COMMONWEALTH of AUSTRALIA
Patents Act 1952

632994

APPLICATION FOR A STANDARD PATENT

I/We

Eli Lilly and Company

of

Lilly Corporate Center, Indianapolis, Indiana, 46285, United States of America

hereby apply for the grant of a Standard Patent for an invention entitled:

Quinazoline derivatives

which is described in the accompanying complete specification.

Details of basic application(s):-

Number	Convention Country	Date
150102	United States of America	29 January 1988

The address for service is care of DAVIES & COLLISON, Patent Attorneys, of 1 Little Collins Street, Melbourne, in the State of Victoria, Commonwealth of Australia.

DATED this TWENTY FOURTH day of JANUARY 1989

To: THE COMMISSIONER OF PATENTS

.....
a member of the firm of
DAVIES & COLLISON for
and on behalf of the
applicant(s)

Davies & Collison, Melbourne

REPRINT OF RECEIPT
M006051 24/01/89

CASE: X-6776A

DAVIES & COLLISON

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

DECLARATION IN SUPPORT OF A
CONVENTION APPLICATION FOR A PATENT

In support of the Convention Application made for a patent for an invention entitled:
QUINAZOLINE DERIVATIVES
I, Mary Ann Tucker, Assistant Patent Counsel, Lilly Corporate Center, City of Indianapolis, State of Indiana 46285, United States of America do solemnly and sincerely declare as follows:

1. I am authorized by ELI LILLY AND COMPANY the applicant for the patent to make this declaration on its behalf.

2. The basic application as defined by Section 141 of the Act was/were made in United States of America

on ~~07/10/102~~ 29th January 1988

by Barry Allen Dreikorn and Robert George Suhr

3. Barry Allen Dreikorn, Robert George Suhr, Glen Phil Jourdan and Ian Glaisby Wright of
9731 Trilobi Drive, Indianapolis, Indiana 46236, 1522 Bruner Drive, Greenfield, Indiana 46140, R.R. #1 Box 74B, Morristown, Indiana 46161 and 300 Meander Way, Greenwood, Indiana 46142 U.S.A. respectively

are the actual inventors of the invention and the facts upon which the applicant is entitled to make the application are as follows:

The said applicant is the assignee of the actual inventors, in respect of the invention.

4. The basic application(~~s~~) referred to in paragraph 2 of this Declaration was/~~were~~ the first application(~~s~~) made in a Convention country in respect of the invention(~~s~~) the subject of the said application.

DECLARED at Indianapolis, Indiana
this 9th day of December, 1988

ELI LILLY AND COMPANY

By Mary Ann Tucker
Mary Ann Tucker
Assistant Patent Counsel

TO: THE COMMISSIONER OF PATENTS
AUSTRALIA

AU8928747

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(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 632994

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QUINAZOLINE DERIVATIVES

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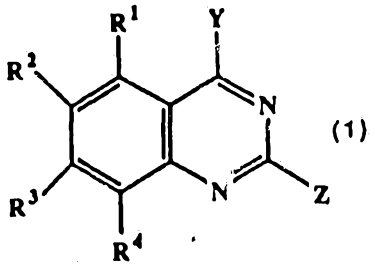
(56) Prior Art Documents
AU 28728/89 C07D 215/22 A61K 31/505
AU 28746/89 C07D 215/42 A01N 43/42
AU 28748/89 C07D 215/04 A01N 43/51

(57) Claim

1. A compound of the formula (1)



wherein

R^1 and R^4 are independently H, halo, $(C_1\text{-}C_4)$ alkyl, branched $(C_3\text{-}C_4)$ alkyl, halo $(C_1\text{-}C_4)$ alkyl, halo $(C_1\text{-}C_4)$ alkoxy, $(C_1\text{-}C_4)$ alkoxy, halo $(C_1\text{-}C_4)$ alkylthio, $(C_1\text{-}C_4)$ alkylthio, NO_2, or NH_2, at least two of R^1 to R^4 being H;

Y is O-W-Ar;

Z is H, Cl, OCH_3, CH_3, or CCl_3;

R^7 is H, $(C_1\text{-}C_4)$ alkyl, or acetyl;

W is an alkylene chain 2 to 8 carbon atoms long, that optionally includes an O, S, SO, SO_2, or NR^7 group, or includes a saturated or unsaturated carbocyclic ring comprising three to seven carbon atoms, or is substituted with $(C_1\text{-}C_3)$ alkyl, $(C_2\text{-}C_4)$

.../2

alkenyl, phenyl, (C_3-C_8) cycloalkyl, halo, hydroxy, or acetyl; and

Ar is

imidazolyl,

indolyl,

thienyl, optionally substituted with CH_3 or Cl,

thiazolyl,

1,3-benzodioxolyl,

fluorenyl,

cyclopentyl,

1-methylcyclopentyl,

cyclohexyl (hexahydrophenyl),

cyclohexenyl (tetrahydrophenyl),

naphthyl,

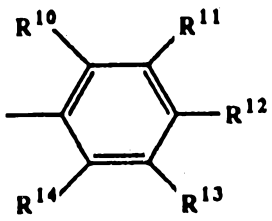
dihydronaphthyl,

tetrahydronaphthyl,

decahydronaphthyl,

pyridyl,

or a group of the formula (2):



(2)

where

R^{10} to R^{14} are independently H, halo, I, (C_1-C_{10}) alkyl, branched (C_3-C_6) alkyl, halo (C_1-C_4) alkyl, (C_1-C_4) alkoxy, halo (C_1-C_4) alkoxy, phenoxy, substituted phenoxy, phenyl, substituted phenyl, phenylthio, substituted phenylthio, NH_2, NO_2, OH, acetoxy, CN $SiR^{15}R^{16}R^{17}$, $OSiR^{15}R^{16}R^{17}$, where R^{15}, R^{16}, and R^{17} are independently C_1-C_4 alkyl, C_3-C_4 branched alkyl, phenyl, or substituted phenyl, at least two of R^{10} to R^{14} being H;

or an acid addition salt of a compound of formula (1).

.../3

6. A fungicidal method which comprises applying to the locus of a plant pathogen a disease inhibiting and phytologically acceptable amount of a compound of formula (1) as defined in any one of claims 1 to 5.

7. A fungicidal composition comprising a disease inhibiting and phytologically acceptable amount of a compound of formula (1) as claimed in any one of claims 1 to 5 in combination with a phytologically-acceptable carrier, optionally in combination with a second plant fungicide.

632994

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PATENTS ACT 1952

COMPLETE SPECIFICATION

NAME & ADDRESS
OF APPLICANT:

Eli Lilly and Company
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United States of America

NAME(S) OF INVENTOR(S):

Barry Allen DREIKORN
Robert George SUHR
Glen Phil JOURDAN
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ADDRESS FOR SERVICE:

DAVIES & COLLISON
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COMPLETE SPECIFICATION FOR THE INVENTION ENTITLED:

Quinazoline derivatives

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

Field of the Invention

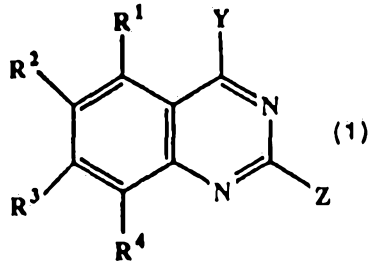
This invention provides new compounds that have excellent plant fungicide activity. Some of the compounds have also demonstrated i, ecticidal and miticidal activity. The invention also provides compositions and combination products that contain a compound of the invention as active ingredient. The invention also provides fungicidal, miticidal, and insecticidal methods.

There is an acute need for new fungicides, insecticides, and miticides, because target pathogens are rapidly developing resistance to currently used pesticides. Widespread failure of N-substituted azole fungicides to control barley mildew was observed in 1983, and has been attributed to the development of resistance. At least 50 species of fungi have developed resistance to the benzimidazole fungicides. The field performance of DMI (demethylation inhibitor) fungicides, which are now widely relied on to protect cereal crops from powdery mildew, has declined since they were introduced in the 1970's. Even recent fungicides, like the acylalanines, which initially exhibited excellent control of potato late blight and grape downy mildew in the field, have become less effective because of widespread resistance. Similarly, mites and insects are developing resistance to the miticides and insecticides in current use. Resistance to insecticides in arthropods is widespread, with at least 400

species resistant to one or more insecticides. The development of resistance to some of the older insecticides, such as DDT, the carbamates, and the organophosphates, is well known. But resistance has even developed to some of the newer pyrethroid insecticides and miticides. Therefore a need exists for new fungicides, insecticides, and miticides.

Summary of the Invention

This invention provides a compound of the formula (1)



(1)

wherein

R^1 and R^4 are independently H, halo, $(C_1\text{-}C_4)$ alkyl, branched $(C_3\text{-}C_4)$ alkyl, halo $(C_1\text{-}C_4)$ alkyl, halo $(C_1\text{-}C_4)$ alkoxy, $(C_1\text{-}C_4)$ alkoxy, halo $(C_1\text{-}C_4)$ alkylthio, $(C_1\text{-}C_4)$ alkylthio, NO_2, or NH_2, at least two of R^1 to R^4 being H;

Y is O-W-Ar;

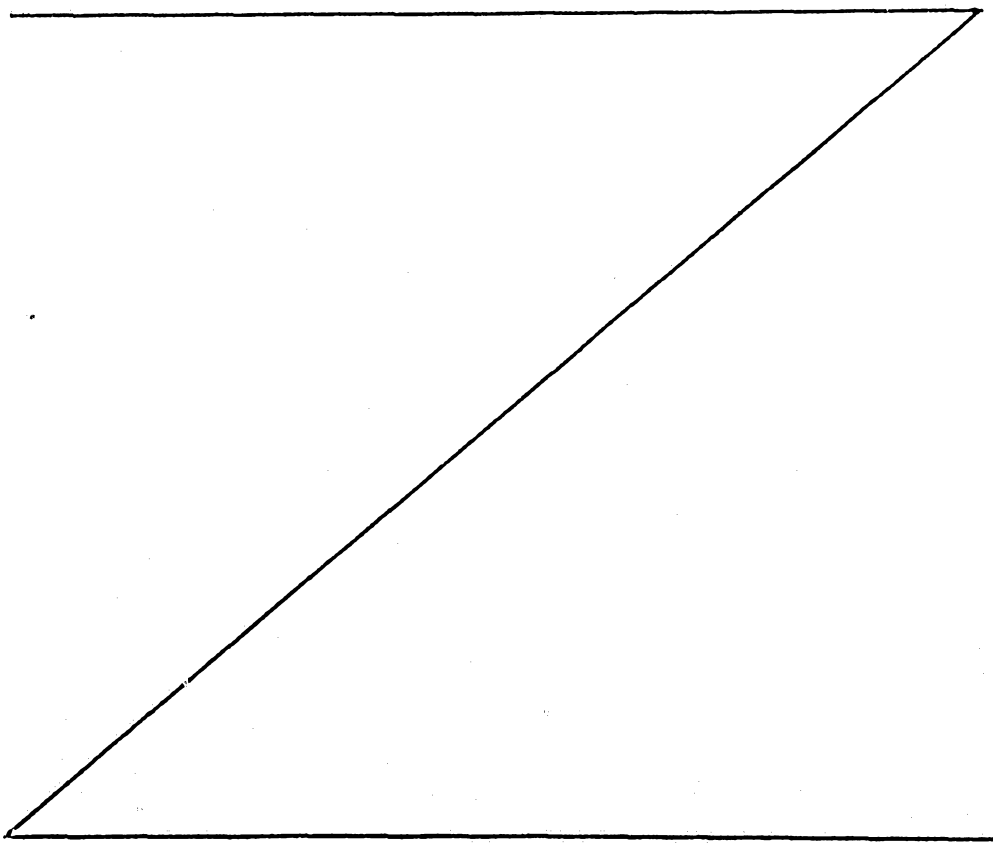
Z is H, Cl, OCH_3, CH_3, or CCl_3;

R^7 is H, $(C_1\text{-}C_4)$ alkyl, or acetyl;

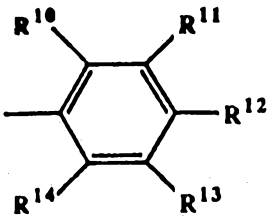
W is an alkylene chain 2 to 8 carbon atoms long, that optionally includes an O, S; SO, SO_2, or NR^7 group, or includes a saturated or unsaturated carbocyclic ring comprising three to seven carbon atoms, or is substituted with $(C_1\text{-}C_3)$ alkyl, $(C_2\text{-}C_4)$ alkenyl, phenyl, $(C_3\text{-}C_8)$ cycloalkyl, halo, hydroxy, or acetyl; and

Ar is

imidazolyl,
indolyl,
thienyl, optionally substituted with CH_3 or Cl,
thiazolyl,
1,3-benzodioxolyl,
fluorenyl,
cyclopentyl,
1-methylcyclopentyl,
cyclohexyl (hexahydrophenyl),
cyclohexenyl (tetrahydrophenyl),
naphthyl,
dihydronaphthyl,
tetrahydronaphthyl,
decahydronaphthyl,
pyridyl,



or a group of the formula (2):



(2)

where

R^{10} to R^{14} are independently H, halo, I, (C_1-C_{10}) alkyl, branched (C_3-C_6) alkyl, halo (C_1-C_4) alkyl, (C_1-C_4) alkoxy, halo (C_1-C_4) alkoxy, phenoxy, substituted phenoxy, phenyl, substituted phenyl, phenylthio, substituted phenylthio, NH_2, NO_2, OH, acetoxy, CN $SiR^{15}R^{16}R^{17}$, $OSiR^{15}R^{16}R^{17}$, where R^{15}, R^{16}, and R^{17} are independently C_1-C_4 alkyl, C_3-C_4 branched alkyl, phenyl, or substituted phenyl, at least two of R^{10} to R^{14} being H;

or an acid addition salt of a compound of formula (1).

The fungicide combinations of the invention comprise at least 1% by weight of a compound of formula (1) in combination with a second plant fungicide.

The fungicide compositions of the invention comprise a disease inhibiting and phytologically acceptable amount of compound of formula (1) in combination with a phytologically-acceptable carrier. Such compositions may optionally contain additional active ingredients, such as an additional fungicidal, miticidal, or insecticidal ingredient.

The fungicidal method of the invention comprises applying to the locus of a plant pathogen a disease inhibiting and phytologically acceptable amount of a compound of formula (1).

The insecticide and miticide combinations of the invention comprise at least 1% by weight of a compound of formula (1) in combination with a second insecticide or miticide.

The insecticide and miticide compositions of the invention comprise an insect- or mite-inactivating amount of a compound of formula (1) in combination with a carrier. Such compositions may optionally contain additional active ingredients, such as an additional fungicidal, miticidal, or insecticidal ingredient.

The insecticidal or miticidal method of the invention comprises applying to a locus of an insect- or mite-inactivating amount of a compound of formula (1), or of a combination described above.

Detailed Description of the Invention

Throughout this document, all temperatures are given in degrees Celsius, and all percentages are weight percentages unless otherwise stated.

The term "halo" refers to a F, Cl, or Br atom.

The terms "(C_1-C_3) alkyl", "(C_1-C_4) alkyl", "(C_2-C_{18}) alkyl", and "(C_1-C_{10}) alkyl", when used alone, refer to straight chain alkyl radicals.

The terms "branched (C_3-C_4) alkyl", and "branched (C_3-C_6) alkyl" refer to all alkyl isomers containing the designated number of carbon atoms, excluding the straight chain isomers.

The term "(C_1-C_4) alkoxy" refers to straight or branched chain alkoxy groups.

The term "halo (C_1-C_4) alkyl" refers to a (C_1-C_4) alkyl group, straight chain or branched, substituted with one or more halo atoms.

The term "halo (C_1-C_4) alkoxy" refers to a (C_1-C_4) alkoxy group substituted with one or more halo groups.

The term "halo (C_1-C_4) alkylthio" refers to a (C_1-C_4) alkylthio group, straight chain or branched, substituted with one or more halo atoms.

The term "substituted phenyl" refers to phenyl substituted with up to three groups selected from halo, I, (C_1-C_{10}) alkyl, branched (C_3-C_6) alkyl, halo (C_1-C_4) alkyl, hydroxy (C_1-C_4) alkyl, (C_1-C_4) alkoxy, halo (C_1-C_4) alkoxy, phenoxy, phenyl, NO_2, OH, CN, (C_1-C_4) alkanoyloxy, or benzyloxy.

The term "substituted phenoxy" refers to phenoxy substituted with up to three groups selected from halo, I, (C_1-C_{10}) alkyl, branched (C_3-C_6) alkyl, halo (C_1-C_4) alkyl, hydroxy (C_1-C_4) alkyl, (C_1-C_4) alkoxy, halo (C_1-C_4) alkoxy, phenoxy, phenyl, NO_2, OH, CN, (C_1-C_4) alkanoyloxy, or benzyloxy.

The term "carbocyclic ring" refers to a saturated or unsaturated carbocyclic ring containing three to seven carbon atoms.

The term "substituted phenylthio" refers to a phenylthio group substituted with up to three groups selected from halo, I, (C_1-C_{10}) alkyl, branched (C_3-C_6) alkyl, halo (C_1-C_4) alkyl, hydroxy (C_1-C_4) alkyl, (C_1-C_4) alkoxy, halo (C_1-C_4) alkoxy, phenoxy, phenyl, NO_2, OH, CN, (C_1-C_4) alkanoyloxy, or benzyloxy.

The term "unsaturated hydrocarbon chain" refers to a hydrocarbon chain containing one or two sites of unsaturation.

The term "HPLC" refers to a high-performance liquid chromatography.

Compounds

While all of the compounds of the invention are useful fungicides, certain classes are preferred for reasons of greater efficacy or ease of synthesis, viz:

1) compounds of formula (1) where at least three of R^1 to R^4 are H;

2) compounds of formula (1) where R^4 is F and the rest of R^1 to R^4 are H;

3) compounds of formula (1) where R^1 to R^4 are all H;

4) compounds of formula (1) where Z is H;

5) compounds of formula (1) where the alkylene chain, W, is two to four carbon atoms long;

6) compounds of formula (1) where W is $-(CH_2)_2-$;

7) compounds of formula (1) where Ar is a phenyl group of formula (2) wherein at least three of R^{10} to R^{14} are H;

8) compounds for formula (1) where Ar is a phenyl group of formula (2) wherein four of R^{10} to R^{14} are H;

9) compounds of formula (1) where Ar is a phenyl group of formula (2) wherein R^{12} is Cl, Br, (C_1-C_4) alkyl, phenyl, or phenoxy.

Compounds particularly preferred for their activity against plant pathogens are:

4-[2-[4-(t-butyl)phenyl]ethoxy]quinazoline,

4-[2-(4-chlorophenyl)ethoxy]quinazoline,

4-[2-(4-chlorophenyl)ethoxy]-8-fluoroquinazoline,

4-[2-(2-naphthyl)ethoxy]quinazoline,

4-[2-(1,1 '-biphenyl)-4-ylethoxy]quinazoline,

4-[2-(4-methylphenyl)ethoxy]quinazoline.

Particularly preferred for their activity against mites and insects are compounds of formula (1) wherein Z is H, and Ar is a substituted phenyl group of formula (2) wherein R^{12} is Cl, Br, (C_1-C_4) alkyl, branched (C_3-C_4) alkyl, phenyl, substituted phenyl, phenoxy, or substituted phenoxy. Examples include:

4-[2-[4-(t-butyl)phenyl]ethoxy]quinazoline,

4-[2-(4-chlorophenyl)ethoxy]quinazoline,

4-[2-(1,1 '-biphenyl)-4-ylethoxy]quinazoline,

4-[2-(4-methylphenyl)ethoxy]quinazoline.

4-[2-[4-(i-propyl)phenyl]ethoxy]quinazoline,

8-fluoro-4-[2-(1,1 '-biphenyl)-4-ylethoxy]quinazoline,

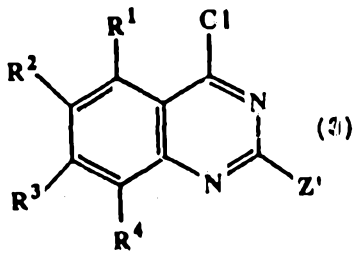
8-fluoro-4-[2-[4-(t-butyl)phenyl]ethoxy]quinazoline.

Synthesis

The compounds of this invention are made using well known chemical procedures. The required starting materials are commercially available, or they are readily synthesized using standard procedures.

Synthesis of Compounds Wherein Y is O-W-Ar

The compounds of formula (1) wherein Y is O-W-Ar were made by condensing a compound of formula (3):



(3)

where R^1 to R^4 are as previously defined, and Z ' is H, Cl, CH_3, or OCH_3, with an alcohol of the formula (4b):

HO-W-Ar (4b)

where

W, and Ar are as previously defined.

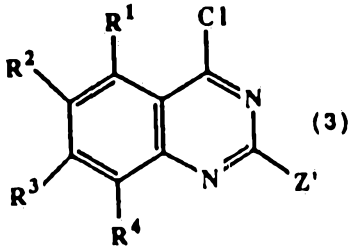
The reaction is preferably carried out in the presence of a strong base, such as sodium hydride, in a non-reactive organic solvent, such as DMF, at a temperature in the range of 0 to 25 °C.

The acid addition salts of compounds of formula (1) are obtained in the usual way.

Compounds of formula (1) wherein Z is OCH_3 can be obtained by treating a compound of formula (1) wherein Z is Cl with sodium methoxide.

Accordingly, the invention also provides a process for preparing a compound of formula (1) which comprises

(a) condensing a compound of formula (3)

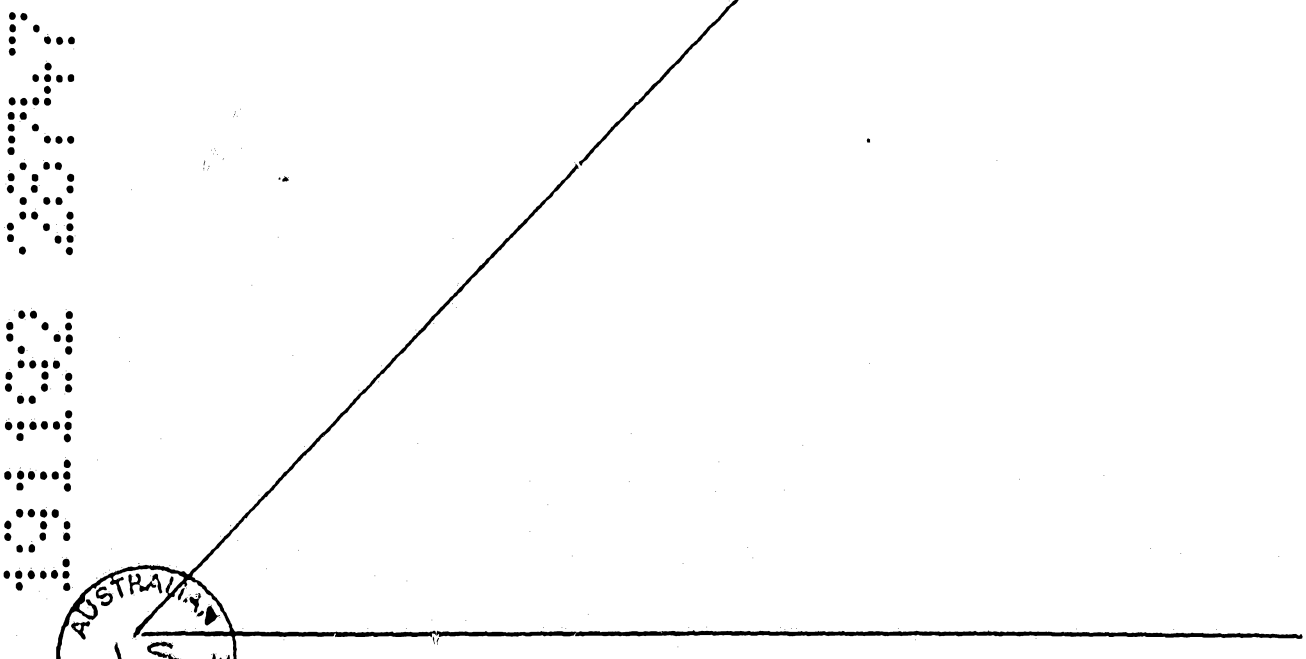


(3)

wherein R^1 to R^4 are as previously defined, and Z ' is H, Cl, CH_3, or OCH_3, with an alcohol of the formula (4b)

HO-W-Ar (4b)

wherein W and Ar are as preivously defined to produce a compound of formula (1) wherein Y is O-W-Ar.



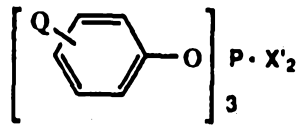
~~wherein R^1, R^2, R^3, R^4, R^8, R^9, Z^1, W, Alk, and Ar are~~ as previously defined, ~~to produce a compound of formula (1) wherein Y is CR^8R^9-Alk or CR^8R^9-W-Ar.~~

Preparation of Quinazoline Starting Materials

Quinazoline starting materials are commercially available or readily prepared using conventional procedures. For example, 4-hydroxy quinazolines can be prepared from commercially available anthranilic acids via condensation with excess formamide at reflux (M. Endicott et al. J. Am. Chem. Soc., 1946, 68, 1299). Alternatively hydroxy quinazolines can be prepared in dioxane at reflux using Gold's reagent (J. Gipton; Correia, K.; Hertel, G. Synthetic Communications, 1984, 14, 1013). Once in hand, the 4-hydroxy quinazoline is chlorinated under standard conditions to provide 4-chloroquinazoline starting materials.

In a preferred procedure, the 4-chloroquinazoline of formula (3) is prepared, and then converted to the desired product of formula (1) without isolation. If phosphorous halide compounds, such as PCl_5 and $POCl_3$ are used to prepare the 4-chloroquinazoline of formula (3), a large excess of phosphorous halide is required. The 4-chloroquinazoline must then be isolated before it can be used to prepare compounds of formula (1), because the excess phosphorous halide would otherwise react with the alcohol of formula (4) or amine of formula (5). It is undesirable to isolate the 4-chloroquinazoline, because it is unstable. It is also mutagenic and smells bad. To avoid these difficulties, the 4-chloroquinazoline can be

prepared from the corresponding 4-hydroxyquinazoline using a triphenylphosphite-halogen complex of the formula (8)



(8)

where Q is H, halo, (C_1-C_4) alkyl, or (C_1-C_4) alkoxy and X' is Cl or Br as the halogenating reagent. These halogenating reagents are described in U.S. Patent No. 4,230,644, where their use in converting alcohols to alkyl halides and amides to imino chlorides is described. The prior art did not suggest use of these halogenating reagents to halogenate nitrogen heterocycles.

The triphenylphosphite-halogen reagent of formula (8) is prepared by reacting chlorine or bromine with a suitable triphenylphosphite in a substantially anhydrous inert organic solvent, such as a hydrocarbon, or halogenated hydrocarbon, at a temperature below 30°C, preferably -15°C to 0°C. The triphenylphosphite-halogen reagent is unstable and converts on standing to a less reactive "thermodynamic" form. The "kinetic" form can be stabilized in solution by adding up to 1 mole of a tertiary amine base, such as pyridine, to the reaction mixture, and by operating at lower temperatures, e.g. less than about -15°C.

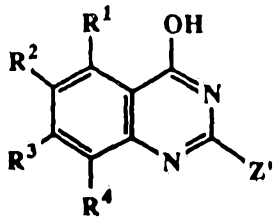
To minimize the opportunity for equilibration to the less reactive thermodynamic product, the halogenating reagents may be prepared immediately before they are utilized, or preferably are prepared in the presence of the 4-hydroxy substrate so that reaction is immediate.

Typically, the halogen is added to a mixture of the triphenylphosphite, pyridine and 4-hydroxyquinazoline in a suitable solvent.

Preferably, 1 to 1.3 equivalents of halogenating reagent of formula (8) are used per equivalent of 4-hydroxy-quinazoline. Following preparation of the 4-chloroquinazoline hydrochloride intermediate, excess halogenating reagent may be quenched by adding a small amount of water to the reaction mixture. The alcohol of formula (4) or amine of formula (5) may then be reacted with the 4-chloroquinazoline intermediate without isolation.

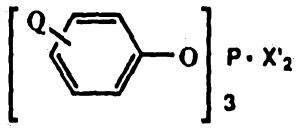
Accordingly, the invention also provides an inventive process for preparation of compounds of formula (1) wherein ~~Y is O-Alk, O-W-Ar, or NR^7-W-Ar~~ which comprises

(a) reacting a 4-hydroxyquinazoline of formula (9)



(9)

wherein R^1, R^2, R^3, R^4, and Z' are as defined above, with 1 to 1.3 equivalents of a halogenating reagent of the formula (8)



(8)

wherein Q is H, halo, (C_1-C_4) alkyl, or (C_1-C_4) alkoxy and X' is Cl or Br; in an inert organic solvent at a temperature below 30°C, and

(b) without isolation of the 4-chloroquinazoline produced in step (a), reacting it with an alcohol of the formula (4b)

HO-W-Ar (4b),

where W, and Ar are as previously defined.

Examples 1-111

The following examples are compounds actually prepared by the above described general procedures. The melting point is given for each compound. In addition, although the data has not been included, each compound was fully characterized by NMR, IR, mass spectra, and combustion analysis. Specific illustrative preparations for the compounds of Examples 1, 2, 34 and 42 follow the tabular listing.

EXAMPLE NUMBER	COMPOUND	M.P.
1	4-[2-[4-(t-butyl)phenyl]ethoxy]quinazoline	70-71 °C
2	4-[2-(4-chlorophenyl)ethoxy]quinazoline	57-58 °C
3	8-fluoro-4-[2-(4-phenoxyphenyl)ethoxy]quinazoline	100-102 °C
4	4-[2-(2-chlorophenyl)ethoxy]quinazoline	67-69 °C
5	4-[2-(3-methoxyphenyl)ethoxy]quinazoline	oil
6	4-[2-(2-methoxyphenyl)ethoxy]quinazoline	124-125 °C
7	4-[2-(4-ethoxyphenyl)ethoxy]quinazoline	80-81 °C
8	8-fluoro-4-[2-[4-(i-propyl)phenyl]ethoxy]quinazoline	53-55 °C
9	4-(1-methyl-2-phenylethoxy)quinazoline	oil

EXAMPLE NUMBER	COMPOUND	M.P.
10	4-[2-(9H-fluoren-2-yl)ethoxy]quinazoline	135-137 °C
11	4-[2-(4-ethoxy-3-methoxyphenyl)ethoxy]quinazoline	62-63 °C
12	4-[2-(4-bromophenyl)ethoxy]quinazoline	64-65 °C
13	4-(2-phenylethoxy)quinazoline	47-48 °C
14	4-[2-(3-chlorophenyl)ethoxy]quinazoline	100 °C
15	4-(4-phenylbutoxy)quinazoline	40 °C
16	4-[2-(2,4,6-trimethylphenyl)ethoxy]quinazoline	90 °C-
17	4-[2-[2-(trifluoromethyl)phenyl]ethoxy]quinazoline	115 °C
18	4-[2-(2-fluorophenyl)ethoxy]quinazoline	52 °C
19	4-[2-(4-methoxyphenyl)ethoxy]quinazoline	47 °C
20	4-[2-[3-(trifluoromethyl)phenyl]ethoxy]quinazoline	oil
21	4-[2-(2-thienyl)ethoxy]quinazoline	62-63 °C
22	4-[2-(4-chlorophenyl)ethoxy]-8-fluoro-quinazoline	85-87 °C
23	8-fluoro-4-[2-[2-(trifluoromethyl)phenyl]ethoxy]-quinazoline	78-81 °C
24	4-(2-phenylpropoxy)quinazoline	oil
25	4-[2-(4-ethylphenyl)ethoxy]quinazoline	oil
26	8-fluoro-4-[2-(2-naphthyl)ethoxy]quinazoline	100-102 °C
27	4-(2,2-diphenylethoxy)quinazoline	77-78 °C
28	4-[2-(3-phenoxyphenyl)ethoxy]quinazoline	oil
29	4-[2-(4-phenoxyphenyl)ethoxy]quinazoline	oil
30	4-(2-cyclohexylethoxy)-8-fluoroquinazoline	81-83 °C

EXAMPLE NUMBER	COMPOUND	M.P.
31	4-[2-(3,4-dimethyoxyphenyl)ethoxy]quinazoline	92-93 °C
32	4-[2-(2-naphthyl)ethoxy]quinazoline	84 °C
33	4-[2-(4-fluorophenyl)ethoxy]quinazoline	93-94 °C
34	4-[2-(1,1 '-biphenyl)-4-ylethoxy]quinazoline	72-74 °C
35	4-[2-(4-methylphenyl)ethoxy]quinazoline	70-71 °C
36	4-[2-[4-(i-propyl)phenyl]ethoxy]quinazoline	45 °C
37	4-[2-(1-naphthyl)ethoxy]quinazoline	85 °C
38	8-fluoro-4-[2-(1,1 '-biphenyl)-4-ylethoxy]quinazoline	120-122 °C
39	8-fluoro-4-[2-[4-(t-butyl)phenyl]ethoxy]quinazoline	92-94 °C
40	8-fluoro-4-(2-phenylethoxy)quinazoline	57-59 °C
41	4-[2-(3-methylphenyl)ethoxy]quinazoline	36 °C
42	8-fluoro-4-[2-(4-methylphenyl)ethoxy]quinazoline	72-74 °C
43	4-[2-(2-methylphenyl)ethoxy]quinazoline	85 °C
44	4-[2-(2-chlorophenoxy)ethoxy]quinazoline	179-180 °C
45	4-[2-(3-hydroxyphenyl)ethoxy]quinazoline	135-137 °C
46	8-fluoro-4-[2-(3,4-dimethoxyphenyl)ethoxy]-quinazoline	80-82 °C
47	8-fluoro-4-[2-[4-(2-methylpropyl)phenyl]propoxy]-quinazoline	90-92 °C
48	4[2-(2-hydroxyphenyl)ethoxy]quinazoline	166-168 °C
49	4-[2-(4-hydroxyphenyl)ethoxy]quinazoline	204-206 °C
50	8-fluoro-4-[2-(1,1 '-biphenyl)-4-ylethoxy]quinazoline	oil

EXAMPLE NUMBER	COMPOUND	M.P.
51	8-fluoro-4-[2-(4-trifluoromethyl)ethoxy]quinazoline	90-93 °C
52	8-fluoro-4-[3-(4-phenoxyphenyl)propoxy]-quinazoline	NA
53	4-[2-(3-acetoxyphenyl)ethoxy]quinazoline	oil
54	4-[3-(4-hydroxyphenyl)propoxy]quinazoline	157-159 °C
55	4-(2,2-dimethylbutoxy)quinazoline	oil
56	4-[2-[2-[dimethyl-(1,1-dimethylethyl)silyloxy]phenyl]-ethoxy]quinazoline	oil
57	8-fluoro-4-[3-[4-ethoxyphenyl]propoxy]quinazoline	73-75 °C
58	4-[2-[3,5-di(trifluoromethyl)phenyl]ethoxy]-quinazoline	65-67 °C
59	4-[(3-methoxy)butoxy]quinazoline	oil
60	4-[3-ethenyl-5-phenyl-pentyloxy]quinazoline	oil
61	8-fluoro-4-[2-(2-methoxyphenyl)ethoxy]quinazoline	80-82 °C
62	8-fluoro-4-[2-(4-methoxyphenyl)ethoxy]quinazoline	78-80 °C
63	8-fluoro-4-[2-[3-(trifluoromethyl)phenyl]ethoxy]-quinazoline	72-74 °C
64	4-[2-[4-(trifluoromethyl)phenyl]ethoxy]quinazoline	oil
65	4-[2-[2-(1-methylethyl)phenyl]ethoxy]quinazoline	oil
66	7-chloro-4-[2-[4-(1,1-dimethylethyl)phenyl]ethoxy]-quinazoline	128-130 °
67	4-[2-[3-(phenylthio)phenyl]ethoxy]quinazoline	65-69 °C

EXAMPLE NUMBER	COMPOUND	M.P.
68	4-[3-[4-(1,1-dimethylethyl)phenyl]propoxy]-quinazoline	oil
69	8-methyl-4-[2-[4-(1,1-dimethylethyl)phenyl]ethoxy]-quinazoline	oil
70	8-fluoro-4-[2-(1-naphthalenyl)ethoxy]quinazoline	114 °C
71	4-[2-(1,1 '-biphenyl)-4-ylbutoxy]quinazoline	oil
72	4-[3-[4-(1-methylethyl)phenyl]propoxy]quinazoline	oil
73	4-[2-(4 '-fluoro-1,1 '-biphenyl)-4-ylethoxy]-quinazoline	92-94 °C
74	4-[2-[2,6-bis(trifluoromethyl)phenyl]ethoxy]-quinazoline	44-45 °C
75	4-[2-[3-(1-methylethoxy)phenyl]ethoxy]quinazoline	oil
76	4-[2-[4-hydroxy-3-methoxyphenyl]ethoxy]quinazoline	68-70 °C
77	4-[(1-benzyl-3-buten-2-yl)oxy]quinazoline	oil
78	8-fluoro-4-[3-[4-(1,1-dimethylethyl)phenyl]propoxy]-quinazoline	NA
79	4-[3-(4-phenoxyphenyl)propoxy]quinazoline	oil
80	8-fluoro-4-[3-[4-(1-methylethyl)phenyl]propoxy]-quinazoline	oil
81	4-[2-[4-[dimethyl-(t-butyl)silyloxy]phenyl]ethoxy]-quinazoline	oil
82	8-fluoro-4-[2-(4-butoxyphenyl)ethoxy]quinazoline	59-61 °C
83	4-[3-(4-ethoxyphenyl)propoxy]quinazoline	44-45 °C

EXAMPLE NUMBER	COMPOUND	M.P.
84	8-fluoro-4-[2-(2,4-difluorophenyl)ethoxy]quinazoline	102-104 °C
85	4-[2-(4-phenoxyphenyl)propoxy]quinazoline	NA
86	4-(2-[4-(2-fluorophenoxy)phenyl]ethoxy]quinazoline	oil
87	8-fluoro-4-[2-(3-phenoxyphenyl)ethoxy]quinazoline	58-60 °C
88	4-(3-methyl-2-phenylbutoxy)quinazoline	oil
89	4-[2-[4-(2-methylpropyl)phenyl]propoxy]quinazoline	57-59 °C
90	4-[4-[4-(i-propyl)phenyl]butoxy]quinazoline	oil
91	4-[2-(4-ethoxyphenyl)ethoxy]-8-fluoroquinazoline	75-76 °C
92	2-(trichloromethyl)-4-[2-[4-(t-butyl)phenyl]ethoxy]-quinazoline	105-107 °C
93	4-[2-(1,1 '-biphenyl)-3-ylethoxy]quinazoline	oil
94	6-chloro-4-[2-[4-(t-butyl)phenyl]ethoxy]quinazoline	91-93 °C
95	6-bromo-4-[2-[4-(t-butyl)phenyl]ethoxy]quinazoline	88-90 °C
96	4-[2-[[5-(trifluoromethyl)-2-pyridinyl]thio]ethoxy]-quinazoline	53-55 °C
97	4-[4-[4-(t-butyl)phenyl]butoxy]quinazoline	oil
98	4-[2-(4-butoxyphenyl)ethoxy]quinazoline	56-58 °C
99	4-[2-[2,6-bis(i-propyl)phenoxy]ethoxy]quinazoline	oil
100	4-[2-(3-phenoxyphenyl)propoxy]quinazoline	oil
101	8-chloro-4-[2-[4-(t-butyl)phenyl]ethoxy]quinazoline	115-118 °C
102	4-[2-(1,1 '-biphenyl)-4-ylpropoxy]quinazoline	oil

EXAMPLE NUMBER	COMPOUND	M.P.
103	4-[2-[4-[3-(trifluoromethyl)phenoxy]phenyl]ethoxy]-quinazoline	69-71 °C
104	4-[2-[4-(trimethylsilyl)phenyl]ethoxy]quinazoline	oil
105	4-[2-[4-(trimethylsilyl)phenyl]ethoxy]quinazoline monohydrochloride	190 °C
106	8-fluoro-4-[2-[2-(i-propyl)phenyl]ethoxy]quinazoline	85-87 °C
107	4-[3-(3-trifluoromethylphenyl)propoxy]quinazoline	30 °C
108	8-fluoro-4-[2-(1,1 '-biphenyl)-4-ylbutoxy]quinazoline	88-90 °C
109	8-fluoro-4-[2-[4-(2-fluorophenoxy)phenyl]ethoxy]-quinazoline	86-88 °C
110	8-fluoro-4-[2-(1,1 '-biphenyl)4-ylpropoxy]quinazoline	115 °C
111	8-fluoro-4-[4-[4-(t-butyl)phenyl]butoxy]quinazoline	oil

The procedures described in the following detailed examples are representative of the procedures used to prepare the compounds of the other examples.

Example 1

4-[2-[4-(t-Butyl)phenyl]ethoxy]quinazoline

To a solution of 1.1 g of sodium hydride in 50 ml of DMF, 4.0 g of 2-[4-(t-butyl)phenyl]ethanol was added, and the mixture was stirred at room temperature for one hour. Then 3.6 g of 4-chloroquinazoline in 20 ml of DMF were added, and the mixture was stirred at room temperature overnight. The mixture was then poured into a mixture of ice in water. The product was extracted into CH_2Cl_2, and the resulting solution was concentrated to dryness. TLC showed one major spot and five minor spots. The product was purified by HPLC (silica gel, CH_2Cl_2). The fractions containing the major product were collected and concentrated, giving 1.9 g of the title product. Yield: 28.4%. M.P. 70-71°C.

The compound of Example 2 was prepared on a larger scale, using a preferred process, as follows: To 54 L of methylene chloride, and 1.8 L of pyridine, 6.5 Kg of 4-hydroxyquinazoline was added, and the mixture was cooled to -5 to 10°C. To this mixture 15.7 Kg of triphenyl phosphite was added. Then 3.67 Kg of chlorine gas was bubbled in over a three hour period while the temperature of the mixture was maintained in the range of 0 to 10°C, to produce 4-chloroquinazoline hydrochloride.

After stirring the mixture an additional hour, 105 mL of water was added to quench excess halogenating reagent. Then 9.7 Kg of 4-(t-butyl)benzeneethanol was added over a 15 minute period while the mixture was maintained at 10 to 20°C. The mixture was heated to reflux (40-45°C) and held at reflux for three hours. After vacuum distilling the contents of the reaction to minimize volume, 56 L of toluene was added. The contents of the reaction were again vacuum distilled, 56 L of heptane were added, and the mixture was cooled to 30-35°C. The HCl salt of the desired product was isolated by filtration, and washed with toluene/heptane.

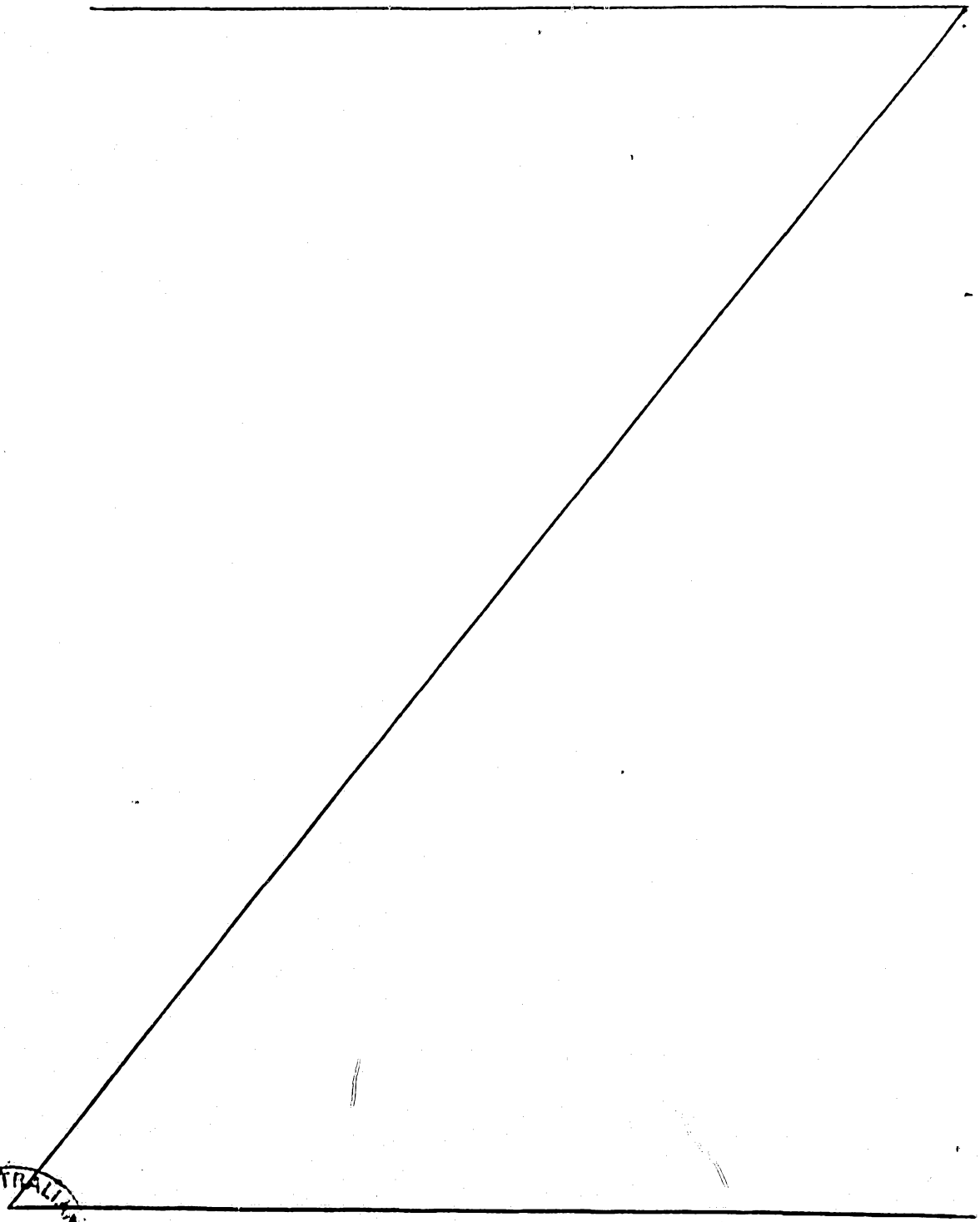
The free base was obtained by combining the wet cake of the HCl salt with 58 L acetone and 6.5 L of triethylamine. After heating the mixture to 25-30°C the contents of the reaction were vacuum distilled to a volume of 45 L, and then 70 L of water were added. The mixture was cooled to 5-10°C over 45 minutes, and the title product was then isolated by filtration. Yield: 11.5 Kg (85%).

Example 9

4-[2-(4-Chlorophenyl)ethoxy]quinazoline

To a solution of 1.1 g of sodium hydride in 50 ml of DMF was added 3.4 g of 2-(4-chlorophenyl)ethanol, and the mixture was stirred at room temperature for one hour. Then 3.6 g of 4-chloroquinazoline in 20 ml of DMF were added, and the mixture was stirred overnight. The

mixture was then poured into a mixture of ice in water. Solid was collected and recrystallized from pentane giving .149 g of the title product. Yield: 2.4%. M.P. 57-58 °C.



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Example ~~85~~

4-[2-(1,1'-biphenyl)-4-ylethoxy]quinazoline

To a solution of 0.53 g of sodium hydride in 200 ml of DMF was added 2.2 g of 2-[(1,1'-biphenyl)-4-yl]ethanol, and the mixture was stirred at room temperature for one hour. Then 1.8 g of 4-chloroquinazoline in 20 ml of DMF were added, and the mixture was stirred at room temperature for another three hours. The mixture was then poured into a mixture of ice in water. The solid phase was collected and washed with water. TLC showed two spots. The product was purified using HPLC (silica gel, CH_2Cl_2) giving 1.1 g of the title product. Yield: 30.6%. M.P. 72-74°C.

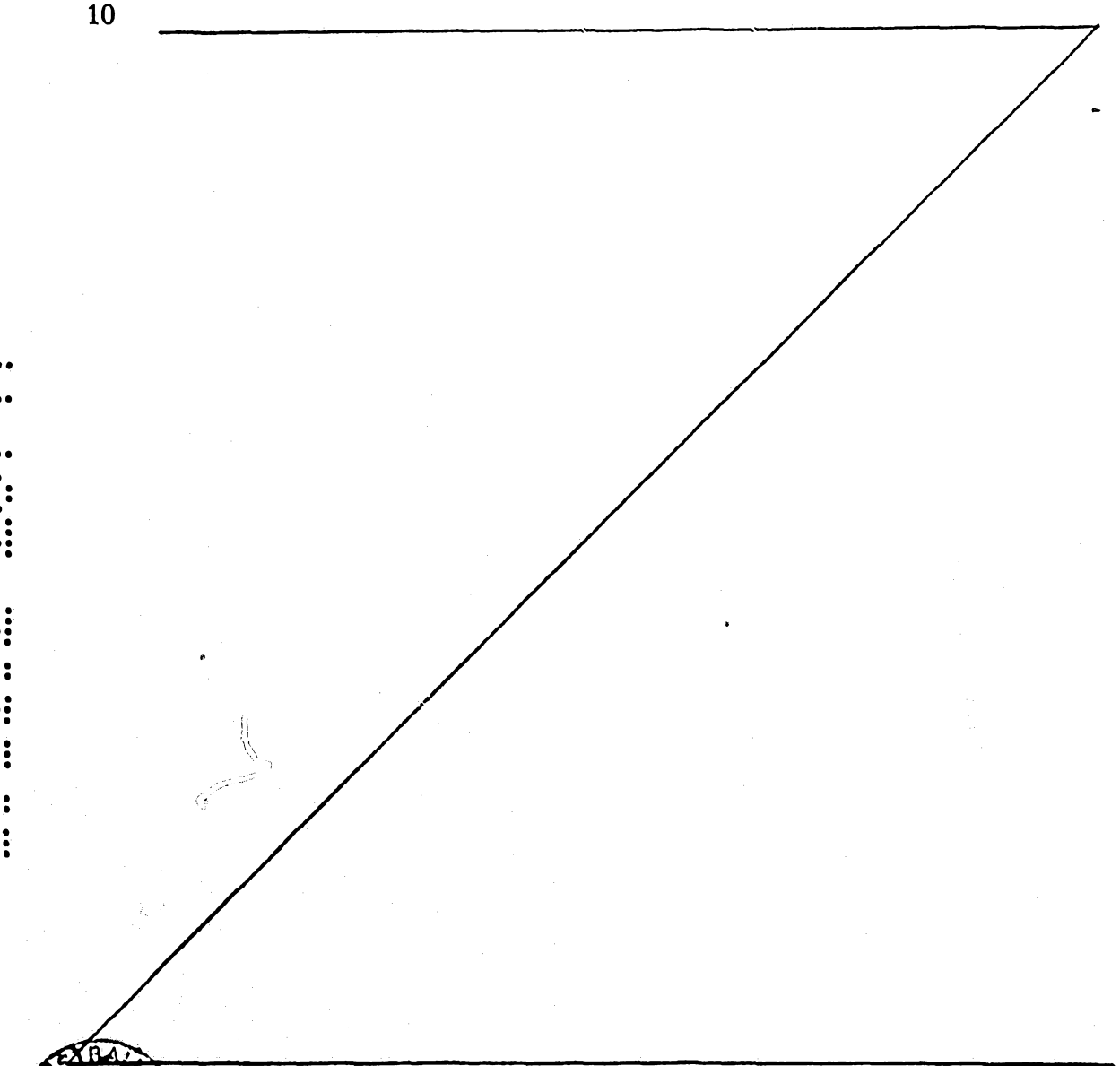
The following is another, preferred process for preparing the title product:

A suspension of 8.2 g of 4-chloroquinazoline and 9.9 g of 2-[(1,1'-biphenyl)-4-yl]ethanol in 250 mL of toluene saturated with HCl gas was heated to 50°C for four hours. Then an additional 3.6 g of 4-chloroquinazoline were added, and heating to 50°C was continued for one hour. Then the mixture was cooled, ice water was added, and the pH was adjusted to 8.5 using dilute sodium hydroxide. The toluene layer was separated, washed with brine, and filtered through phase separating paper. The toluene solution was placed in a freezer overnight. A small amount of hydroxyquinazoline crystallized, and was separated by filtration. The toluene solution was concentrated to dryness, and the residue was dissolved in ether, then pentane was added, and the title product crystallized. Yield: 12.3 g (75%). M.P. 71-72°C.

Example 42

8-fluoro-4-[2-(4-methylphenyl)ethoxy]quinazoline

To a mixture of 0.6 g of sodium hydride (50%, suspension in oil) and 2 g of 4-chloro-8-fluoroquinazoline in 20 ml of DMF was added 1.64 g of 2-(4-methylphenyl)-ethanol, and the mixture was stirred for one hour. Then the mixture was poured into ice water. The solid was collected by filtration. Yield: 0.7 g (20.5%). M.P. 72-74 °C



Fungicide Utility

The compounds of the present invention have been found to control fungi, particularly plant pathogens. When employed in the treatment of plant fungal diseases, the compounds are applied to the plants in a disease inhibiting and phytologically acceptable amount. The term "disease inhibiting and phytologically acceptable amount," as used herein, refers to an amount of a compound of the invention which kills or inhibits the plant disease for which control is desired, but is not significantly toxic to the plant. This amount will generally be from about 1 to 1000 ppm, with 10 to 500 ppm being preferred. The exact concentration of compound required varies with the fungal disease to be controlled, the type formulation employed, the method of application, the particular plant species, climate conditions and the like. A suitable application rate is typically in the range from .25 to 4 lb/A. The compounds of the invention may also be used to protect stored grain and other non-plant loci from fungal infestation.

Greenhouse Tests

The following experiments were performed in the laboratory to determine the fungicidal efficacy of the compounds of the invention.

Test 1

This screen was used to evaluate the efficacy of the present compounds against a variety of different organisms that cause plant diseases.

The test compounds were formulated for application by dissolving 50 mg of the compound into 1.25 ml of solvent. The solvent was prepared by mixing 50 ml of "Tween 20" (polyoxyethylene (20) sorbitan monolaurate emulsifier) with 475 ml of acetone and 475 ml of ethanol. The solvent/compound solution was diluted to 125 ml with deionized water. The resulting formulation contains 400 ppm test chemical. Lower concentrations were obtained by serial dilution with the solvent-surfactant mixture.

The formulated test compounds were applied by foliar spray. The following plant pathogens and their corresponding plants were employed.

	Pathogen	Designation in Following Table	Host
5	Erysiphe graminis tritici (powdery mildew)	POWD MDEW	wheat
	Pyricularia oryzae (rice blast)	RICE BLAS	rice
10	Puccinia recondita tritici (leaf rust)	LEAF RUST	wheat
	Botrytis cinerea (gray mold)	GRAY MOLD	grape berries
15			
	Pseudoperonospora cubensis (downy mildew)	DOWN MDEW	squash
	Cercospora beticola (leaf spot)	LEAF SPOT	sugar beet
20			
	Venturia inaequalis (apple scab)	APPL SCAB	apple seedling
25	Septoria tritici (leaf blotch)	LEAF BLOT	wheat

The formulated technical compounds were sprayed on all foliar surfaces of the host plants (or cut berry) to past run-off. Single pots of each host plant were placed on raised, revolving pedestals in a fume hood. Test solutions were sprayed on all foliar surfaces. All treatments were allowed to dry and the plants were inoculated with the appropriate pathogens within 2-4 hours.

Table 1 presents the activity of typical compounds of the present invention when evaluated in this experiment. The effectiveness of test compounds in controlling disease was rated using the following scale.

0	=	not tested against specific organism
-	=	0-19% control at 400 ppm
+	=	20-89% control at 400 ppm
++	=	90-100% control at 400 ppm
+++	=	90-100% control at 100 ppm

TABLE 1

EX. NO.	POWD MDEW	RICE BLAST	LEAF RUST	GRAY MOLD	DOWN MDEW	LEAF SPOT	APPL SCAB	LEAF BLOT
1	++	+++	+++	-	+++	++	+	+
2	+++	+++	+++	-	+	+++	+++	++
3	+++	+++	+++	-	+++	0	0	0
4	++	-	++	-	+++	0	0	0
5	+++	+++	+++	-	+++	0	0	0
6	+	+	+	-	++	0	0	0
7	+++	+++	+++	-	+++	0	0	0
8	+++	+++	+++	-	+++	0	0	0
9	++	+	+	-	++	0	0	0
10	++	++	+	-	+	0	0	0
11	+++	+++	+++	-	+++	0	0	0
12	+++	+++	+++	-	+++	0	0	0
13	++	-	+++	-	++	0	0	0
14	+++	++	+++	-	+++	0	0	0
15	+++	+++	+++	-	+++	0	0	0
16	++	++	++	-	++	0	0	0
17	+++	+++	+++	-	+++	0	0	0
18	+++	+	+++	-	++	0	0	0
19	+++	+++	+++	-	+++	0	0	0
20	++	+++	++	-	+++	0	0	0

TABLE 1

EX. NO.	POWD MDEW	RICE BLAST	LEAF RUST	GRAY MOLD	DOWN MDEW	LEAF SPOT	APPL SCAB	LEAF BLOT
21	++	++	++	-	++	+	+	+
22	+++	+++	+++	-	+++	0	0	0
23	+++	+++	+++	-	+++	0	0	0
24	+	+++	+	-	++	0	0	0
25	+++	+++	+++	-	+++	0	0	0
26	+++	+++	+++	-	+++	0	0	0 -
27	+	+	-	-	++	0	0	0
28	+++	+++	+++	-	+++	0	0	0
29	+++	+++	+++	-	+++	0	0	0
30	+	+++	+	-	+	0	0	0
31	++	+++	+++	-	+++	0	0	0
32	+++	+++	+++	-	+++	0	0	0
33	++	++	+++	-	++	-	++	+
34	++	+	+++	-	+++	-	-	+++
35	++	+++	++	-	+++	+	-	-
36	+++	+++	+++	-	+++	0	0	0
37	+	++	+	-	++	0	0	0
38	+++	+++	+++	-	+++	0	0	0
39	+++	+++	+++	-	+++	0	0	0
40	+++	-	+++	-	+++	0	0	0
41	+++	++	+++	-	++	0	0	0

TABLE 1

EX. NO.	POWD MDEW	RICE BLAST	LEAF RUST	GRAY MOLD	DOWN MDEW	LEAF SPOT	APPL SCAB	LEAF BLOT
42	+++	+++	+++	-	+++	0	0	0
43	+	+	+++	-	+	0	0	0
44	-	+	++	-	+	-	-	-
45	-	++	+	-	+	0	0	0
46	+	+++	+++	-	+++	0	0	0
47	+	+++	+++	-	+++	0	0	0
48	-	-	+	-	+	0	0	0
49	+	+	+++	-	+	0	0	0
50	++	+++	+	-	+++	0	0	0
51	+++	+++	+++	-	+++	0	0	0
52	+	++	+	-	-	0	0	0
53	+	+	+	-	++	0	0	0
54	-	-	-	-	-	0	0	0
55	-	-	-	-	-	0	0	0
56	+	-	-	-	-	0	0	0
57	+	+	+	-	+	0	0	0
58	++	+	+	-	+	0	0	0
59	-	+	-	-	+	0	0	0
60	+	-	-	-	-	0	0	0
61	+++	+++	+++	-	+++	0	0	0
62	+++	+++	+++	-	+++	0	0	0

TABLE 1

EX. NO.	POWD MDEW	RICE BLAST	LEAF RUST	GRAY MOLD	DOWN MDEW	LEAF SPOT	APPL SCAB	LEAF BLOT
63	+++	+++	+++	-	+	0	0	0
64	+++	+++	+++	0	0	0	0	0
65	+++	+++	+++	-	+++	0	0	0
66	-	-	-	-	-	0	0	0
67	+++	+++	+++	-	+++	0	0	0
68	++	+	-	-	++	0	0	0
69	+	+++	+	-	++	0	0	0
70	+	+	+	-	+	0	0	0
71	+	++	+	-	-	0	0	0
72	+	++	-	-	++	0	0	0
73	+++	+++	+++	-	+++	0	0	0
74	+	+++	+	-	++	0	0	0
75	++	+++	++	+	+++	0	0	0
76	+++	-	+++	-	+++	0	0	0
77	++	++	+	-	++	0	0	0
78	++	-	-	-	-	0	0	0
79	+	-	-	-	-	0	0	0
80	+++	+	+	-	+	0	0	0
81	++	-	-	-	-	0	0	0
82	+++	+++	+++	-	+++	0	0	0
83	+	++	+	-	++	0	0	0

TABLE 1

EX. NO.	POWD MDEW	RICE BLAST	LEAF RUST	GRAY MOLD	DOWN MDEW	LEAF SPOT	APPL SCAB	LEAF BLOT
84	+++	+++	+++	-	+++	0	0	0
85	+	+	++	-	-	0	0	0
86	+++	+++	+++	-	+++	0	0	0
87	+++	+++	+++	-	+++	0	0	0
88	++	++	++	-	++	0	0	0
89	+	+++	+	-	-	0	0	0
90	+++	+++	+	-	++	0	0	0
91	+++	+++	+++	-	+++	0	0	0
92	-	-	-	-	-	0	0	0
93	++	+++	+	-	+	0	0	0
94	+	++	-	-	++	0	0	0
95	-	++	+	-	-	0	0	0
96	+	++	-	-	+	0	0	0
97	++	-	-	+	+	0	0	0
98	+++	+++	+++	-	+++	0	0	0
99	++	+	-	-	+	0	0	0
100	++	-	++	-	-	0	0	0
101	+	++	+	-	++	0	0	0
102	-	+++	+	-	+	0	0	0
103	+++	+++	+++	-	+++	0	0	0
104	+++	-	+++	-	+++	0	0	0

TABLE 1

EX. NO.	POWD MDEW	RICE BLAST	LEAF RUST	GRAY MOLD	DOWN MDEW	LEAF SPOT	APPL SCAB	LEAF BLOT
105	-	-	-	-	-	0	0	0
106	+++	+++	+++	-	++	0	0	0
107	++	-	-	-	-	0	0	0
108	+	+	-	-	-	0	0	0
109	+++	+++	+++	-	+++	0	0	0
110	+++	+	+++	-	+	0	0	0
111	+++	+++	+	-	+++	0	0	0

Field Tests

Selected compounds were field tested on various crops against a variety of pathogens. Table 2 identifies pathogens against which given compounds demonstrated activity in these field tests.

TABLE 2

COMPOUND EX. NO.	CROP	PATHOGEN
2	barley	Erysiphe graminis hordei
5		Pyrenophora teres
		Rhynchosporium secalis
	cucumber	Sphaerotheca fuliginea
	grape	Plasmopara viticola
	sugar beet	Erysiphe sp.
10	wheat	Erysiphe graminis tritici
		Pseudocercosporella herpotrichoides
5	grape	Plasmopara viticola
	potato	Phytophthora infestans
15		
53	apple	Podosphaera leucotricha
	barley	Erysiphe graminis hordei
		Pyrenophora teres
		Rhynchosporium secalis
20	cucumber	Sphaerotheca fuliginea
	grapes	Plasmopara viticola
		Uncinula necator
	rape	Alternaria brassicae
	wheat	Septoria nodorum
25		Erysiphe graminis tritici
		Pseudocercosporella herpotrichoides

Combinations

Fungal disease pathogens are known to develop resistance to fungicides. When strains resistant to a fungicide do develop, it becomes necessary to apply larger and larger amounts of the fungicide to obtain desired results. To retard the development of resistance to new fungicides, it is desirable to apply the new fungicides in combination with other fungicides. Use of a combination product also permits the product's spectrum of activity to be adjusted.

Accordingly, another aspect of the invention is a fungicidal combination comprising at least 1% by weight of a compound of formula (1) in combination with a second fungicide.

Contemplated classes of fungicides from which the second fungicide may be selected include:

1) N-substituted azoles, for example propiconazole, triademefon, flusilazol, diniconazole, ethyltrianol, myclobutanil, and prochloraz;

2) pyrimidines, such as fenarimol and nuarimol;

3) morpholines, such as fenpropimorph and tridemorph;

4) piperazines, such as triforine; and

5) pyridines, such as pyrifenox.

Fungicides in these five classes all function by inhibiting sterol biosynthesis. Additional classes of contemplated fungicides, which have other mechanisms of action include:

6) dithiocarbamates, such as maneb and mancozeb;

7) phthalimides, such as captafol;

8) isophthalonitrites, such as chlorothalonil;

9) dicarboximides, such as iprodione;

10) benzimidazoles, such as benomyl and carbendazim;

11) 2-aminopyrimidines, such as ethirimol;

12) carboxamides, such as carboxin; and

13) dinitrophenols, such as dinocap.

The fungicide combinations of the invention contain at least 1%, ordinarily 20 to 80%, and more typically 50 to 75% by weight of a compound of formula (1).

Insecticide and Miticide Utility

The compounds of the invention are also useful for the control of insects and mites. Therefore, the present invention also is directed to a method for inhibiting an insect or mite which comprises applying to a locus of the insect or mite an insect- or mite-inhibiting amount of a compound of formula (1).

The compounds of the invention show activity against a number of insects and mites. More specifically, the compounds show activity against melon aphid, which is a member of the insect order Homoptera. Other members of the Homoptera include leafhoppers, planthoppers, pear pyslla, apple sucker, scale insects, whiteflies, spittle bugs as well as numerous other host specific aphid species. Activity has also been observed against greenhouse thrips, which are members of the order Thysanoptera. The compounds also show activity against Southern armyworm, which

is a member of the insect order Lepidoptera. Other typical members of this order are codling moth, cutworm, clothes moth, Indianmeal moth, leaf rollers, corn earworm, European corn borer, cabbage worm, cabbage looper, cotton bollworm, bagworm, eastern tent caterpillar, sod webworm, and fall armyworm.

Representative mite species with which it is contemplated that the present invention can be practiced include those listed below.

FAMILY	SCIENTIFIC NAME	COMMON NAME
ACARIDAE		
	Aleurobius farinae	
	Rhizoglyphus echinopus	Bulb mite
	Rhizoglyphus elongatus	
	Rhizoglyphus rhizophagus	
	Rhizoglyphus sagittatae	
	Rhizoglyphus tarsalis	
ERIOPHYIDAE		
	Abacarus farinae	Grain rust mite
	Aceria brachytarsus	
	Acalitus essigi	Redberry mite
	Aceria ficus	
	Aceria fraaxinivorus	
	Aceria granati	
	Aceria parapopuli	
	Eriophyes sheldoni	Citrus bud mite
	Aceria tulipae	
	Aculus carnutus	Peach silver mite
	Aculus schlechtendali	Apple rust mite
	Colomerus vitis	Grape erineum mite
	Eriophyes convolvens	
	Eriophyes insidiosus	
	Eriophyes malifoliae	
	Eriophyes padi	
	Eriophyes pruni	
	Epitrimerus pyri	Pear leaf blister mite
	Eriophyes ramosus	

FAMILY	SCIENTIFIC NAME	COMMON NAME
	Eriophyes sheldoni	Citrus bud mite
	Eriophyes ribis	
	Phyllocoptes gracilis	Dryberry mite
	Phyllocoptruta oleivora	Citrus rust mite
	Phytoptus ribis	
	Trisetacus pini	
	Vasates amygdalina	
	Vasates eurynotus	
	Vasates quadripedes	Maple bladdergall mite
	Vasates schlechtendali	
EUPODIDAE		
	Penthaleus major	Winter grain mite
	Linopodes spp.	
NALEPELLIDAE		
	Phylocoptella avellanae	Filbert bud mite
PENTHALEIDAE		
	Halotydeus destrustor	
PYEMOTIDAE		
	Pyemotes tritici	Straw itch mite
	Siteroptes cerealium	
TARSONEMIDAE		
	Polyphagotarsonemus latus	Broad mite
	Steneotarsonemus pallidus	Cyclamen mite

FAMILY	SCIENTIFIC NAME	COMMON NAME
TENUIPALPIDAE		
	Brevipalpus californicus	
	Brevipalpus obovatus	Privet mite
	Brevipalpus lewisi	Citrus flat mite
	Dolichotetranychus floridanus	Pineapple flase spider mite
	Tenuipalpes granati	
	Tenuipalpes pacificus	
TETRANYCHIDAE		
	Bryobia arborea	
	Bryobia practiosa	Clover mite
	Bryobia rubrioculus	Brown mite
	Eotetranychus coryli	
	Eotetranychus hicoriae	Pecan deaf scorch mite
	Eotetranychus lewisi	
	Eotetranychus sexmaculatus	Sixspotted spider mite
	Eotetranychus willametti	
	Eotetranychus banksi	Texas citrus mite
	Oligonychus ilicis	Southern red mite
	Oligonychus pratensis	Banks grass mite
	Oligonychus ununguis	Spruce spider mite
	Panonychus citri	Citrus red mite
	Panonychus ulmi	European red mite
	Paratetranychus modestus	
	Paratetranychus pratensis	
	Paratetranychus viridis	
	Petrobia latens	Brown wheat mite

FAMILY	SCIENTIFIC NAME	COMMON NAME
	Schizotetranychus celarius	Bamboo spider mite
	Schizotetranychus pratensis	
5	Tetranychus canadensis	Fourspotted spider mite
	Tetranychus cinnabarinus	Carmine spider mite
	Tetranychus mcdanieli	McDaniel spider mite
	Tetranychus pacificus	Pacific spider mite
	Tetranychus schoenei	Schoene spider mite
10	Tetranychus urticae	Twospotted spider mite
	Tetranychus turkestani	Strawberry spider mite
	Tetranychus desertorum	Desert spider mite

The compounds are useful for reducing populations of insects and mites, and are used in a method of inhibiting an insect or mite population which comprises applying to a locus of the insect or arachnid an effective insect- or mite-inactivating amount of a compound of formula (1). The "locus" of insects or mites is a term used herein to refer to the environment in which the insects or mites live or where their eggs are present, including the air surrounding them, the food they eat, or objects which they contact. For example, plant-ingesting insects or mites can be controlled by applying the active compound to plant parts, which the insects or mites eat, particularly the foliage. It is contemplated that the compounds might also be useful to protect textiles, paper, stored grain, or seeds by applying an active compound to such substance. The term "inhibiting an insect or mite" refers to a decrease in the numbers of living insects or mites; or a decrease in the number of viable insect or mite eggs. The extent of reduction accomplished by a compound depends, of course, upon the application rate of the compound, the particular compound used, and the target insect or mite species. At least an insect-inactivating or mite-inactivating amount should be used. The terms "insect-inactivating amount" and "mite-inactivating amount" are used to describe the amount, which is sufficient to cause a measurable reduction in the treated insect or mite population. Generally an amount in the range from about 1 to about 1000 ppm active compound is used.

In a preferred embodiment, the present invention is directed to a method for inhibiting a mite which comprises applying to a plant an effective mite-inactivating amount of a compound of formula (1) in accordance with the present invention.

MITE/INSECT SCREEN

The compounds of Examples 1-111 were tested for miticidal and insecticidal activity in the following mite/insect screen.

Each test compound was formulated by dissolving the compound in acetone/alcohol (50:50) mixture containing 23 g of "TOXIMUL R" (sulfonate/nonionic emulsifier blend) and 13 g of "TOXIMUL S" (sulfonate/nonionic emulsifier blend) per liter. These mixtures were then diluted with water to give the indicated concentrations.

Twospotted spider mites (Tetranychus urticae Koch) and melon aphids (Aphis gossypii Glover) were introduced on squash cotyledons and allowed to establish on both leaf surfaces. Other plants in the same treatment pot were left uninfested. The leaves were then sprayed with 5 ml of test solution using a DeVilbiss atomizing sprayer at 10 psi. Both surfaces of the leaves were covered until runoff, and then allowed to dry for one hour. Two uninfested leaves were then excised and placed into a Petri dish containing larval southern armyworm (Spodopetra eridania Cramer).

Activity on Southern corn rootworm (Diabrotica undecimpuctata howardi Barber) was evaluated by adding two ml of tap water, a presoaked corn seed, and 15 g of dry sandy soil to a one ounce plastic container. The soil was treated with 1 mL of test solution containing a predetermined concentration of test compound. After six to 12 hours of drying, five 2-3 instar corn rootworm larvae were added to the individual cups, which were then capped and held at 23°C.

After standard exposure periods, percent mortality and phytotoxicity were evaluated. Results for the compounds found to be active are reported in Table 3. The remaining compounds showed no activity. The following abbreviations are used in Table 3:

CRW refers to corn rootworm
SAW refers to Southern armyworm
SM refers to twospotted spider mites
MA refers to melon aphids.

TABLE 3

Mite/Insect Screen

	COMPOUND	CRW RATE PPM	CRW RESULTS %	SAW SM & MA RATE PPM	SAW RESULTS %	SM RESULTS %	MA RESULTS %
	1	24.00	0	400	20	90	80
5		12.00	0	200	0	100	90
	2	24.00	0	400	0	50	100
		12.00	0	200	20	100	100
	3	24.00	0	400	100	0	0
	4	24.00	0	400	0	0	0
10	5	24.00	0	400	0	90	90
	6	24.00	0	400	0	0	0
	7	24.00	0	400	0	0	0
	8	24.00	0	400	0	0	0
	9	24.00	100	400	0	0	0
15	10	24.00	100	400	60	100	100
	11	24.00	100	400	0	60	80
	12	24.00	0	400	0	20	80
	13	24.00	80	400	0	80	100
		12.00	0	200	0	50	80
20	14	24.00	0	400	0	80	80
			0		0	0	100
	15	24.00	0	400	50	100	100
		12.00	0	200	0	100	100

TABLE 3

Mite/Insect Screen

	COMPOUND	CRW RATE PPM	CRW RESULTS %	SAW SM & MA RATE PPM	SAW RESULTS %	SM RESULTS %	MA RESULTS %
	16	24.00	0	400	0	0	0
	17	24.00	0	400	0	0	0
	18	24.00	0	400	0	90	100
	19	24.00	0	400	0	80	0
5			0		0	90	100
	20	24.00	0	400	0	0	0
	21	12.00	0	200	0	0	0
	22	24.00	0	400	0	0	0
		12.00	0	200	100	100	100
10	23	24.00	0	400	0	0	0
		12.00	0	200	0	40	100
	24	24.00	0	400	0	100	100
	25	24.00	0	400	0	100	100
	26	24.00	0	400	0	0	0
15	27	24.00	0	400	0	60	30
	28	24.00	0	400	0	90	100
	29	24.00	0	400	100	100	0
	30	24.00	0	400	0	80	0
	31	24.00	100	400	0	0	0
20	32	24.00	100	400	0	100	100

TABLE 3

Mite/Insect Screen

COMPOUND	CRW RATE PPM	CRW RESULTS %	SAW SM & MA RATE PPM	SAW RESULTS %	SM RESULTS %	MA RESULTS %
33	24.00	40	400	0	0	0
	12.00	0	200	0	0	0
34	12.00	0	200	10	100	100
	24.00	0	400	80	100	100
35	24.00	0	400	50	90	100
	12.00	0	200	0	90	100
36	24.00	0	400	100	0	0
	12.00	0	200	0	100	100
37	24.00	0	400	0	0	0
38	24.00	0	400	100	0	0
	12.00	0	200	100	80	80
39	24.00	0	400	100	0	0
	12.00	0	200	100	100	80
40	24.00	0	400	0	0	0
	12.00	0	200	0	0	80
41	24.00	0	400	0	0	0
42	24.00	0	400	0	0	0
	12.00	0	200	0	100	100

TABLE 3

Mite/Insect Screen

COMPOUND	CRW RATE PPM	CRW RESULTS %	SAW SM & MA RATE PPM	SAW RESULTS %	SM RESULTS %	MA RESULTS %
43	24.00	0	400	0	0	0
44	12.00	0	200	0	0	0
	24.00	0	400	0	0	0
45	12.00	0	200	0	0	0
	24.00	0	400	0	0	0
46	12.00	0	200	0	0	80
	24.00	0	400	0	0	0
47	12.00	0	200	0	100	100
	24.00	0	400	40	0	0
48	12.00	0	200	0	0	60
	24.00	0	400	0	0	0
49	12.00	0	200	0	0	0
	24.00	0	400	0	0	0
50	12.00	0	200	0	0	0
	24.00	0	400	0	0	0
51	12.00	0	200	60	100	100
	24.00	0	400	100	0	0
52	12.00	0	200	0	50	80
	24.00	0	400	90	0	0

TABLE 3

Mite/Insect Screen

	COMPOUND	CRW RATE PPM	CRW RESULTS %	SAW SM & MA RATE PPM	SAW RESULTS %	SM RESULTS %	MA RESULTS %
	53	12.00	0	200	0	10	30
		24.00	0	400	0	0	0
	54	12.00	0	200	0	0	0
		24.00	0	400	0	0	0
5	55	12.00	0	200	0	0	0
		24.00	0	400	60	0	0
	56	12.00	0	200	0	50	80
		24.00	0	400	0	0	0
	57	12.00	0	200	0	0	0
10		24.00	0	400	0	0	0
	58	12.00	0	200	0	0	0
		24.00	0	400	0	0	0
	59	12.00	0	200	0	0	0
		24.00	0	400	0	80	100
15	60	12.00	0	200	0	80	80
		24.00	0	400	0	70	100
	61	24.00	0	400	0	0	0
	62	12.00	0	200	0	20	80
		24.00	0	400	0	0	0

TABLE 3

Mite/Insect Screen

COMPOUND	CRW RATE PPM	CRW RESULTS %	SAW SM & MA RATE PPM	SAW RESULTS %	SM RESULTS %	MA RESULTS %
63	12.00	0	200	0	0	0
	12.00	0	200	0	100	80
	24.00	100	400	0	100	100
64	12.00	0	200	60	90	100
	24.00	0	400	100	100	100
65	12.00	0	200	0	0	0
	24.00	0	400	0	0	0
66	12.00	0	200	100	0	0
	24.00	0	400	0	0	0
67	12.00	0	200	0	0	60
	24.00	100	400	0	0	0
68	12.00	0	200	0	0	30
	24.00	0	400	0	80	60
69	12.00	0	200	0		30
	24.00	0	400	0	100	0
70	24.00	0	400	0	0	0
71	24.00	0	400	0	60	30
72	12.00	0	200	80	0	0
	24.00	0	400	0	0	0

TABLE 3

Mite/Insect Screen

	COMPOUND	CRW RATE PPM	CRW RESULTS %	SAW SM & MA RATE PPM	SAW RESULTS %	SM RESULTS %	MA RESULTS %
	73	12.00	100	200	40		60
		24.00	40	400	0	100	100
	74	12.00	0	200	0	80	80
		24.00	0	400	0	0	80
5	75	12.00	0	200	0	100	100
		24.00	0	400	0	60	80
	76	12.00	0	200	0	0	50
		24.00	0	400	0	0	0
	77	24.00	0	400	0	0	0
10	78	12.00	0	200	0	0	0
		24.00	0	400	0	0	0
	79	12.00	0	200	0	0	80
		24.00	0	400	0	0	0
	80	12.00	0	200	0	90	40
15		24.00	0	400	0	60	80
	81	12.00	0	200	0	0	0
		24.00	0	400	0	90	90
	82	12.00	0	200	60	100	100
		24.00	0	400	0	80	100

TABLE 3

Mite/Insect Screen

COMPOUND	CRW RATE PPM	CRW RESULTS %	SAW SM & MA RATE PPM	SAW RESULTS %	SM RESULTS %	MA RESULTS %
83	12.00	0	200	0	0	0
	24.00	0	400	0	60	40
84	12.00	0	200	0	90	80
	24.00	0	400	0	80	100
85	12.00	0	200	20	70	30
	24.00	100	400	100	0	0
86	12.00	0	200	60	100	80
	24.00	100	400	0	100	80
87	12.00	0	200	80	0	80
	24.00	100	400	100	0	80
88	12.00	0	200	0	0	50
	24.00	0	400	0	0	80
89	12.00	0	200	0	90	90
	24.00	0	400	0	80	80
90	12.00	0	200	0	0	0
	24.00	0	400	0	0	80
91	12.00	0	200	0	20	80
	24.00	0	400	100	100	100
92	12.00	100	200	0	0	40
	24.00	0	400	0	0	0

TABLE 3

Mite/Insect Screen

COMPOUND	CRW RATE PPM	CRW RESULTS %	SAW SM & MA RATE PPM	SAW RESULTS %	SM RESULTS %	MA RESULTS %
93	12.00	0	200	0	0	80
	24.00	0	400	0	0	0
94	12.00	0	200	0	80	0
	24.00	100	400	0	40	0
95	12.00	0	200	100	60	80
	24.00	0	400	0	0	0
96	12.00	0	200	0	0	0
	24.00	0	400	0	0	0
97	12.00	0	200	0	40	80
	24.00	0	400	0	100	100
98	12.00	0	200	0	80	50
	24.00	0	400	100	100	100
99	12.00	0	200	0	0	60
	24.00	0	400	0	40	50
100	12.00	0	200	0	0	80
	24.00	0	400	0	80	100
101	12.00	0	200	0	80	50
	24.00	0	400	0	30	30
102	12.00	0	200	0	0	0
	24.00	0	400	0	0	0

TABLE 3

Mite/Insect Screen

COMPOUND	CRW RATE PPM	CRW RESULTS %	SAW SM & MA RATE PPM	SAW RESULTS %	SM RESULTS %	MA RESULTS %
103	12.00	0	200	0	100	100
	24.00	100	400	80		80
104	12.00	0	200	0	80	100
	24.00	0	400	0	100	100
105	12.00	0	200	80	100	100
	24.00	0	400	0	80	80
106	12.00	0	200	0	0	80
	24.00	0	400	0	0	0
107	12.00	0	200	0	0	0
	24.00	0	400	0	0	0
108	12.00	0	200	0	80	80
	24.00	0	400	0	0	0
109	12.00	0	200	100	100	100
	24.00	0	400	100	0	0
110	12.00	0	200	0	100	100
	24.00	0	400	60	0	0
111	12.00	100	200	0	80	60
	24.00	100	400	0	100	80

Field Trials

4-[2-[4-(t-butyl)phenyl]ethoxy]quinazoline and 4-[2-(1,1'-biphenyl)-4-ylethoxy]quinazoline were evaluated against a variety of mite and insect species in field trials. The following table reports the plants on which these compounds were tested, and the mite or insect species against which they showed activity.

PLANT	PEST
alfalfa (Lucerne)	pea aphid, potato leafhopper, tarnished plant bug, green cloverworm
apples	apple aphid, European red mite, green peach aphid, white apple leafhopper, apple rust mite, rosy apple aphid
azaleas	greenhouse thrips twospotted spider mite
barley	cereal aphid
bean, faba broad	bean aphid
broccoli	twospotted spider mite

PLANT	PEST
cotton	cotton aphid
grape (European)	grape thrips, grape leafhopper
hops	Dawson-hop aphid
lemon	black citrus aphid
pecan nut	yellow hickory aphid
pea, garden (English)	pea aphid
plum (Japanese)	twospotted spider mite
privet	thrips
sugar beet	green peach aphid
turnip	potato aphid
wheat	wheat aphid

In addition 4-[2-[4-(t-butyl)phenyl]ethoxy]quinazoline was tested on grapefruit, showing activity against citrus rust mite; and 4-[2-(1,1'-biphenyl)-4-ylethoxy]quinazoline was tested on tomato, showing activity against glasshouse whitefly.

Compositions

The compounds of this invention are applied in the form of compositions which are important embodiments of the invention, and which comprise a compound of this invention and a phytologically-acceptable inert carrier. The compositions are either concentrated formulations which are dispersed in water for application, or are dust or granular formulations which are applied without further treatment. The compositions are prepared according to procedures and formulae which are conventional in the agricultural chemical art, but which are novel and important because of the presence therein of the compounds of this invention. Some description of the formulation of the compositions will be given, however, to assure that agricultural chemists can readily prepare any desired composition.

The dispersions in which the compounds are applied are most often aqueous suspensions or emulsions prepared from concentrated formulations of the compounds. Such water-soluble, water-suspendable or emulsifiable formulations are either solids usually known as wettable powders, or liquids usually known as emulsifiable concentrates or aqueous suspensions. Wettable powders, which may be compacted to form water dispersible granules, comprise an intimate mixture of the active compound, an inert carrier and surfactants. The concentration of the active compound is usually from about 10% to about 90% by weight. The inert carrier is usually chosen from among the attapulgite clays, the montmorillonite clays, the diatomaceous

earths, or the purified silicates. Effective surfactants, comprising from about 0.5% to about 10% of the wettable powder, are found among the sulfonated lignins, the condensed naphthalenesulfonates, the naphthalenesulfonates, the alkylbenzenesulfonates, the alkyl sulfates, and nonionic surfactants such as ethylene oxide adducts of alkyl phenols.

Emulsifiable concentrates of the compounds comprise a convenient concentration of a compound, such as from about 50 to about 500 grams per liter of liquid, equivalent to about 10% to about 50%, dissolved in an inert carrier which is either a water miscible solvent or a mixture of water-immiscible organic solvent and emulsifiers. Useful organic solvents include aromatics, especially the xylenes, and the petroleum fractions, especially the high-boiling naphthalenic and olefinic portions of petroleum such as heavy aromatic naphtha. Other organic solvents may also be used, such as the terpenic solvents including rosin derivatives, aliphatic ketones such as cyclohexanone, and complex alcohols such as 2-ethoxyethanol. Suitable emulsifiers for emulsifiable concentrates are chosen from conventional nonionic surfactants, such as those discussed above.

Aqueous suspensions comprise suspensions of water-insoluble compounds of this invention, dispersed in an aqueous vehicle at a concentration in the range from about 5% to about 50% by weight. Suspensions are prepared by finely grinding the compound, and vigorously mixing it into a vehicle comprised of water and surfactants chosen from the same types discussed above. Inert

ingredients, such as inorganic salts and synthetic or natural gums, may also be added, to increase the density and viscosity of the aqueous vehicle. It is often most effective to grind and mix the compound at the same time by preparing the aqueous mixture, and homogenizing it in an implement such as a sand mill, ball mill, or piston-type homogenizer.

The compounds may also be applied as granular compositions, which are particularly useful for applications to the soil. Granular compositions usually contain from about 0.5% to about 10% by weight of the compound, dispersed in an inert carrier which consists entirely or in large part of clay or a similar inexpensive substance. Such compositions are usually prepared by dissolving the compound in a suitable solvent, and applying it to a granular carrier which has been pre-formed to the appropriate particle size, in the range of from about 0.5 to 3 mm. Such compositions may also be formulated by making a dough or paste of the carrier and compound, and crushing and drying to obtain the desired granular particle size.

Dusts containing the compounds are prepared simply by intimately mixing the compound in powdered form with a suitable dusty agricultural carrier, such as kaolin clay, ground volcanic rock and the like. Dusts can suitably contain from about 1% to about 10% of the compound.

It is equally practical, when desirable for any reason, to apply the compound in the form of a solution in an appropriate organic solvent, usually a bland petroleum oil, such as the spray oils, which are widely used in agricultural chemistry.

Insecticides and miticides are generally applied in the form of a dispersion of the active ingredient in a liquid carrier. It is conventional to refer to application rates in terms of the concentration of active ingredient in the carrier. The most widely used carrier is water.

The compounds of the invention can also be applied in the form of an aerosol composition. In such compositions the active compound is dissolved or dispersed in an inert carrier, which is a pressure-generating propellant mixture. The aerosol composition is packaged in a container from which the mixture is dispensed through an atomizing valve. Propellant mixtures comprise either low-boiling halocarbons, which may be mixed with organic solvents, or aqueous suspensions pressurized with inert gases or gaseous hydrocarbons.

The actual amount of compound to be applied to loci of insects and mites is not critical and can readily be determined by those skilled in the art in view of the examples above. In general, concentrations of from 10 ppm to 5000 ppm of compound are expected to provide good control. With many of the compounds, concentrations of from 100 to 1500 ppm will suffice. For field crops, such as soybeans and cotton, a suitable application rate for the compounds is about 0.5 to 1.5 lb/A, typically applied in 50 gal/A of spray formulation containing 1200 to 3600 ppm of compound. For citrus crops, a suitable application rate is from about 100 to 1500 gal/A spray formulation, which is a rate of 100 to 1000 ppm.

The locus to which a compound is applied can be any locus inhabited by an insect or arachnid, for example, vegetable crops, fruit and nut trees, grape vines, and ornamental plants. Inasmuch as many mite species are specific to a particular host, the foregoing list of mite species provides exemplification of the wide range of settings in which the present compounds can be used.

Because of the unique ability of mite eggs to resist toxicant action, repeated applications may be desirable to control newly emerged larvae, as is true of other known acaricides.

The following formulations of compounds of the invention have been prepared, and are typical of compositions useful in the practice of the present invention.

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A. 0.75 Emulsifiable Concentrate

4-[2-[4-(t-butyl)phenyl]ethoxy]-quinazoline	9.38%
"TOXIMUL D" (nonionic/anionic surfactant blend)	2.50%
"TOXIMUL H" (nonionic/anionic surfactant blend)	2.50%
"EXXON 200" (naphthalenic solvent)	85.62%

B. 1.5 Emulsifiable Concentrate

4-[2-[4-(t-butyl)phenyl]ethoxy]-quinazoline	18.50%
"TOXIMUL D"	2.50%
"TOXIMUL H"	2.50%
"EXXON 200"	76.50%

C. 0.75 Emulsifiable Concentrate

4-[2-(1,1'-biphenyl)-4-ylethoxy]-quinazoline	9.38%
"TOXIMUL D"	2.50%
"TOXIMUL H"	2.50%
"EXXON 200"	85.62%

D. 1.0 Emulsifiable Concentrate

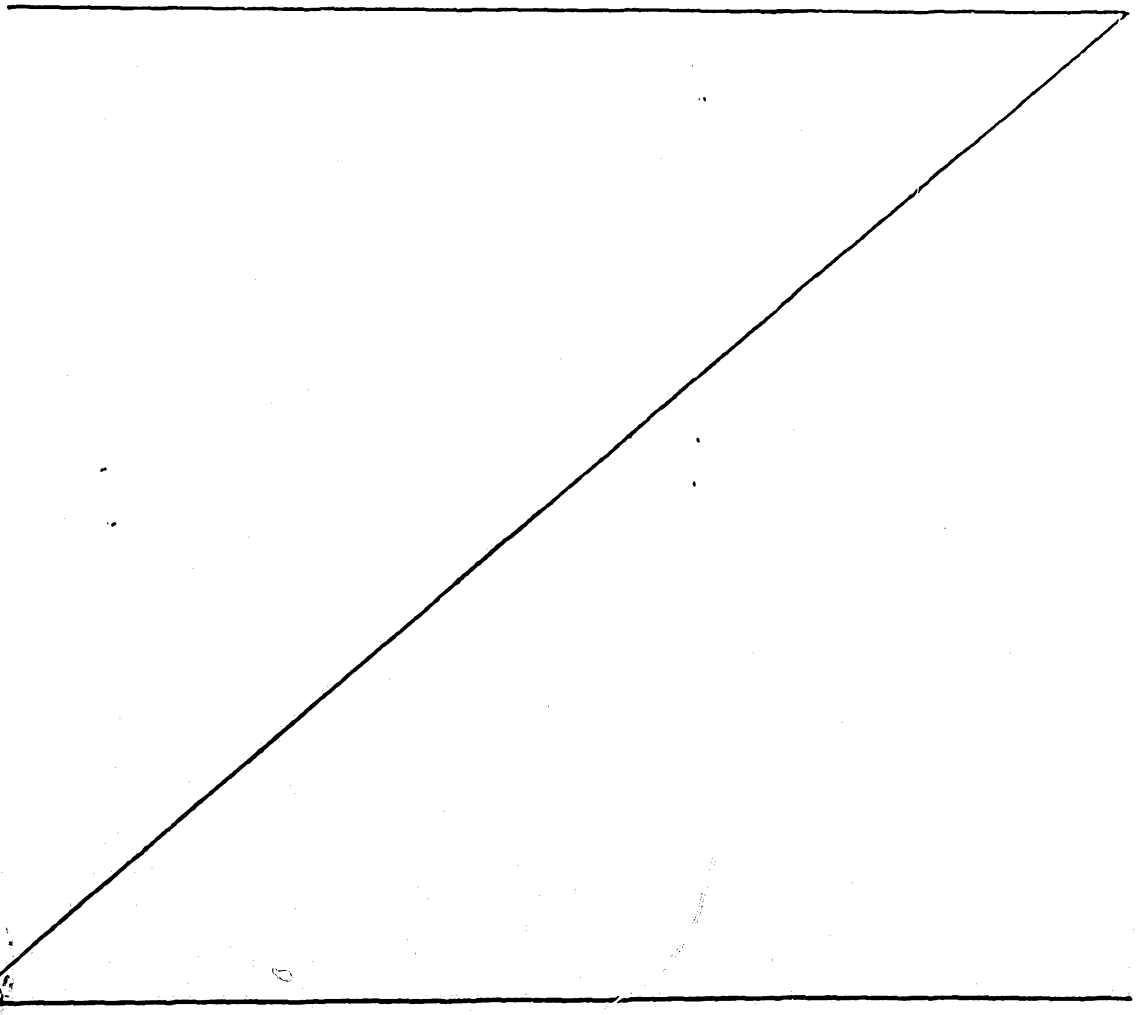
4-[2-(1,1'-biphenyl)-4-ylethoxy]-quinazoline	12.50%
N-methylpyrrolidone	25.00%
"TOXIMUL D"	2.50%
"TOXIMUL H"	2.50%
"EXXON 200"	57.50%

E. 1.0 Aqueous Suspension

4-[2-[4-(t-butyl)phenyl]ethoxy]-quinazoline	12.00%
"PLURONIC P-103" (block copolymer of propylene oxide and ethylene oxide, surfactant)	1.50%
"PROXEL GXL" (biocide/preservative)	.05%
"AF-100" (silicon based antifoam agent)	.20%
"REAX 88B" (lignosulfonate dispersing agent)	1.00%
propylene glycol	10.00%
veegum	.75%
xanthan	.25%
water	74.25%

F. 1.0 Aqueous Suspension

4-[2-(1,1'-biphenyl)-4-ylethoxy]-quinazoline	12.50%
"MAKON 10"	1.50%
"ZEOSYL 200" (silica)	1.00%
"AF-100"	0.20%
"POLYFON H" (lignosulfonate dispersing agent)	0.20%
2% xanthan hydrate	10.00%
water	74.60%



G. Wettable Powder

4-[2-[4-(t-butyl)phenyl]ethoxy]-quinazoline	25.80%
"POLYFON H"	3.50%
"SELLOGEN HR"	5.00%
"STEPANOL ME DRY"	1.00%
gum arabic	0.50%
"HISIL 233"	2.50%
Barden clay	61.70%

H. Aqueous Suspension

8-fluoro-4-[2-[4-phenoxyphenyl]-ethoxy]quinazoline	12.40%
"TERGITOL 158-7"	5.00%
"ZEOSYL 200"	1.00%
"AF-100"	0.20%
"POLYFON H"	0.50%
2% xanthan solution	10.00%
tap water	70.90%

I. Emulsifiable Concentrate

8-fluoro-4-[2-(4-methoxyphenyl)-ethoxy]quinazoline	12.40%
"TOXIMUL D"	2.50%
"TOXIMUL H"	2.50%
"EXXON 200"	82.60%

J. Wettable Powder

8-fluoro-4-[2-(4-methoxyphenyl)ethoxy]-quinazoline	25.80%
"SELLOGEN HR"	5.00%
"POLYFON H"	4.00%
"STEPANOL ME DRY"	2.00%
"HISIL 233"	3.00%
Barden clay	60.20%

K. Emulsifiable Concentrate

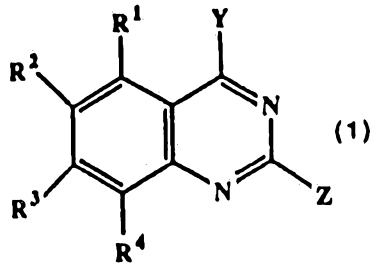
4-[2-(4-ethoxyphenyl)ethoxy]-quinazoline	6.19%
"TOXIMUL H"	3.60%
"TOXIMUL D"	0.40%
"EXXON 200"	89.81%

L. Wettable Powder

4-[2-(4-ethoxyphenyl)ethoxy]-quinazoline	25.80%
"SELLOGEN HR"	5.00%
"POLYFON H"	4.00%
"STEPANOL ME DRY"	2.00%
"HISIL 233"	3.00%
Barden clay	60.20%

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. A compound of the formula (1)



(1)

wherein

R^1 and R^4 are independently H, halo, $(C_1\text{-}C_4)$ alkyl, branched $(C_3\text{-}C_4)$ alkyl, halo $(C_1\text{-}C_4)$ alkyl, halo $(C_1\text{-}C_4)$ alkoxy, $(C_1\text{-}C_4)$ alkoxy, halo $(C_1\text{-}C_4)$ alkylthio, $(C_1\text{-}C_4)$ alkylthio, NO_2, or NH_2, at least two of R^1 to R^4 being H;

Y is O-W-Ar;

Z is H, Cl, OCH_3, CH_3, or CCl_3;

R^7 is H, $(C_1\text{-}C_4)$ alkyl, or acetyl;

W is an alkylene chain 2 to 8 carbon atoms long, that optionally includes an O, S, SO, SO_2, or NR^7 group, or includes a saturated or unsaturated carbocyclic ring comprising three to seven carbon atoms, or is substituted with $(C_1\text{-}C_3)$ alkyl, $(C_2\text{-}C_4)$ alkenyl, phenyl, $(C_3\text{-}C_8)$ cycloalkyl, halo, hydroxy, or acetyl; and

Ar is

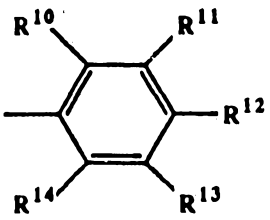
imidazolyl,
indolyl,
thienyl, optionally substituted with CH_3 or Cl,
thiazolyl,
1,3-benzodioxolyl,
fluorenyl,
cyclopentyl,
1-methylcyclopentyl,
cyclohexyl (hexahydrophenyl),
cyclohexenyl (tetrahydrophenyl),
naphthyl,
dihydronaphthyl,

tetrahydronaphthyl,

decahydronaphthyl,

pyridyl,

or a group of the formula (2):



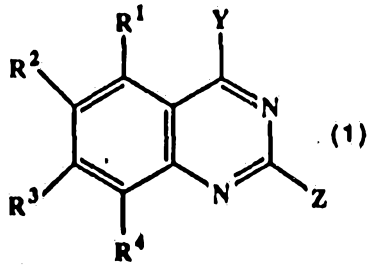
(2)

where

R^{10} to R^{14} are independently H, halo, I, (C_1-C_{10}) alkyl, branched (C_3-C_6) alkyl, halo (C_1-C_4) alkyl, (C_1-C_4) alkoxy, halo (C_1-C_4) alkoxy, phenoxy, substituted phenoxy, phenyl, substituted phenyl, phenylthio, substituted phenylthio, NH_2, NO_2, OH, acetoxy, CN $SiR^{15}R^{16}R^{17}$, $OSiR^{15}R^{16}R^{17}$, where R^{15}, R^{16}, and R^{17} are independently C_1-C_4 alkyl, C_3-C_4 branched alkyl, phenyl, or substituted phenyl, at least two of R^{10} to R^{14} being H;

or an acid addition salt of a compound of formula (1).

2. A compound of the formula (1)



(1)

wherein

R^1 and R^4 are independently H, halo, (C_1-C_4) alkyl, branched (C_3-C_4) alkyl, halo (C_1-C_4) alkyl, halo (C_1-C_4) alkoxy, NO_2, or NH_2,

provided that

at least two of R^1 to R^4 are H;

Y is O-W-Ar;

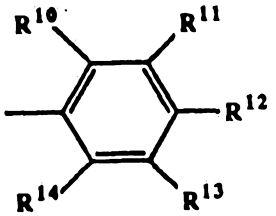
Z is H, Cl, OCH_3, or CH_3;

W is an alkylene chain 2 to 6 carbon atoms long, that optionally includes a carbocyclic ring or substituted with (C_1-C_3) alkyl, phenyl, (C_3-C_8) cycloalkyl, halo, hydroxy, or acetyl; and

Ar is

imidazolyl,
indolyl,
thienyl, optionally substituted with CH_3 or Cl,
thiazolyl,
1,3-benzodioxolyl,
fluorenyl,
cyclohexyl (hexahydrophenyl),
cyclohexenyl (tetrahydrophenyl),
naphthyl,
dihydronaphthyl,
tetrahydronaphthyl,
decahydronaphthyl,

or a group of the formula (2):



(2)

where

R^{10} to R^{14} are independently H, halo, I, (C_1-C_{10}) alkyl, branched (C_3-C_6) alkyl, halo (C_1-C_4) alkyl, (C_1-C_4) alkoxy, halo (C_1-C_4) alkoxy, phenoxy, substituted phenoxy, phenyl, substituted phenyl, phenylthio, substituted phenylthio, NH_2, NO_2, OH, or CN, at least two of R^{10} to R^{14} being H;

or an acid addition salt of a compound of formula (1).

3. A compound of claim 1 or 2 wherein Y is -O-$(CH_2)_2$-Ar.

4. A compound of any one of claims 1 to 3 wherein Ar is naphthyl or a phenyl group of formula (2) wherein one of R^{10} to R^{14} is Cl, Br, (C_1-C_{10}) alkyl, branched (C_3-C_6) alkyl, phenyl, substituted phenyl, phenoxy, substituted phenoxy, phenylthio, or substituted phenylthio, and the rest of R^{10} to R^{14} are H.

5. A compound of claim 1 which is 4-[2-[4-(t-butyl)phenyl]ethoxy]quinazoline; 4-(2-[1,1'-biphenyl]-4-ylethoxy)quinazoline; or 4-[2-(4-ethoxyphenyl)ethoxy]-quinazoline.

6. A fungicidal method which comprises applying to the locus of a plant pathogen a disease inhibiting and phytologically acceptable amount of a compound of formula (1) as defined in any one of claims 1 to 5.

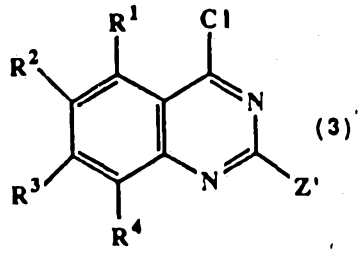
7. A fungicidal composition comprising a disease inhibiting and phytologically acceptable amount of a compound of formula (1) as claimed in any one of claims 1 to 5 in combination with a phytologically-acceptable carrier, optionally in combination with a second plant fungicide.

8. A method of inhibiting an insect or mite which comprises applying to a locus of the insect or mite an insect- or mite-inactivating amount of a compound of formula (1) as claimed in any one of claims 1 to 5.

9. An insect or miticide composition comprising an insect- or mite- inactivating amount of a compound of formula (1) as claimed in any one of claims 1 to 5 in combination with a phytologically-acceptable carrier, optionally in combination with a second insecticide or miticide.

10. A process for preparing a compound of formula (1) as defined in claim 1 which comprises

(a) condensing a compound of formula (3)



(3)

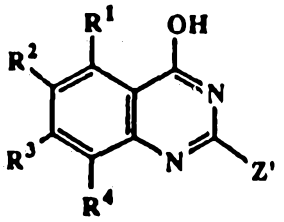
wherein R^1 to R^4 are as previously defined, and Z ' is H, Cl, CH_3, or OCH_3, with an alcohol of the formula (4b)

HO-W-Ar (4b)

wherein W and Ar are as previously defined to produce a compound of formula (1) wherein Y is O-W-Ar.

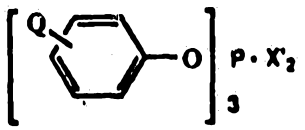
11. A process for preparing a compound of formula (1) as defined in claim 1, which comprises

(a) reacting a 4-hydroxyquinazoline of formula (9)



(9)

wherein R^1, R^2, R^3, R^4, and, Z ' are as defined above, with 1 to 1.3 equivalents of a halogenating reagent of the formula (8)



(8)

wherein Q is H, halo, (C_1-C_4) alkyl, or (C_1-C_4)alkoxy and X ' is Cl or Br, in an inert organic solvent at a temperautre below 30 °C, and

(b) without isolation of the 4-chloroquinazoline produced in step (a), reacting it with an alcohol of the formula (4b):

HO-W-Ar (4b)

wherein W and Ar are as previously defined.

12. Compounds of formula (1) as claimed in claim 1, processes for their manufacture or fungicidial compositions or methods involving them, substantially as hereinbefore described with reference to the Examples.

DATED this 17th day of November, 1992.

ELI LILLY AND COMPANY
By Its Patent Attorneys
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