	N	CH=CCl ₂	3	CH	N	OCHF ₂	3
CH	N	OCH(Me)CH=CH ₂	2				

Table 6



wherein U is S, O or N.

R¹ is Me; R², R³ and R⁸ are H; R⁷ is 2-Me; U is O

X	Y	Z	n	X	Y	Z	n
N	CH	CH	1	CH	N	COEt	3
N	CH	CH	2	CH	N	CF	1

N	CH	CH	3	CH	N	CF	2
N	CH	N	2	CH	N	CF	3
N	CH	N	3	CH	CH	CMe	2
N	CH	N	4	CH	CH	CMe	3
N	CH	CMe	3	CH	CH	CF	2
N	CH	CF	3	CH	CH	CF	3
CH	N	CEt	3	CH	CH	COEt	3
CH	N	COMe	3	CH	CH	CEt	3
CH	N	CCl	3	CH	CH	CBr	3
CH	N	CBr	3	CH	CH	COMe	3

R^1 and R^2 are Me; R^3 , R^7 and R^8 are H; U is S

X	Y	Z	n	X	Y	Z	n
N	N	CH	2	CH	COEt	N	3
N	N	CH	3	CH	CF	N	2
N	N	N	3	CH	CF	N	3
N	N	N	4	CH	CMe	N	4
N	CH	CH	2	CH	CF	CH	3
N	CH	CH	3	CH	CMe	CH	3
N	CH	N	3	CH	COMe	CH	3
N	CH	N	4	CH	CEt	CH	3
CH	CCl	N	3	CH	COEt	CH	3
CH	CBr	N	3	CH	CI	CH	2
CH	CEt	N	3	CH	CMe	CF	3
CH	COMe	N	3	CH	CMe	CMe	3

X and Y are CH; Z is N; R^3 and R^8 are H; R^7 is 2-Me; U is O

R^1	R^2	n	R^1	R^2	n
H	H	2	Me	Me	3
H	H	3	Me	Me	4
H	H	4	Me	OMe	2
H	Me	2	Me	OMe	3
H	Me	3	Me	OMe	4
H	Me	4	Et	H	2
H	OMe	2	Et	H	3

H	SMe	3	Et	H	4
H	Cl	4	CF ₃	H	3
H	OEt	3	i-Pr	H	3
H	Ph	3	n-Bu	H	3
Me	H	1	α-Hex	H	3
Me	H	2	Ph	H	2
Me	H	3	t-Bu	H	3
Me	H	4	OMe	H	3
Me	Me	1	SMe	H	2
Me	Me	2			

X and Y are CH; Z is N; R³, R⁷ and R⁸ are H; U is S

R ¹	R ²	n	R ¹	R ²	n
α-Pr	Me	1	Me	OMe	3
α-Pr	Me	2	Me	OCH ₂ CF ₃	2
α-Pr	Me	3	Me	OCH ₂ OMe	3
α-Pr	Me	4	Me	CH=CHMe	2
Me	F	1	OCH ₂ CH=CH ₂	H	3
Me	Cl	2	OH	Me	2
Me	Br	3	n-Bu	NMe ₂	3
Me	CN	4	C≡C-Me	H	2
Me	Et	1	Me	OPh	3
Me	OH	2	Ph	OCH ₂ C≡CH	2
H	n-Hex	3	Me	1-piperidinyl	3
H	t-Bu	4	CH=CCl ₂	H	2
H	CF ₃	2	NHEt	H	3
Me	SMe	3	Me	4-CF ₃ -Ph	3
Me	S(O) ₂ -n-Bu	2	CH ₂ CH ₂ OMe	S(O)Me	3
Me	2-Me-α-Pr	3	CH ₂ C≡CH	H	3
α-Hex	H	2			

X and Z are CH; Y is N; R³ and R⁸ are H; R⁷ is Me; U is NR⁷

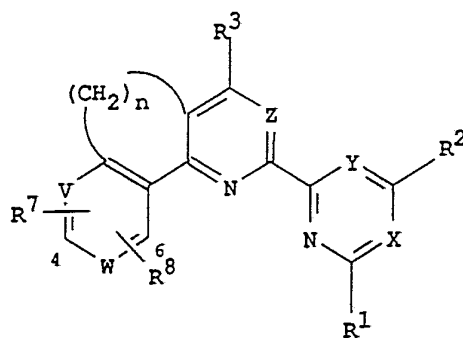
R ¹	R ²	n	R ¹	R ²	n
H	H	2	Me	Me	3
H	H	3	Me	Me	4

H	H	4	Me	OMe	2
H	α -Pr	2	Me	OMe	3
H	α -Pr	3	Me	OMe	4
H	α -Pr	4	Et	H	2
H	OMe	2	Et	H	3
H	SMe	3	Et	H	4
H	Cl	4	CF ₃	H	3
H	OEt	3	<i>i</i> -Pr	H	3
H	Ph	3	<i>n</i> -Bu	H	3
Me	H	1	α -Hex	H	3
Me	H	2	Ph	H	2
Me	H	3	<i>t</i> -Bu	H	3
Me	H	4	OMe	H	3
Me	Me	1	SMe	H	2
Me	Me	2			

X and Z are CH; Y is N; R³ and R⁸ are H; R⁷ is 2-*i*-Pr; U is S

R ¹	R ²	n	R ¹	R ²	n
α -Pr	Me	1	Me	OMe	3
α -Pr	Me	2	Me	OCH ₂ CF ₃	2
α -Pr	Me	3	Me	OCH ₂ OMe	3
α -Pr	Me	4	Me	CH=CHMe	2
Me	F	1	OCH ₂ CH=CH ₂	H	3
Me	Cl	2	OH	Me	2
Me	Br	3	<i>n</i> -Bu	NMe ₂	3
Me	CN	4	C≡C-Me	H	2
Me	Et	1	Me	OPh	3
Me	OH	2	Ph	OCH ₂ C≡CH	2
H	<i>n</i> -Hex	3	Me	1-piperidinyl	3
H	<i>t</i> -Bu	4	CH=CCl ₂	H	2
H	CF ₃	2	NHEt	H	3
Me	SMe	3	Me	4-CF ₃ -Ph	3
Me	S(O) ₂ - <i>n</i> -Bu	2	CH ₂ CH ₂ OMe	S(O)Me	3
Me	2-Me- α -Pr	3	CH ₂ C≡CH	H	3
α -Hex	H	2			

Table 7



wherein V and W are independently N or C.

R^1 is Me; R^2 , R^3 , R^7 and R^8 are H; V is N; W is CH

X	Y	Z	n	X	Y	Z	n
N	CH	CH	1	CH	N	COEt	3
N	CH	CH	2	CH	N	CF	1
N	CH	CH	3	CH	N	CF	2
N	CH	N	2	CH	N	CF	3
N	CH	N	3	CH	CH	CMe	2
N	CH	N	4	CH	CH	CMe	3
N	CH	CMe	3	CH	CH	CF	2
N	CH	CF	3	CH	CH	CF	3
CH	N	CEt	3	CH	CH	COEt	3
CH	N	COMe	3	CH	CH	CEt	3
CH	N	CCl	3	CH	CH	CBr	3
CH	N	CBr	3	CH	CH	COMe	3

R^1 and R^2 are Me; R^3 , R^7 and R^8 are H; V is CH; W is N

X	Y	Z	n	X	Y	Z	n
N	N	CH	2	CH	COEt	N	3
N	N	CH	3	CH	CF	N	2
N	N	N	3	CH	CF	N	3
N	N	N	4	CH	CMe	N	4
N	CH	CH	2	CH	CF	CH	3
N	CH	CH	3	CH	CMe	CH	3
N	CH	N	3	CH	COMe	CH	3

N	CH	N	4	CH	CEt	CH	3
CH	CCl	N	3	CH	COEt	CH	3
CH	CBr	N	3	CH	CI	CH	2
CH	CEt	N	3	CH	CMe	CF	3
CH	COMe	N	3	CH	CMe	CMe	3

X and Y are CH; Z is N; R³, R⁷ and R⁸ are H; V is N; W is CH

R ¹	R ²	n	R ¹	R ²	n
H	H	2	Me	Me	3
H	H	3	Me	Me	4
H	H	4	Me	OMe	2
H	Me	2	Me	OMe	3
H	Me	3	Me	OMe	4
H	Me	4	Et	H	2
H	OMe	2	Et	H	3
H	SMe	3	Et	H	4
H	Cl	4	CF ₃	H	3
H	OEt	3	i-Pr	H	3
H	Ph	3	n-Bu	H	3
Me	H	1	α-Hex	H	3
Me	H	2	Ph	H	2
Me	H	3	t-Bu	H	3
Me	H	4	OMe	H	3
Me	Me	1	SMe	H	2
Me	Me	2			

X and Y are CH; Z is N; R³ and R⁸ are H; R⁷ is 4-Me; V is CH; W is N

R ¹	R ²	n	R ¹	R ²	n
α-Pr	Me	1	Me	OMe	3
α-Pr	Me	2	Me	OCH ₂ CF ₃	2
α-Pr	Me	3	Me	OCH ₂ OMe	3
α-Pr	Me	4	Me	CH=CHMe	2
Me	F	1	OCH ₂ CH=CH ₂	H	3
Me	Cl	2	OH	Me	2
Me	Br	3	n-Bu	NMe ₂	3

Me	CN	4	C≡C-Me	H	2
Me	Et	1	Me	OPh	3
Me	OH	2	Ph	OCH ₂ C≡CH	2
H	n-Hex	3	Me	1-piperidiny1	3
H	t-Bu	4	CH=CCl ₂	H	2
H	CF ₃	2	NHEt	H	3
Me	SMe	3	Me	4-CF ₃ -Ph	3
Me	S(O) ₂ -n-Bu	2	CH ₂ CH ₂ OMe	S(O)Me	3
Me	2-Me- α -Pr	3	CH ₂ C≡CH	H	3
α -Hex	H	2			

X, Y and Z are CH; R³ and R⁸ are H; R⁷ is 4-Me; V and W are N

R ¹	R ²	n	R ¹	R ²	n
H	H	2	Me	Me	3
H	H	3	Me	Me	4
H	H	4	Me	OMe	2
H	Me	2	Me	OMe	3
H	Me	3	Me	OMe	4
H	Me	4	Et	H	2
H	OMe	2	Et	H	3
H	SMe	3	Et	H	4
H	Cl	4	CF ₃	H	3
H	OEt	3	i-Pr	H	3
H	Ph	3	n-Bu	H	3
Me	H	1	α -Hex	H	3
Me	H	2	Ph	H	2
Me	H	3	t-Bu	H	3
Me	H	4	OMe	H	3
Me	Me	1	SMe	H	2
Me	Me	2			

X, Y and Z are CH; R³ is H; R⁷ is 4-Me; R⁸ is Me; V is N; W is CR⁸

R ¹	R ²	n	R ¹	R ²	n
α -Pr	Me	1	Me	OMe	3
α -Pr	Me	2	Me	OCH ₂ CF ₃	2

α -Pr	Me	3	Me	OCH ₂ OMe	3
α -Pr	Me	4	Me	CH=CHMe	2
Me	F	1	OCH ₂ CH=CH ₂	H	3
Me	Cl	2	OH	Me	2
Me	Br	3	<i>n</i> -Bu	NMe ₂	3
Me	CN	4	C≡C-Me	H	2
Me	Et	1	Me	OPh	3
Me	OH	2	Ph	OCH ₂ C≡CH	2
H	<i>n</i> -Hex	3	Me	1-piperidinyl	3
H	<i>t</i> -Bu	4	CH=CCl ₂	H	2
H	CF ₃	2	NHEt	H	3
Me	SMe	3	Me	4-CF ₃ -Ph	3
Me	S(O) ₂ - <i>n</i> -Bu	2	CH ₂ CH ₂ OMe	S(O)Me	3
Me	2-Me- α -Pr	3	CH ₂ C≡CH	H	3
α -Hex	H	2			

X and Z are CH; Y is N; R³, R⁷ and R⁸ are H; V is N; W is CH

R ¹	R ²	<i>n</i>	R ¹	R ²	<i>n</i>
H	H	2	Me	Me	3
H	H	3	Me	Me	4
H	H	4	Me	OMe	2
H	α -Pr	2	Me	OMe	3
H	Me	3	Me	OMe	4
H	Me	4	Et	H	2
H	OMe	2	Et	H	3
H	SMe	3	Et	H	4
H	Cl	4	CF ₃	H	3
H	OEt	3	<i>i</i> -Pr	H	3
H	Ph	3	<i>n</i> -Bu	H	3
Me	H	1	α -Hex	H	3
Me	H	2	Ph	H	2
Me	H	3	<i>t</i> -Bu	H	3
Me	H	4	OMe	H	3
Me	Me	1	SMe	H	2
Me	Me	2			

X and Z are CH; Y is N; R³, R⁷ and R⁸ are H; V is CH; W is N

R ¹	R ²	n	R ¹	R ²	n
<i>iso</i> -Pr	Me	1	Me	OMe	3
<i>iso</i> -Pr	Me	2	Me	OCH ₂ CF ₃	2
<i>iso</i> -Pr	Me	3	Me	OCH ₂ OMe	3
<i>iso</i> -Pr	Me	4	Me	CH=CHMe	2
Me	F	1	OCH ₂ CH=CH ₂	H	3
Me	Cl	2	OH	Me	2
Me	Br	3	<i>n</i> -Bu	NMe ₂	3
Me	CN	4	C≡C-Me	H	2
Me	Et	1	Me	OPh	3
Me	OH	2	Ph	OCH ₂ C≡CH	2
H	<i>n</i> -Hex	3	Me	1-piperidinyl	3
H	<i>tert</i> -Bu	4	CH=CCl ₂	H	2
H	CF ₃	2	NHEt	H	3
Me	SMe	3	Me	4-CF ₃ -Ph	3
Me	S(O) ₂ - <i>n</i> -Bu	2	CH ₂ CH ₂ OMe	S(O)Me	3
Me	2-Me- <i>iso</i> -Pr	3	CH ₂ C≡CH	H	3
<i>iso</i> -Hex	H	2			

R², R³, R⁷ and R⁸ are H; X is CR⁴; V is N; W is CH

X	Z	R ¹ -R ⁴	n	X	Z	R ¹ -R ⁴	n
N	CH	-(CH ₂) ₃ -	2	CH	CH	-(CH ₂) ₄ -	2
N	CH	-(CH ₂) ₃ -	3	CH	CH	-(CH ₂) ₄ -	3
N	CH	-(CH ₂) ₃ -	4	CH	CH	-(CH ₂) ₄ -	4
CH	N	-(CH ₂) ₃ -	2	N	N	-(CH ₂) ₄ -	2
CH	N	-(CH ₂) ₃ -	3	N	N	-(CH ₂) ₄ -	3
CH	N	-(CH ₂) ₃ -	4	N	CH	-CH=CH-CH=CH-	1
CH	CH	-(CH ₂) ₃ -	2	N	CH	-CH=CH-CH=CH-	2
CH	CH	-(CH ₂) ₃ -	3	N	CH	-CH=CH-CH=CH-	3
CH	CH	-(CH ₂) ₃ -	4	CH	N	-CH=CH-CH=CH-	2
N	N	-(CH ₂) ₃ -	2	CH	N	-CH=CH-CH=CH-	3
N	N	-(CH ₂) ₃ -	3	CH	N	-CH=CH-CH=CH-	4
N	CH	-(CH ₂) ₄ -	1	CH	CH	-CH=CH-CH=CH-	2

N	CH	-(CH ₂) ₄ -	2	CH	CH	-CH=CH-CH=CH-	3
N	CH	-(CH ₂) ₄ -	3	CH	CH	-CH=CH-CH=CH-	4
CH	N	-(CH ₂) ₄ -	2	N	N	-CH=CH-CH=CH-	2
CH	N	-(CH ₂) ₄ -	3	N	N	-CH=CH-CH=CH-	3
CH	N	-(CH ₂) ₄ -	4				

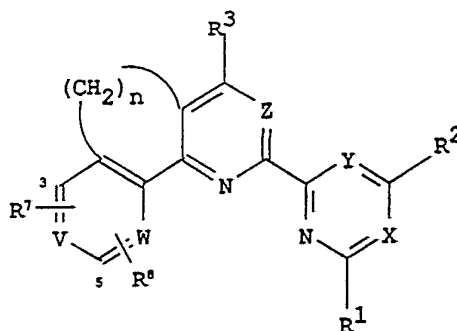
R¹ is Me; R³, R⁷ and R⁸ are H; X is CR⁴; W is CH; V is N

Y	Z	R ² -R ⁴	n	Y	Z	R ² -R ⁴	n
N	CH	-(CH ₂) ₃ -	2	CH	N	-(CH ₂) ₄ -	3
N	CH	-(CH ₂) ₃ -	3	CH	CH	-(CH ₂) ₄ -	2
CH	N	-(CH ₂) ₃ -	2	CH	CH	-(CH ₂) ₄ -	3
CH	N	-(CH ₂) ₃ -	3	N	CH	-CH=CH-CH=CH-	2
CH	CH	-(CH ₂) ₃ -	2	N	CH	-CH=CH-CH=CH-	3
CH	CH	-(CH ₂) ₃ -	3	N	CH	-CH=CH-CH=CH-	4
N	CH	-(CH ₂) ₄ -	2	CH	N	-CH=CH-CH=CH-	2
N	CH	-(CH ₂) ₄ -	3	CH	N	-CH=CH-CH=CH-	3
CH	N	-(CH ₂) ₄ -	2	CH	N	-CH=CH-CH=CH-	4

R¹ is Me; R³, R⁷ and R⁸ are H; Y is CR⁵; V and W are N

X	Z	R ² -R ⁵	n	X	Z	R ² -R ⁵	n
CH	N	-(CH ₂) ₃ -	2	N	CH	-(CH ₂) ₃ -	2
CH	N	-(CH ₂) ₃ -	3	N	CH	-CH=CH-CH=CH-	3
CH	N	-CH=CH-CH=CH-	2	N	CH	-CH=CH-CH=CH-	4
CH	N	-CH=CH-CH=CH-	3	N	N	-CH=CH-CH=CH-	2
CH	CH	-CH=CH-CH=CH-	2	N	N	-CH=CH-CH=CH-	3
CH	CH	-CH=CH-CH=CH-	3				

Table 8



wherein V and W are independently N or C.

R^1 is Me; R^2 , R^3 , R^7 and R^8 are H; V is N; W is CH

X	Y	Z	n	X	Y	Z	n
N	CH	CH	1	CH	N	COEt	3
N	CH	CH	2	CH	N	CF	1
N	CH	CH	3	CH	N	CF	2
N	CH	N	2	CH	N	CF	3
N	CH	N	3	CH	CH	CMe	2
N	CH	N	4	CH	CH	CMe	3
N	CH	CMe	3	CH	CH	CF	2
N	CH	CF	3	CH	CH	CF	3
CH	N	COEt	3	CH	CH	COEt	3
CH	N	COMe	3	CH	CH	COEt	3
CH	N	CCl	3	CH	CH	CBr	3
CH	N	CBr	3	CH	CH	COMe	3

R^1 and R^2 are Me; R^3 , R^7 and R^8 are H; V is CH; W is N

X	Y	Z	n	X	Y	Z	n
N	N	CH	2	CH	COEt	N	3
N	N	CH	3	CH	CF	N	2
N	N	N	3	CH	CF	N	3
N	N	N	4	CH	CMe	N	4
N	CH	CH	2	CH	CF	CH	3
N	CH	CH	3	CH	CMe	CH	3
N	CH	N	3	CH	COMe	CH	3

N	CH	N	4	CH	CEt	CH	3
CH	CCl	N	3	CH	COEt	CH	3
CH	CBr	N	3	CH	CI	CH	2
CH	CEt	N	3	CH	CMe	CF	3
CH	COMe	N	3	CH	CMe	CMe	3

X, Y and Z are CH; R³ and R⁷ are H; R⁸ is 5-Me; V is N; W is CH

R ¹	R ²	n	R ¹	R ²	n
H	H	2	Me	Me	3
H	H	3	Me	Me	4
H	H	4	Me	OMe	2
H	Me	2	Me	OMe	3
H	Me	3	Me	OMe	4
H	Me	4	Et	H	2
H	OMe	2	Et	H	3
H	SMe	3	Et	H	4
H	Cl	4	CF ₃	H	3
H	OEt	3	i-Pr	H	3
H	Ph	3	n-Bu	H	3
Me	H	1	α-Hex	H	3
Me	H	2	Ph	H	2
Me	H	3	t-Bu	H	3
Me	H	4	OMe	H	3
Me	Me	1	SMe	H	2
Me	Me	2			

X, Y and Z are CH; R³ and R⁷ are H; R⁸ is 5-Et; V and W are N

R ¹	R ²	n	R ¹	R ²	n
α-Pr	Me	1	Me	OMe	3
α-Pr	Me	2	Me	OCH ₂ CF ₃	2
α-Pr	Me	3	Me	OCH ₂ OMe	3
α-Pr	Me	4	Me	CH=CHMe	2
Me	F	1	OCH ₂ CH=CH ₂	H	3
Me	Cl	2	OH	Me	2
Me	Br	3	n-Bu	NMe ₂	3

Me	CN	4	C≡C-Me	H	2
Me	Et	1	Me	OPh	3
Me	OH	2	Ph	OCH ₂ C≡CH	2
H	n-Hex	3	Me	1-piperidinyl	3
H	t-Bu	4	CH=CCl ₂	H	2
H	CF ₃	2	NHEt	H	3
Me	SMe	3	Me	4-CF ₃ -Ph	3
Me	S(O) ₂ -n-Bu	2	CH ₂ CH ₂ OMe	S(O)Me	3
Me	2-Me- α -Pr	3	CH ₂ C≡CH	H	3
α -Hex	H	2			

X and Z are CH; Y is N; R³, R⁷ and R⁸ are H; V is N; W is CH

R ¹	R ²	n	R ¹	R ²	n
H	H	2	Me	Me	3
H	H	3	Me	Me	4
H	H	4	Me	OMe	2
H	α -Pr	2	Me	OMe	3
H	α -Pr	3	Me	OMe	4
H	α -Pr	4	Et	H	2
H	OMe	2	Et	H	3
H	SMe	3	Et	H	4
H	Cl	4	CF ₃	H	3
H	OEt	3	i-Pr	H	3
H	Ph	3	n-Bu	H	3
Me	H	1	α -Hex	H	3
Me	H	2	Ph	H	2
Me	H	3	t-Bu	H	3
Me	H	4	OMe	H	3
Me	Me	1	SMe	H	2
Me	Me	2			

X and Z are CH; Y is N; R³ is H; R⁷ is Me; R⁸ is 5-Me; V is CR⁷; W is N

R ¹	R ²	n	R ¹	R ²	n
α -Pr	Me	1	Me	OMe	3
α -Pr	Me	2	Me	OCH ₂ CF ₃	2

α -Pr	Me	3	Me	OCH ₂ OMe	3
α -Pr	Me	4	Me	CH=CHMe	2
Me	F	1	OCH ₂ CH=CH ₂	H	3
Me	Cl	2	OH	Me	2
Me	Br	3	<i>n</i> -Bu	NMe ₂	3
Me	CN	4	C=C-Me	H	2
Me	Et	1	Me	OPh	3
Me	OH	2	Ph	OCH ₂ C≡CH	2
H	<i>n</i> -Hex	3	Me	1-piperidinyl	3
H	<i>t</i> -Bu	4	CH=CCl ₂	H	2
H	CF ₃	2	NHEt	H	3
Me	SMe	3	Me	4-CF ₃ -Ph	3
Me	S(O) ₂ - <i>n</i> -Bu	2	CH ₂ CH ₂ OMe	S(O)Me	3
Me	2-Me- α -Pr	3	CH ₂ C≡CH	H	3
α -Hex	H	2			

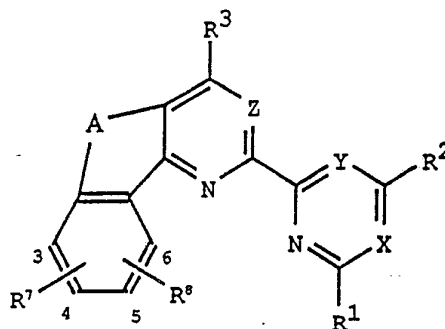
X is CR⁴; R¹ is Me; R², R³, R⁷ and R⁸ are H; V is N; W is CH

Y	Z	R ⁴	n	Y	Z	R ⁴	n
N	CH	F	1	CH	N	CH ₂ OEt	3
N	CH	Cl	2	CH	N	vinyl	3
N	CH	Br	3	CH	CH	CH=CF ₂	3
N	CH	I	4	CH	CH	OCH ₂ CH=CH ₂	3
N	CH	CN	2	CH	CH	C=C-Me	3
N	CH	OH	3	CH	CH	OCH ₂ C≡C-Me	3
N	CH	Me	4	CH	CH	NH ₂	3
N	CH	<i>i</i> -Pr	2	CH	CH	4-CF ₃ Ph	3
N	CH	<i>n</i> -Bu	3	CH	CH	OPh	3
N	N	CH ₂ Cl	4	N	CH	F	3
N	N	<i>n</i> -C ₄ F ₉	2	CH	N	F	3
N	N	S- <u>sec</u> -Bu	3	CH	CH	F	3
CH	N	S(O)Me	2	N	CH	Cl	3
CH	N	S(O)Et	3	CH	N	Cl	3
CH	N	α -Pr	2	N	CH	Me	3
CH	N	O- <i>i</i> -Pr	3	CH	N	Me	3
CH	N	OCH ₂ CF ₃	2				

X is CH; R¹ and R² are Me; R⁷ is H; R⁸ is 5-Me; V is CH; W is N

X	Z	R ³	n	X	Z	R ³	n
N	CH	F	1	CH	N	C≡CH	3
N	CH	Cl	2	CH	N	OCH ₂ C≡C-Me	3
N	CH	CN	3	CH	CH	4-morpholinyl	3
N	CH	OH	4	CH	CH	NEt ₂	3
N	CH	Me	2	CH	CH	2-MePh	3
N	CH	n-Pr	3	CH	CH	4-OCF ₂ CF ₂ H-Ph	3
N	CH	CF ₃	4	CH	CH	O-3-F-Ph	3
N	CH	SEt	2	N	CH	Me	3
N	CH	S(O) ₂ Me	3	CH	N	Me	3
N	N	2-Me- <u>o</u> -Pr	4	CH	CH	Me	3
N	N	O-n-Bu	2	N	CH	OMe	3
N	N	OMe	3	CH	N	OMe	3
CH	N	OCHF ₂	2	N	CH	SMe	3
CH	N	CH ₂ OMe	3	N	CH	SMe	3
CH	N	CH=CHMe	2	N	CH	OCHF ₂	3
CH	N	CH=CCl ₂	3	CH	N	OCHF ₂	3
CH	N	OCH(Me)CH=CH ₂	2				

Table 9



wherein the left side of A is bonded to the phenyl ring and the right side of is bonded to the pyridyl (when Z = CR⁶) or pyrimidinyl (when Z = N) ring.

X and Z are CH; Y is N; R¹ is Me; R², R³, R⁷ and R⁸ are H

<u>-A-</u>	<u>-A-</u>
-O-	-S(O) ₂ -CH ₂ -CH ₂ -
-NH-	-CH ₂ -S-CH ₂ -
-S(O)-	-CH ₂ -S(O) ₂ -CH ₂ -
-CH(Et)-	-CH ₂ -C(=O)-CH ₂ -
-C(=O)-	-CH ₂ -C(=O)-O
-C(=O)-CH(Me)-	-N(Me)-C(=O)-NH-
-O-CH ₂ -CH ₂ -O-	-C(Me) ₂ -CH=CH-
-CH ₂ -CH ₂ -S(O)-	-CH=CH-CH=CH-
-C(=O)-NH-	-CH ₂ -CH ₂ -CH ₂ -O-
-C(Et) ₂ -CH ₂ -	-S(O)-CH ₂ -CH ₂ -CH ₂ -
-CH ₂ -CH ₂ -S(O) ₂ -	-O-C(=O)-CH ₂ -CH ₂ -
-CH ₂ -CH ₂ -S-	-C(=O)-CH=CH-

X, Y, and Z are CH; R¹ is Me; R², R³, R⁷ and R⁸ are H

<u>-A-</u>	<u>-A-</u>
-S-	-CH ₂ -CH ₂ -CH ₂ -NH-
-N(Et)-	-CH ₂ -S(O)-CH ₂ -
-S(O) ₂ -	-CH ₂ -N(Me)-CH ₂ -
-C(Me) ₂ -	-O-C(=O)-CH ₂ -

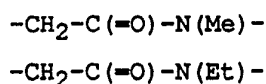
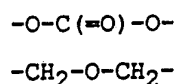
$-\text{CH}_2-\text{C}(=\text{O})-$
 $-\text{CH}_2\text{N}(\text{Me})-$
 $-\text{C}(=\text{O})-\text{O}-$
 $-\text{CH}_2-\text{CH}_2-\text{S}(\text{O})_2-$
 $-\text{N}(\text{Me})-\text{C}(=\text{O})-$
 $-\text{CH}_2-\text{CH}_2-\text{S}(\text{O})-$
 $-\text{CH}_2-\text{CH}_2-\text{O}-$
 $-\text{S}(\text{O})-\text{CH}_2-\text{CH}_2-$

$-\text{CH}_2-\text{O}-\text{C}(=\text{O})-$
 $-\text{C}(=\text{O})-\text{O}-\text{CH}_2-$
 $-\text{CH}_2-\text{CH}=\text{CH}-$
 $-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-$
 $-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{S}-$
 $-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{N}(\text{Me})-$
 $-\text{CH}_2-\text{O}-$
 $-\text{CH}=\text{CH}-\text{C}(=\text{O})-$

X, Y and Z are CH; R^1 is Me; R^2 , R^3 , R^7 and R^8 are H

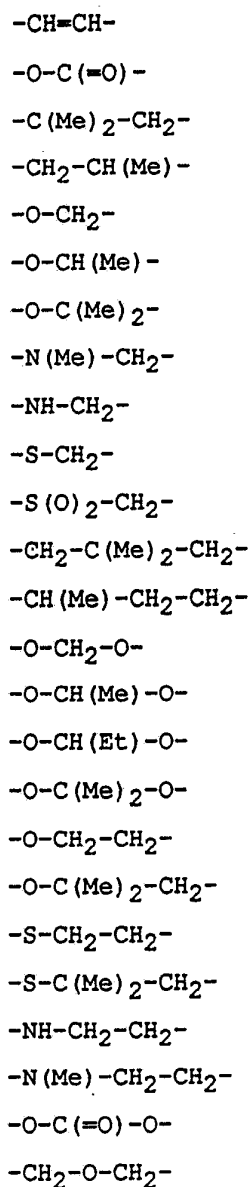
$-\text{A}-$
 $-\text{CH}=\text{CH}-$
 $-\text{O}-\text{C}(=\text{O})-$
 $-\text{C}(\text{Me})_2-\text{CH}_2-$
 $-\text{CH}_2-\text{CH}(\text{Me})-$
 $-\text{O}-\text{CH}_2-$
 $-\text{O}-\text{CH}(\text{Me})-$
 $-\text{O}-\text{C}(\text{Me})_2-$
 $-\text{N}(\text{Me})-\text{CH}_2-$
 $-\text{NH}-\text{CH}_2-$
 $-\text{S}-\text{CH}_2-$
 $-\text{S}(\text{O})_2-\text{CH}_2-$
 $-\text{CH}_2-\text{C}(\text{Me})_2-\text{CH}_2-$
 $-\text{CH}(\text{Me})-\text{CH}_2-\text{CH}_2-$
 $-\text{O}-\text{CH}_2-\text{O}-$
 $-\text{O}-\text{CH}(\text{Me})-\text{O}-$
 $-\text{O}-\text{CH}(\text{Et})-\text{O}-$
 $-\text{O}-\text{C}(\text{Me})_2-\text{O}-$
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 $-\text{S}-\text{C}(\text{Me})_2-\text{CH}_2-$
 $-\text{NH}-\text{CH}_2-\text{CH}_2-$
 $-\text{N}(\text{Me})-\text{CH}_2-\text{CH}_2-$

$-\text{A}-$
 $-\text{CH}(\text{Me})-\text{O}-\text{CH}_2-$
 $-\text{CH}_2-\text{CH}(\text{Me})-\text{CH}_2-\text{CH}_2-$
 $-\text{O}-\text{CH}_2-\text{CH}_2-\text{CH}_2-$
 $-\text{S}-\text{CH}_2-\text{CH}_2-\text{CH}_2-$
 $-\text{S}(\text{O})_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-$
 $-\text{S}(\text{O})_2-\text{C}(\text{Me})_2-\text{CH}_2-\text{CH}_2-$
 $-\text{NH}-\text{CH}_2-\text{CH}_2-\text{CH}_2-$
 $-\text{N}(\text{Me})-\text{CH}_2-\text{CH}_2-\text{CH}_2-$
 $-\text{O}-\text{CH}_2-\text{O}-\text{CH}_2-$
 $-\text{C}(=\text{O})-\text{NH}-\text{CH}_2-$
 $-\text{C}(=\text{O})-\text{N}(\text{Me})-\text{CH}_2-$
 $-\text{C}(=\text{O})-\text{N}(\text{Et})-\text{CH}_2-$
 $-\text{NH}-\text{C}(=\text{O})-\text{CH}_2-$
 $-\text{N}(\text{Me})-\text{C}(=\text{O})-\text{CH}_2-$
 $-\text{N}(\text{Et})-\text{C}(=\text{O})-\text{CH}_2-$
 $-\text{C}(=\text{O})-\text{CH}_2-\text{CH}_2-$
 $-\text{CH}_2-\text{NH}-\text{C}(=\text{O})-$
 $-\text{CH}_2-\text{O}-\text{CH}_2-\text{CH}_2-$
 $-\text{CH}_2-\text{CH}_2-\text{C}(=\text{O})-$
 $-\text{CH}_2-\text{CH}_2-\text{NH}-$
 $-\text{CH}_2-\text{CH}_2-\text{N}(\text{Me})-$
 $-\text{CH}_2-\text{CH}_2-\text{N}(\text{Et})-$
 $-\text{CH}_2-\text{C}(=\text{O})-\text{NH}-$

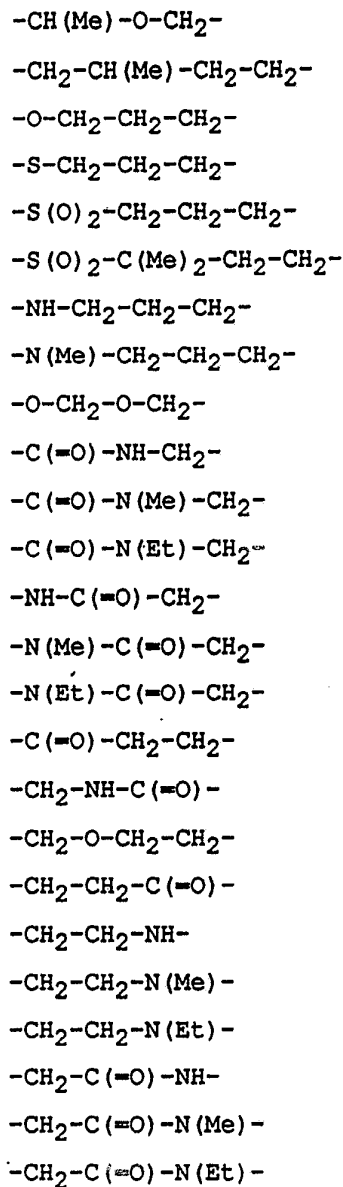


X and Y are CH; Z is N; R¹ is Me; R², R³, R⁷ and R⁸ are H

-A-

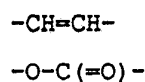


-A-

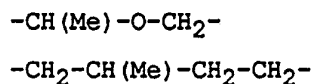


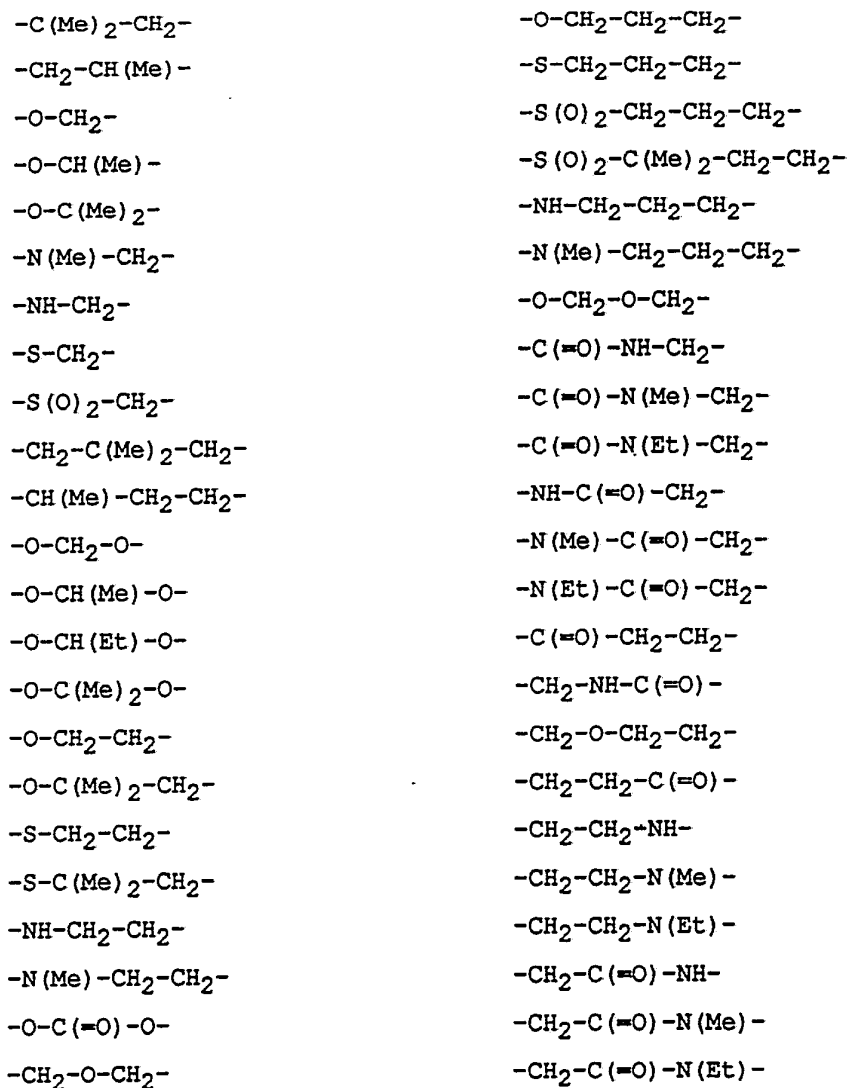
X and Z are CH; Y is N; R¹ is Me; R², R³, R⁷ and R⁸ are H

-A-

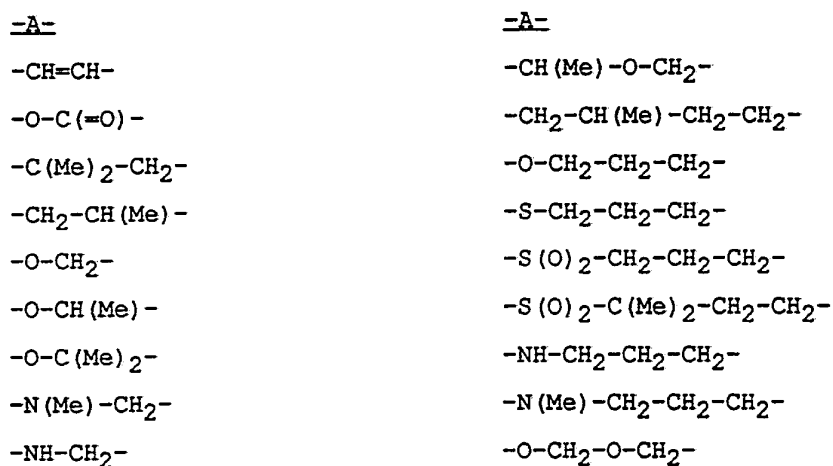


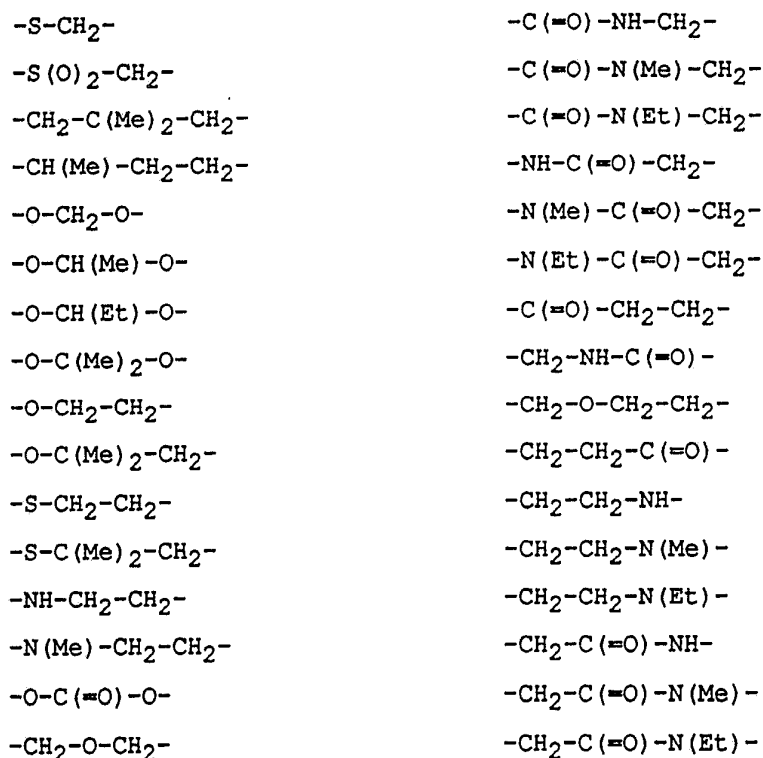
-A-





X and Z are CH; Y is N; R¹ and R² are Me; R³, R⁷ and R⁸ are H





Formulation/Utility

Compounds of this invention will generally be used in formulation with an agriculturally suitable composition. The fungicidal compositions of the present invention comprise an effective amount of at least one compound of Formula I as defined above and at least one of (a) a surfactant, (b) an organic solvent, and (c) at least one solid or liquid diluent. Useful formulations can be prepared in conventional ways. They include dusts, granules, pellets, solutions, suspensions, emulsions, wettable powders, emulsifiable concentrates, dry flowables and the like. Sprayable formulations can be extended in suitable media and used at spray volumes from about one to several hundred liters per hectare. High strength compositions are primarily used as intermediates for further formulation. The formulations will typically contain effective amounts of active ingredient, diluent and

surfactant within the following approximate ranges which add up 100 weight percent.

	Weight Percent		
	<u>Active</u> <u>Ingredient</u>	<u>Diluent</u>	<u>Surfactant</u>
Wettable Powders	25-90	0-74	1-10
Oil Suspensions, Emulsions, Solutions, (including Emulsifiable Concentrates)	5-50	40-95	0-15
Dusts	1-25	70-99	0-5
Granules, Baits and Pellets	0.01-99	5-99.99	0-15
High Strength Compositions	90-99	0-10	0-2

Typical solid diluents are described in Watkins, et al., *Handbook of Insecticide Dust Diluents and Carriers*, 2nd Ed., Dorland Books, Caldwell, New Jersey. Typical liquid diluents and solvents are described in Marsden, *Solvents Guide*, 2nd Ed., Interscience, New York, 1950. *McCutcheon's Detergents and Emulsifiers Annual*, Allured Publ. Corp., Ridgewood, New Jersey, as well as Sisely and Wood, *Encyclopedia of Surface Active Agents*, Chemical Publ. Co., Inc., New York, 1964, list surfactants and recommended uses. All formulations can contain minor amounts of additives to reduce foam, caking, corrosion, microbiological growth, etc.

Methods for formulating such compositions are well known. Solutions are prepared by simply mixing the ingredients. Fine solid compositions are made by blending and, usually, grinding as in a hammer mill or fluid energy mill. Water-dispersible granules can be produced by agglomerating a fine powder composition; see for example, Cross et al., *Pesticide Formulations*, Washington, D.C., 1988, pp 251-259. Suspensions are prepared by wet-milling; see, for example, U.S. 3,060,084. Granules and pellets can be made by spraying the active material upon preformed granular

carriers or by agglomeration techniques. See Browning, "Agglomeration", *Chemical Engineering*, December 4, 1967, pp 147-148, *Perry's Chemical Engineer's Handbook*, 4th Ed., McGraw-Hill, New York, 1963, pp 8-57 and
5 following, and WO 91/13546. Pellets can be prepared as described in U.S. 4,172,714. Water-dispersible and water-soluble granules can be prepared as taught in DE 3,246,493.

For further information regarding the art of
10 formulation, see U.S. 3,235,361, Col. 6, line 16 through Col. 7, line 19 and Examples 10 through 41; U.S. 3,309,192, Col. 5, line 43 through Col. 7, line 62 and Examples 8, 12, 15, 39, 41, 52, 53, 58, 132, 138-140, 162-164, 166, 167 and 169-182; U.S. 2,891,855,
15 Col. 3, line 66 through Col. 5, line 17 and Examples 1-4; Klingman, *Weed Control as a Science*, John Wiley and Sons, Inc., New York, 1961, pp 81-96; and Hance et al., *Weed Control Handbook*, 8th Ed., Blackwell Scientific Publications, Oxford, 1989.

20 In the following Examples, all percentages are by weight and all formulations are worked up in conventional ways. Compound numbers refer to Index Table A hereinafter.

EXAMPLE A

25 Wettable Powder

Compound 1	65.0%
dodecylphenol polyethylene glycol ether	2.0%
sodium ligninsulfonate	4.0%
sodium silicoaluminate	6.0%
30 montmorillonite (calcined)	23.0%

EXAMPLE B

Granule

Compound 1	10.0%
attapulgit granules (low volative 35 matter, 0.71/0.30 mm; U.S.S. No.	

25-50 sieves) 90.0%

EXAMPLE CExtruded Pellet

	Compound 1	25.0%
5	anhydrous sodium sulfate	10.0%
	crude calcium ligninsulfonate	5.0%
	sodium alkyl naphthalenesulfonate	1.0%
	calcium/magnesium bentonite	59.0%

EXAMPLE D10 Emulsifiable Concentrate

	Compound 1	20.0%
	blend of oil soluble sulfonates	
	and polyoxyethylene ethers	10.0%
	isophorone	70.0%

15 The compounds of this invention are useful as plant disease control agents. The present invention therefore further comprises a method for controlling plant diseases caused by fungal plant pathogens comprising applying to the plant or portion thereof to

20 be protected, or to the plant seed or seedling to be protected, an effective amount of a compound of Formula I or a fungicidal composition containing said compound. The compounds and compositions of this invention provide control of diseases caused by a broad spectrum

25 of fungal plant pathogens in the *Basidiomycete*, *Ascomycete*, *Oomycete* and *Deuteromycete* classes. They are effective in controlling a broad spectrum of plant diseases, particularly foliar pathogens of ornamental, vegetable, field, cereal, and fruit crops. These

30 pathogens include *Plasmopara viticola*, *Phytophthora infestans*, *Peronospora tabacina*, *Pseudoperonospora cubensis*, *Pythium aphanidermatum*, *Alternaria brassicae*, *Septoria nodorum*, *Cercosporidium personatum*, *Cercospora arachidicola*, *Pseudocercospora herpotrichoides*,

35 *Cercospora beticola*, *Botrytis cinerea*, *Monilinia*

fructicola, *Pyricularia oryzae*, *Podosphaera leucotricha*, *Venturia inaequalis*, *Erysiphe graminis*, *Uncinula necatur*, *Puccinia recondita*, *Puccinia graminis*, *Hemileia vastatrix*, *Puccinia striiformis*,
5 *Puccinia arachidis*, *Rhizoctonia solani*, *Sphaerotheca fuliginea*, *Fusarium oxysporum*, *Verticillium dahliae*, *Pythium aphanidermatum*, *Phytophthora megasperma* and other genera and species closely related to these pathogens.

10 Compounds of this invention can also be mixed with one or more other insecticides, fungicides, nematocides, bactericides, acaricides, semiochemicals, repellants, attractants, pheromones, feeding stimulants or other biologically active compounds to form a multi-
15 component pesticide giving an even broader spectrum of agricultural protection. Examples of other agricultural protectants with which compounds of this invention can be formulated are: insecticides such as monocrotophos, carbofuran, tetrachlorvinphos,
20 malathion, parathion-methyl, methomyl, chlordimeform, diazinon, deltamethrin, oxamyl, fenvalerate, esfenvalerate, permethrin, profenofos, sulprofos, triflumuron, diflubenzuron, methoprene, buprofezin, thiodicarb, acephate, azinphosmethyl, chlorpyrifos,
25 dimethoate, fipronil, flufenprox, fonophos, isofenphos, methidathion, methamidophos, phosmet, phosphamidon, phosalone, pirimicarb, phorate, terbufos, trichlorfon, methoxychlor, bifenthrin, biphenate, cyfluthrin, fenpropathrin, fluvalinate, flucythrinate,
30 tralomethrin, metaldehyde and rotenone; fungicides such as carbendazim, thiuram, dodine, maneb, chloroneb, benomyl, cymoxanil, fenpropidine, fenpropimorph, triadimefon, captan, thiophanate-methyl, thiabendazole, phosethyl-Al, chlorothalonil, dichloran, metalaxyl,
35 captafol, iprodione, oxadixyl, vinclozolin,

kasugamycin, myclobutanil, tebuconazole,
difenoconazole, diniconazole, fluquinconazole,
ipconazole, metconazole, penconazole, propiconazole,
uniconazole, flutriafol, prochloraz, pyrifenox,
5 fenarimol, triadimenol, diclobutrazol, copper
oxychloride, furalaxyl, folpet, flusilazol, blastidicidin
S, diclomezine, edifenphos, isoprothiolane, iprobenfos,
mepronil, neo-asozin, pencycuron, probenazole,
pyroquilon, tricyclazole, validamycin, and flutolanil;
10 nematocides such as aldoxycarb, fenamiphos and
fosthietan; bactericides such as oxytetracycline,
streptomycin and tribasic copper sulfate; acaricides
such as binapacryl, oxythioquinox, chlorobenzilate,
dicofol, dienochlor, cyhexatin, hexythiazox, amitraz,
15 propargite, tebufenpyrad and fenbutatin oxide; and
biological agents such as *Bacillus thuringiensis*,
baculovirus and avermectin B.

In certain instances, combinations with other
fungicides having a similiar spectrum of control but a
20 different mode of action will be particularly
advantageous for resistance management.

Plant disease control is ordinarily accomplished
by applying an effective amount of a compound of this
invention either pre- or post-infection, to the portion
25 of the plant to be protected such as the roots, stems,
foliage, fruit, seeds, tubers or bulbs, or to the media
(soil or sand) in which the plants to be protected are
growing. The compounds can also be applied to the seed
to protect the seed and seedling.

30 Rates of application for these compounds can be
influenced by many factors of the environment and
should be determined under actual use conditions.
Foliage can normally be protected when treated at a
rate of from less than 1 g/ha to 5,000 g/ha of active
35 ingredient. Seed and seedlings can normally be

protected when seed is treated at a rate of from 0.1 to 10 g per kilogram of seed.

The following Tests demonstrate the control efficacy of compounds of this invention on specific pathogens. The pathogen control protection afforded by the compounds is not limited, however, to these species. See Index Table A for compound descriptions.

Test compounds were first dissolved in acetone in an amount equal to 3% of the final volume and then suspended at a concentration of 200 ppm in purified water containing 250 ppm of the surfactant Trem® 014 (polyhydric alcohol esters). The resulting test suspensions were then used in the following tests.

TEST A

The test suspension was sprayed to the point of run-off on wheat seedlings. The following day the seedlings were inoculated with a spore dust of *Erysiphe graminis f. sp. tritici*, (the causal agent of wheat powdery mildew) and incubated in a growth chamber at 20°C for 7 days, after which disease ratings were made.

TEST B

The test suspension was sprayed to the point of run-off on wheat seedlings. The following day the seedlings were inoculated with a spore suspension of *Puccinia recondita* (the causal agent of wheat leaf rust) and incubated in a saturated atmosphere at 20°C for 24 h, and then moved to a growth chamber at 20°C for 6 days, after which disease ratings were made.

TEST C

The test suspension was sprayed to the point of run-off on rice seedlings. The following day the seedlings were inoculated with a spore suspension of *Pyricularia oryzae* (the causal agent of rice blast) and incubated in a saturated atmosphere at 27°C for 24 h,

and then moved to a growth chamber at 30°C for 5 days, after which disease ratings were made.

TEST D

The test suspension was sprayed to the point of
5 run-off on tomato seedlings. The following day the seedlings were inoculated with a spore suspension of *Phytophthora infestans* (the causal agent of potato and tomato late blight) and incubated in a saturated atmosphere at 20°C for 24 h, and then moved to a growth
10 chamber at 20°C for 5 days, after which disease ratings were made.

TEST E

The test suspension was sprayed to the point of run-off on grape seedlings. The following day the
15 seedlings were inoculated with a spore suspension of *Plasmopara viticola* (the causal agent of grape downy mildew) and incubated in a saturated atmosphere at 20°C for 24 h, moved to a growth chamber at 20°C for 6 days, and then incubated in a saturated atmosphere at 20°C
20 for 24 h, after which disease ratings were made.

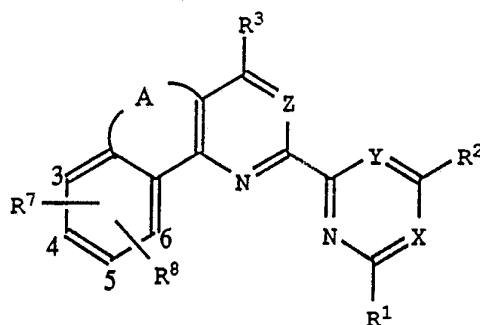
TEST F

The test suspension was sprayed to the point of run-off on cucumber seedlings. The following day the seedlings were inoculated with a spore suspension of
25 *Botrytis cinerea* (the causal agent of gray mold on many crops) and incubated in a saturated atmosphere at 20°C for 48 h, and moved to a growth chamber at 20°C for 5 days, after which disease ratings were made.

Index Table A

30 Results for Tests A-F are given in Table 1. In the table, a rating of 100 indicates 100% disease control and a rating of 0 indicates no disease control (relative to the controls). NT = not tested.

INDEX TABLE A



CMPD No.	A	X	Y	Z	R ¹	R ²	R ³	R ⁷	R ⁸	mp (°C) ^a
1	-(CH ₂) ₃ -	CH	N	CH	Me	H	H	H	H	166-166.5
2	-(CH ₂) ₃ -	CH	N	CH	Me	Me	H	H	H	120.5-123
3	-(CH ₂) ₃ -	CH	CH	N	H	Me	H	H	H	109-113
4	-(CH ₂) ₃ -	CH	N	N	Me	Me	H	H	H	172.5-173.5
5	-(CH ₂) ₃ -	CH	CH	N	Me	H	H	H	H	151-153
6	-(CH ₂) ₃ -	CH	CH	N	H	H	H	H	H	94-99.5
7	-(CH ₂) ₃ -	CH	CH	N	Me	Me	H	H	H	178-181
8	-(CH ₂) ₃ -	CH	CH	CH	H	H	H	H	H	72-73.5
9	-(CH ₂) ₃ -	CH	CH	N	H	H	SMe	H	H	oil ^b
10	-(CH ₂) ₃ -	CH	N	CH	Me	H	H	5-F	H	123.5-128.5
11	-(CH ₂) ₃ -	CH	CH	CH	Me	H	H	H	H	144-145
12	-(CH ₂) ₂ -	CH	CH	N	Me	H	H	H	H	124.5-126
13	-(CH ₂) ₂ -	CH	N	CH	Me	H	H	H	H	110.5-112
14	-(CH ₂) ₂ -	CH	N	N	Me	Me	H	H	H	138.5-143
15	-(CH ₂) ₂ -	CH	CH	N	H	H	H	H	H	oil
16	-(CH ₂) ₂ -	CH	CH	N	H	Me	H	H	H	109.5-114
17	-(CH ₂) ₂ -	CH	CH	N	Me	Me	H	H	H	oil ^c
18	-CH ₂ -	CH	CH	N	Me	H	H	H	H	oil
19	-CH ₂ -	CH	CH	N	Me	Me	H	H	H	108-115
20	-CH=CH-	CH	N	CH	Me	H	H	H	H	139-141
21	$\begin{array}{c} \text{O} \\ \\ \text{---C---} \end{array}$	CH	CH	N	Me	Me	H	H	H	185-190

22	-(CH ₂) ₃ -	CH	N	CH	Me	H	H	5-Br	H	137-138
23	-(CH ₂) ₃ -	CH	N	CH	Me	H	H	3-Br	H	112-116 ^d

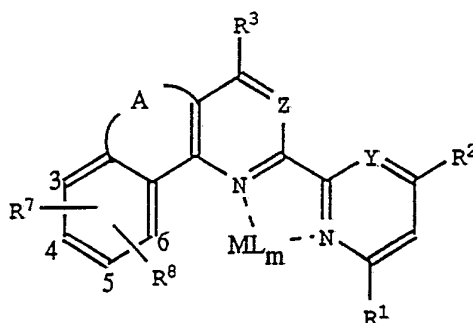
^a¹H NMR data for oils are given in Index Table C.

^b97% compound plus 3% dimethylformamide.

^c90% compound plus 10% 2-[(dimethylamino)methylene]-3,4-dihydro-1(2H)-naphthalenone

^d93% compound plus 7% of compound No. 1.

INDEX TABLE B



CMPD										
No.	ML _m	A	Y	Z	R ¹	R ²	R ³	R ⁷	R ⁸	mp (°C)
24	ZnCl ₂	-(CH ₂) ₃ -	N	CH	Me	H	H	H	H	>250

INDEX TABLE C

CMPD

No. ¹H NMR Data^a

9	2.30 (p, 2H), 2.58 (t, 2H), 2.63 (t, 2H), 2.76 (s, 3H), 7.25 (m, 1H), 7.40 (m, 3H), 7.85 (t, 1H), 7.92 (d, 1H), 8.56 (d, 1H), 8.83 (d, 1H)
15	3.03 (s, 4H), 7.28 (dd, 1H), 7.42 (m, 3H), 7.87 (t, 1H), 8.54 (d, 1H), 8.66 (d, 1H), 8.76 (s, 1H), 8.83 (d, 1H)
17	2.44 (s, 3H), 2.68 (s, 3H), 3.00 (s, 4H), 7.09 (s, 1H), 7.29 (m, 1H), 7.43 (m, 2H), 8.28 (s, 1H), 8.54 (m, 1H), 8.74 (s, 1H)

2.77 (s, 3H), 4.01 (s, 2H), 7.29 (d, 1H), 7.55 (m, 2H),
7.65 (d, 1H), 7.79 (t, 1H), 8.32 (d, 1H), 8.47 (d, 1H),
9.04 (s, 1H)

¹H NMR data are in ppm downfield from tetramethylsilane.
Couplings are designated by (s)-singlet, (d)-doublet, (t)-
triplet, (q)-quartet, (p)-pentet, (m)-multiplet, (dd)-doublet of
doublets. Samples dissolved in CDCl₃ unless otherwise indicated.

TABLE 1

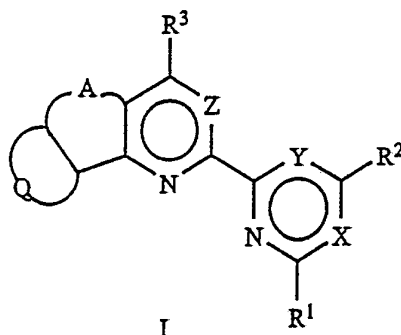
<u>COMPD No.</u>	<u>Test A</u>	<u>Test B</u>	<u>Test C</u>	<u>Test D</u>	<u>Test E</u>	<u>Test F</u>
1	86	100	93	75	47*	99
2	100	100	99	61*	91	99
3	94	97	74	87	100	84
4	27	32	18	15*	24	14
5	98	97	94	88	100*	83
6	94	91	67	95	63	72
7	95	98	89	17	100	83
8	100	55	90	0	96	10
12	97	86	77	72	76	80
13	73	95	75	92	100	28
14	37	42	39	0	100	0
15	94	99	60	32	100	42
16	90	97	60	79	97	63
17	21	92	0	NT	97	0
18	61	85	53	0	61	94
19	72	90	0	NT	91	6
20	89	79	0	0	63	7
21	0	82	94	8*	70	0
24	39*	83*	88*	0*	89*	90*

*The compound was sprayed at a concentration of 40 ppm.

WHAT IS CLAIMED IS:

1. Compounds of Formula I

5



including all geometric and stereoisomers wherein:

X is N or CR⁴;10 Y is N or CR⁵;Z is N or CR⁶;Q is a fused benzene, naphthalene, thiophene, furan, pyrrole, pyridine or pyrimidine ring each optionally substituted with R⁷ and R⁸;

15 A is a bridge -G¹-G²-G³-G⁴-, wherein G¹, G², G³ or G⁴ are independently O, S(O)_p, NR⁹, CR¹⁰R¹¹, C(=O), a direct bond, or G¹-G², G²-G³ or G³-G⁴ may be taken together to form -CH=CH-; such that at least one of G¹, G², G³ and G⁴ is

20 other than a direct bond;

R¹, R², R³ and R⁴ are independently H; halogen; cyano; hydroxy; C₁-C₆ alkyl; C₁-C₄ haloalkyl; C₁-C₄ alkylthio; C₁-C₄ alkylsulfinyl; C₁-C₄ alkylsulfonyl; C₃-C₆ cycloalkyl optionally

25 substituted with 1-2 methyl groups; C₁-C₄ alkoxy; C₁-C₄ haloalkoxy; C₂-C₄ alkoxyalkyl; C₂-C₄ alkenyl; C₂-C₄ haloalkenyl; C₂-C₄ alkenyloxy; C₂-C₄ alkynyl; C₂-C₄ alkynyloxy; NR¹²R¹³; phenyl or phenoxy optionally

- substituted with R^{14} ; or R^1 and R^4 , R^2 and R^4
or R^2 and R^5 can be taken together to form
- $(CH_2)_3$ -, - $(CH_2)_4$ - or a fused phenyl ring;
 R^5 and R^6 are independently H, halogen, C_1 - C_2
5 alkyl or C_1 - C_2 alkoxy;
 R^7 is halogen; cyano; nitro; hydroxy;
hydroxycarbonyl; C_1 - C_6 alkyl; C_1 - C_4
haloalkyl; C_1 - C_4 alkylthio; C_1 - C_4
alkylsulfinyl; C_1 - C_4 alkylsulfonyl; (C_1 - C_4
10 alkyl)₃silyl; C_3 - C_6 cycloalkyl; C_2 - C_5
alkylcarbonyl; C_2 - C_4 alkenyl; C_2 - C_4
alkenyloxy; C_2 - C_4 alkynyl; C_2 - C_4 alkynyloxy;
 C_1 - C_4 alkoxy; C_1 - C_4 haloalkoxy; C_2 - C_4
alkoxyalkyl; C_2 - C_5 alkoxycarbonyl; C_2 - C_4
15 alkoxyalkoxy; $NR^{15}R^{16}$; $C(=O)NR^{17}R^{18}$; or
phenyl, phenoxy or phenylthio each optionally
substituted with R^{19} ;
 R^8 and R^{14} are independently 1-2 halogen, 1-2 C_1 - C_3
alkyl, C_1 - C_2 haloalkyl, C_1 - C_2 alkoxy or C_1 - C_2
20 haloalkoxy;
 R^9 , R^{10} and R^{11} are independently H or C_1 - C_2 alkyl;
 R^{12} , R^{13} , R^{15} , R^{16} , R^{17} , and R^{18} are independently H
or C_1 - C_2 alkyl; or R^{12} and R^{13} , R^{15} and R^{16} or
 R^{17} and R^{18} can be taken together with the
25 nitrogen to which they are attached to form a
piperidino, pyrrolidino or morpholino ring;
 R^{19} is halogen, C_1 - C_2 alkyl, C_1 - C_2 haloalkyl, C_1 - C_2
alkoxy or C_1 - C_2 haloalkoxy;
 p is 0, 1 or 2;
30 or their agriculturally suitable salts or metal
complexes thereof;
provided that:
i) when any of G^1 , G^2 , G^3 or G^4 are O, then they
are not directly bonded to O or $S(O)_p$;

- ii) when any of G^1 , G^2 , G^3 or G^4 are $S(O)$ or $S(O)_2$, then they are not bonded directly to $C(=O)$;
- iii) the total number of heteroatoms in the ring containing A does not exceed two;
- iv) when X, Y and Z are CH ; A is CH_2 ; Q is fused unsubstituted benzene; R^1 and R^2 are H; then R^3 is not unsubstituted phenyl; and
- v) the compounds are not 2-[4,6-bis(trichloromethyl)-1,3,5-triazin-2-yl]-1,10-phenanthroline or 2-(2-pyridinyl)-1,10-phenanthroline.

2. Compounds of Claim 1 wherein:

A is a bridge selected from the group

- consisting of: $-CR^{10}R^{11}-$; $-G-$;
- $-(CR^{10}R^{11}-CR^{10}R^{11})-$; $-(G-CR^{10}R^{11})-$;
- $-(CH=CH)-$; $-[O-C(=O)]-$; $-[NR^9-C(=O)]-$;
- $-(CR^{10}R^{11}-CR^{10}R^{11}-CR^{10}R^{11})-$;
- $-(G-CR^{10}R^{11}-CR^{10}R^{11})-$;
- $-(CR^{10}R^{11}-G-CR^{10}R^{11})-$; $-(CR^{10}R^{11}-CH=CH)-$;
- $-(O-CR^{10}R^{11}-O)-$; $-[O-C(=O)-CR^{10}R^{11}]-$;
- $-[CR^{10}R^{11}-O-C(=O)]-$;
- $-[NR^9-C(=O)-CR^{10}R^{11}]-$;
- $-[CR^{10}R^{11}-NR^9-C(=O)]-$; $-[C(=O)-CH=CH]-$;
- $-[O-C(=O)-O]-$; $-[NR^9-C(=O)-NR^9]-$;
- $-(CR^{10}R^{11}-CR^{10}R^{11}-CR^{10}R^{11}-CR^{10}R^{11})-$;
- $-(G-CR^{10}R^{11}-CR^{10}R^{11}-CR^{10}R^{11})-$;
- $-(CR^{10}R^{11}-G-CR^{10}R^{11}-CR^{10}R^{11})-$;
- $-(CR^{10}R^{11}-CR^{10}R^{11}-CH=CH)-$;
- $-(CR^{10}R^{11}-CH=CH-CR^{10}R^{11})-$;
- $-(CH=CH-CH=CH)-$; $-(O-CR^{10}R^{11}-O-CR^{10}R^{11})-$;
- $-(O-CR^{10}R^{11}-CR^{10}R^{11}-O)-$;
- $-[O-C(=O)-CR^{10}R^{11}-CR^{10}R^{11}]-$;
- $-[CR^{10}R^{11}-O-C(=O)-CR^{10}R^{11}]-$;
- $-[CR^{10}R^{11}-CR^{10}R^{11}-O-C(=O)]-$;

-[NR⁹-C(=O)-CR¹⁰R¹¹-CR¹⁰R¹¹]-;
-[CR¹⁰R¹¹-NR⁹-C(=O)-CR¹⁰R¹¹]-; and
-[CR¹⁰R¹¹-CR¹⁰R¹¹-NR⁹-C(=O)]-;

5

such that A taken together with the
attached atoms forms a 5-8 membered
ring; and the directionality of A may be
that the left side of A is bonded to the
Q ring and the right side is bonded to
the pyridyl (when Z=CR⁶) or pyrimidinyl
(when Z=N) ring, or that the left side
of A is bonded to the pyridyl or
pyrimidinyl ring and the right side is
bonded to Q; and

10

G is O; S(O)_p; NR⁹; or C(=O).

15

3. Compounds of Claim 2 wherein:

X is CR⁴;

Y is N or CH;

Z is N or CH; and

A is a bridge selected from the group

20

consisting of: -(CR¹⁰R¹¹-CR¹⁰R¹¹)-;
-(G-CR¹⁰R¹¹)-; -(CH=CH)-; -[O-C(=O)]-;
-[NR⁹-C(=O)]-;
-(CR¹⁰R¹¹-CR¹⁰R¹¹-CR¹⁰R¹¹)-;
-(G-CR¹⁰R¹¹-CR¹⁰R¹¹)-;
25 -(CR¹⁰R¹¹-G-CR¹⁰R¹¹)-; -(CR¹⁰R¹¹-CH=CH)-;
-(O-CR¹⁰R¹¹-O)-; -[O-C(=O)-CR¹⁰R¹¹]-;
-[CR¹⁰R¹¹-O-C(=O)]-;
-[NR⁹-C(=O)-CR¹⁰R¹¹]-;
-[CR¹⁰R¹¹-NR⁹-C(=O)]-; -[C(=O)-CH=CH]-;
30 -[O-C(=O)-O]-; and -[NR⁹-C(=O)-NR⁹]-.

4. Compounds of Claim 3 wherein:

Q is a fused benzene, thiophene, furan or
pyridine ring each optionally
substituted with R⁷ and R⁸;

A is selected from the group consisting of

-(CH₂-CH₂)-; -[CH₂-C(=O)]-; -(CH=CH)-;
-[C(=O)-O]-; -[C(=O)-NR⁹]-;
-(CH₂-CH₂-CH₂)-; -(O-CH₂-O)-;
5 -(CH₂-CH₂-O)-; -[CH₂-CH₂-S(O)_p]-;
-(CH₂-CH₂-NR⁹)-; -(CH₂-O-CH₂)-;
-[CH₂-S(O)_p-CH₂]-; -(CH₂-NR⁹-CH₂)-;
-[O-C(=O)-O]-;

R¹, R², R³ and R⁴ are independently H,
10 halogen, C₁-C₄ alkyl, C₁-C₄ haloalkyl,
cyclopropyl, C₁-C₄ alkoxy or C₂-C₃
alkynyl; and

R⁷ is halogen, cyano, C₁-C₄ alkyl, C₁-C₄
haloalkyl, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy
15 or C₂-C₄ alkoxyalkoxy.

5. Compounds of Claim 4 wherein:

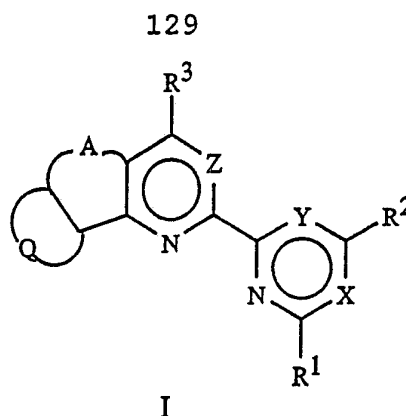
Q is a fused benzene ring optionally
substituted with R⁷ and R⁸; and

A is selected from the group consisting of

20 -(CH₂-CH₂)-; -(CH=CH)-; -[C(=O)-O]-;
-[C(=O)-NR⁹]-; -(CH₂-CH₂-CH₂)-;
-(O-CH₂-O)-; -(CH₂-CH₂-O)-;
-[CH₂-CH₂-S(O)_p]-; -(CH₂-CH₂-NR⁹)-;
-(CH₂-O-CH₂)-; -[CH₂-S(O)_p-CH₂]- and
25 -(CH₂-NR⁹-CH₂)-.

6. A compound of Claim 5 which is 6,7-dihydro-2-(4-methyl-2-pyrimidinyl)-5H-benzo[6,7]cyclohepta[1,2-b]pyridine.

7. A fungicidal composition comprising an
30 effective amount of a compound of Formula I



wherein:

X is N or CR⁴;

Y is N or CR⁵;

5 Z is N or CR⁶;

Q is a fused benzene; naphthalene; thiophene;
furan; pyrrole; pyridine or pyrimidine ring
each optionally substituted with R⁷ and R⁸;

10 A is a bridge selected from the group consisting
of: -CR¹⁰R¹¹-; -G-; -(CR¹⁰R¹¹-CR¹⁰R¹¹)-;

-(G-CR¹⁰R¹¹)-; -(CH=CH)-; -[O-C(=O)]-;

-[NR⁹-C(=O)]-; -(CR¹⁰R¹¹-CR¹⁰R¹¹-CR¹⁰R¹¹)-;

-(G-CR¹⁰R¹¹-CR¹⁰R¹¹)-; -(CR¹⁰R¹¹-G-CR¹⁰R¹¹)-;

-(CR¹⁰R¹¹-CH=CH)-; -(O-CR¹⁰R¹¹-O)-;

15 -[O-C(=O)-CR¹⁰R¹¹]-; -[CR¹⁰R¹¹-O-C(=O)]-;

-[NR⁹-C(=O)-CR¹⁰R¹¹]-; -[CR¹⁰R¹¹-NR⁹-C(=O)]-;

-[C(=O)-CH=CH]-; -[O-C(=O)-O]-;

-[NR⁹-C(=O)-NR⁹]-;

-(CR¹⁰R¹¹-CR¹⁰R¹¹-CR¹⁰R¹¹-CR¹⁰R¹¹)-;

20 -(G-CR¹⁰R¹¹-CR¹⁰R¹¹-CR¹⁰R¹¹)-;

-(CR¹⁰R¹¹-G-CR¹⁰R¹¹-CR¹⁰R¹¹)-;

-(CR¹⁰R¹¹-CR¹⁰R¹¹-CH=CH)-;

-(CR¹⁰R¹¹-CH=CH-CR¹⁰R¹¹)-; -(CH=CH-CH=CH)-;

-(O-CR¹⁰R¹¹-O-CR¹⁰R¹¹)-;

25 -(O-CR¹⁰R¹¹-CR¹⁰R¹¹-O)-;

-[O-C(=O)-CR¹⁰R¹¹-CR¹⁰R¹¹]-;

-[CR¹⁰R¹¹-O-C(=O)-CR¹⁰R¹¹]-;

-[CR¹⁰R¹¹-CR¹⁰R¹¹-O-C(=O)]-;

$-\text{[NR}^9\text{-C(=O)-CR}^{10}\text{R}^{11}\text{-CR}^{10}\text{R}^{11}\text{]-}$;
 $-\text{[CR}^{10}\text{R}^{11}\text{-NR}^9\text{-C(=O)-CR}^{10}\text{R}^{11}\text{]-}$; and
 $-\text{[CR}^{10}\text{R}^{11}\text{-CR}^{10}\text{R}^{11}\text{-NR}^9\text{-C(=O)-}]$ -;

5 such that A taken together with the attached
 atoms forms a 5-8 membered ring; and the
 directionality of A may be that the left side
 of A is bonded to the Q ring and the right
 side is bonded to the pyridyl (when $\text{Z}=\text{CR}^6$) or
 pyrimidinyl (when $\text{Z}=\text{N}$) ring, or that the left
 10 side of A is bonded to the pyridyl or
 pyrimidinyl ring and the right side is bonded
 to Q;

G is O; S(O)_p ; NR^9 ; or C(=O) ;

p is 0, 1 or 2;

15 R^1 , R^2 , R^3 and R^4 are independently H; halogen;
 cyano; hydroxy; $\text{C}_1\text{-C}_6$ alkyl; $\text{C}_1\text{-C}_4$ haloalkyl;
 $\text{C}_1\text{-C}_4$ alkylthio; $\text{C}_1\text{-C}_4$ alkylsulfinyl; $\text{C}_1\text{-C}_4$
 alkylsulfonyl; $\text{C}_3\text{-C}_6$ cycloalkyl optionally
 substituted with 1-2 methyl groups; $\text{C}_1\text{-C}_4$
 20 alkoxy; $\text{C}_1\text{-C}_4$ haloalkoxy; $\text{C}_2\text{-C}_4$ alkoxyalkyl;
 $\text{C}_2\text{-C}_4$ alkenyl; $\text{C}_2\text{-C}_4$ haloalkenyl; $\text{C}_2\text{-C}_4$
 alkenyloxy; $\text{C}_2\text{-C}_4$ alkynyl; $\text{C}_2\text{-C}_4$ alkynyloxy;
 $\text{NR}^{12}\text{R}^{13}$; phenyl or phenoxy optionally
 substituted with R^{14} ; or R^1 and R^4 , R^2 and R^4
 25 or R^2 and R^5 can be taken together to form
 $-(\text{CH}_2)_3-$, $-(\text{CH}_2)_4-$ or a fused phenyl ring;

R^5 and R^6 are independently H; halogen; $\text{C}_1\text{-C}_2$
 alkyl or $\text{C}_1\text{-C}_2$ alkoxy;

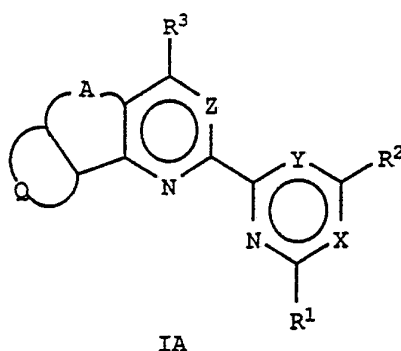
R^7 is halogen; cyano; nitro; hydroxy;

30 hydroxycarbonyl; $\text{C}_1\text{-C}_6$ alkyl; $\text{C}_1\text{-C}_4$
 haloalkyl; $\text{C}_1\text{-C}_4$ alkylthio; $\text{C}_1\text{-C}_4$
 alkylsulfinyl; $\text{C}_1\text{-C}_4$ alkylsulfonyl; $(\text{C}_1\text{-C}_4$
 alkyl) $_3$ silyl; $\text{C}_3\text{-C}_6$ cycloalkyl; $\text{C}_2\text{-C}_5$
 alkylcarbonyl; $\text{C}_2\text{-C}_4$ alkenyl; $\text{C}_2\text{-C}_4$
 35 alkenyloxy; $\text{C}_2\text{-C}_4$ alkynyl; $\text{C}_2\text{-C}_4$ alkynyloxy;

- C₁-C₄ alkoxy; C₁-C₄ haloalkoxy; C₂-C₄ alkoxyalkyl; C₂-C₅ alkoxycarbonyl; C₂-C₄ alkoxyalkoxy; NR¹⁵R¹⁶; C(=O)NR¹⁷R¹⁸; or phenyl, phenoxy or phenylthio each optionally substituted with R¹⁹;
- R⁸ and R¹⁴ are independently 1-2 halogen; 1-2 C₁-C₃ alkyl; C₁-C₂ haloalkyl; C₁-C₂ alkoxy or C₁-C₂ haloalkoxy;
- R⁹, R¹⁰ and R¹¹ are independently H or C₁-C₂ alkyl;
- R¹², R¹³, R¹⁵, R¹⁶, R¹⁷, and R¹⁸ are independently H or C₁-C₂ alkyl; or R¹² and R¹³, R¹⁵ and R¹⁶ or R¹⁷ and R¹⁸ can be taken together with the nitrogen to which they are attached to form a piperidino, pyrrolidino or morpholino ring;
- R¹⁹ is halogen; C₁-C₂ alkyl; C₁-C₂ haloalkyl; C₁-C₂ alkoxy or C₁-C₂ haloalkoxy;
- or the agriculturally suitable salts or metal complexes thereof;
- provided that:
- i) when any of G¹, G², G³ or G⁴ are O, then they are not directly bonded to O or S(O)_p;
 - ii) when any of G¹, G², G³ or G⁴ are S(O) or S(O)₂, then they are not bonded directly to C(=O);
 - iii) the total number of heteroatoms in the ring containing A does not exceed two;
 - iv) when X, Y and Z are CH; A is CH₂, Q is fused unsubstituted benzene; and R¹ and R² are H; then R³ is not unsubstituted phenyl; and
 - v) the compounds are other than 2-[4,6-bis(trichloromethyl)-1,3,5-triazin-2-yl]-1,10-phenanthroline or 2-(2-pyridinyl)-1,10-phenanthroline

and at least one of (a) a surfactant, (b) an organic solvent, and (c) at least one solid or liquid diluent.

8. A method for controlling plant diseases caused by fungal plant pathogens comprising applying to the plant or portion thereof to be protected, or to the plant seed or seedling to be protected, an effective amount of a compound of Formula IA:



10

wherein:

X is N or CR⁴;

Y is N or CR⁵;

Z is N or CR⁶;

15

Q is a fused benzene, naphthalene, thiophene, furan, pyrrole, pyridine or pyrimidine ring each optionally substituted with R⁷ and R⁸;

.20

A is a bridge -G¹-G²-G³-G⁴-, wherein G¹, G², G³ or G⁴ are independently O, S(O)_p, NR⁹, CR¹⁰R¹¹, C(=O), a direct bond, or G¹-G², G²-G³ or G³-G⁴ may be taken together to form -CH=CH-; such that at least one of G¹, G², G³ and G⁴ is other than a direct bond;

25

R¹, R², R³ and R⁴ are independently H; halogen; cyano; hydroxy; C₁-C₆ alkyl; C₁-C₄ haloalkyl; C₁-C₄ alkylthio; C₁-C₄ alkylsulfinyl; C₁-C₄ alkylsulfonyl; C₃-C₆ cycloalkyl optionally substituted with 1-2 methyl groups; C₁-C₄ alkoxy; C₁-C₄ haloalkoxy; C₂-C₄ alkoxyalkyl;

- C₂-C₄ alkenyl; C₂-C₄ haloalkenyl; C₂-C₄ alkenyloxy; C₂-C₄ alkynyl; C₂-C₄ alkynyloxy; NR¹²R¹³; phenyl or phenoxy optionally substituted with R¹⁴; or R¹ and R⁴, R² and R⁴ or R² and R⁵ can be taken together to form -(CH₂)₃-, -(CH₂)₄- or a fused phenyl ring;
- R⁵ and R⁶ are independently H, halogen, C₁-C₂ alkyl or C₁-C₂ alkoxy;
- R⁷ is halogen; cyano; nitro; hydroxy; hydroxycarbonyl; C₁-C₆ alkyl; C₁-C₄ haloalkyl; C₁-C₄ alkylthio; C₁-C₄ alkylsulfinyl; C₁-C₄ alkylsulfonyl; (C₁-C₄ alkyl)₃silyl; C₃-C₆ cycloalkyl; C₂-C₅ alkylcarbonyl; C₂-C₄ alkenyl; C₂-C₄ alkenyloxy; C₂-C₄ alkynyl; C₂-C₄ alkynyloxy; C₁-C₄ alkoxy; C₁-C₄ haloalkoxy; C₂-C₄ alkoxyalkyl; C₂-C₅ alkoxy carbonyl; C₂-C₄ alkoxyalkoxy; NR¹⁵R¹⁶; C(=O)NR¹⁷R¹⁸; or phenyl, phenoxy or phenylthio each optionally substituted with R¹⁹;
- R⁸ and R¹⁴ are independently 1-2 halogen, 1-2 C₁-C₃ alkyl, C₁-C₂ haloalkyl, C₁-C₂ alkoxy or C₁-C₂ haloalkoxy;
- R⁹, R¹⁰ and R¹¹ are independently H or C₁-C₂ alkyl;
- R¹², R¹³, R¹⁵, R¹⁶, R¹⁷, and R¹⁸ are independently H or C₁-C₂ alkyl; or R¹² and R¹³, R¹⁵ and R¹⁶ or R¹⁷ and R¹⁸ can be taken together with the nitrogen to which they are attached to form a piperidino, pyrrolidino or morpholino ring;
- R¹⁹ is halogen, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₁-C₂ alkoxy or C₁-C₂ haloalkoxy;
- p is 0, 1 or 2;
- or their agriculturally suitable salts or metal complexes thereof;
- provided that:

i) when any of G^1 , G^2 , G^3 or G^4 are O, then they are not directly bonded to O or $S(O)_p$;

ii) when any of G^1 , G^2 , G^3 or G^4 are $S(O)$ or $S(O)_2$, then they are not bonded directly to $C(=O)$; and

5 iii) the total number of heteroatoms in the ring containing A does not exceed two.

9. A method for controlling plant diseases caused by fungal plant pathogens comprising applying to the plant or portion thereof to be protected, or to the
10 plant seed or seedling to be protected, an effective amount of a composition of Claim 7.

INTERNATIONAL SEARCH REPORT

PCT/US 92/11329

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 C07D401/04; C07D471/04;	C07D403/04; C07D487/04;	C07D495/04; A01N43/90; C07D491/048 A01N43/42
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	C07D ; A01N	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	US,A,4 189 323 (HOECHST AKTIENGESELLSCHAFT) 19 February 1980 cited in the application ---	1,8
A	CHEMICAL ABSTRACTS, vol. 83, no. 5, 1975, Columbus, Ohio, US; abstract no. 43159q, 'Reactions of tertiary amine N-oxides' page 485 ; cited in the application & YAKUGAKU ZASSHI vol. 95, no. 2, 1975, pages 204 - 210 --- -/--	1,8
¹⁰ 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 document 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 "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		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
23 MARCH 1993	19. 04. 93	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	SCRUTON-EVANS I.	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		Relevant to Claim No.
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	
X	CHEMICAL ABSTRACTS, vol. 93, no. 1, 1980, Columbus, Ohio, US; abstract no. 7980y, 'Reactions concerned in tertiary amine-N-oxides' page 7971 ; see abstract *see structure VI* & YAKUGAKU ZASSHI vol. 99, no. 12, 1979, pages 1181 - 1185 ---	1-5,7
X	JOURNAL OF HETEROCYCLIC CHEMISTRY vol. 16, no. 6, 1979, pages 1135 - 1139 'The synthesis and chelation properties of oximes of certain 2-quinolylmethyl and 2-phenanthrolylmethyl ketones' *see compound of formula VIII, page 1135* ---	1-3,7
A	US,A,4 927 827 (SUMITOMO CHEMICAL COMPANY LTD.) 22 May 1990 ---	1-9
A	EP,A,0 051 177 (CIBA-GEIGY) 12 May 1982 ---	1-9
A	EP,A,0 278 610 (SUMITOMO CHEMICAL COMPANY LTD.) 17 August 1988 ---	1-9
A	WO,A,9 107 400 (HOECHST AKTIENGESELLSCHAFT) 30 May 1991 -----	1-9

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

US 9211329
SA 68690

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 23/03/93

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