Title: HERBICIDAL COMPOSITION

Abstract: A herbicidal composition having an excellent weed control effect, which comprises a pyridazine compound represented by the formula (I): wherein R¹ represents a C₁₄ alkyl group or a C₁₄ alkoxy group, R² represents a hydrogen atom or a C₁₄ alkyl group; G represents a hydrogen atom, etc. Z represents a C₁₄ alkyl group, Z' represents a C₁₄ alkyl group, n represents 0, 1, 2, 3 or 4, and when n represents an integer of two or more, each Z' may be the same or different, provided that the total number of carbon atoms in the groups represented by Z' and n x Z' is two or more; a specific herbicide; and a specific safener.
DESCRIPTION

HERBICIDAL COMPOSITION

Technical Field

The present invention relates to a herbicidal composition.

Background Art

Nowadays, a number of herbicides are commercially available (for example see non-Patent Document 1). However, in view of herbicidal effects and crop safety, there is a need for further diverse herbicidal compositions.


Disclosure of the Invention

An object of the present invention is to provide a herbicidal composition, which has an excellent weed control, and reduces phytotoxicity to crops.

The present inventors have studied intensively and found that a herbicidal composition comprising a pyridazinone compound represented by the general formula (I), a specific herbicide and a specific safener exerts an
excellent weed control without severe phytotoxicity to crops, in foliar or soil treatment against weeds. Thus, the present invention has been completed.

That is, the present invention provides:

[1] A herbicidal composition comprising a pyridazinone compound represented by the general formula

\[ \text{D} : \]

\[
\begin{array}{c}
\text{R}^1 \text{N} \text{O} \text{O} \\
\text{R}^2 \text{O} \\
\text{R}^3 \text{G} \\
\text{Z}^2 \text{R}^4 \text{R}^5 \\
\end{array}
\]

wherein \( \text{R}^1 \) represents a Ci\(_6\) alkyl group or a (Ci\(_6\) alkyloxy) Ci\(_6\) alkyl group,
\( \text{R}^2 \) represents a hydrogen atom or a Ci\(_6\) alkyl group,
\( \text{G} \) represents a hydrogen atom or any one of the groups represented by the following formulas:

\[ \begin{array}{c}
\text{L} \\
\text{R}^3, \quad \text{SO} \quad \text{R}^4, \quad \text{P} \quad \text{R}^6 \quad \text{R}^8 \\
\end{array} \]

wherein \( \text{L} \) represents an oxygen atom or a sulfur atom,
\( \text{R}^3 \) represents a Ci\(_6\) alkyl group, a C\(_3\)\(-\)C\(_8\) cycloalkyl group, a C\(_2\)\(-\)C\(_6\) alkenyl group, a C\(_2\)\(-\)C\(_6\) alkynyl group, a C\(_6\)\(-\)10 aryl group, a (C\(_6\)\(-\)10 aryl) Ci\(_6\) alkyl group, a Ci\(_6\) alkyloxy group, a C\(_3\)\(-\)C\(_8\) cycloalkyloxy group, a C\(_2\)\(-\)C\(_6\) alkenyloxy group, a C\(_6\)\(-\)10 aryloxy group, a (C\(_6\)\(-\)10 aryl) Ci\(_6\) alkynyloxy group, a C\(_6\)\(-\)10 aryloxy group, a (C\(_6\)\(-\)10 aryl) Ci\(_6\) alkynyloxy group.
alkyloxy group, an amino group, a C_{1-6} alkylamino group, a C_{2-6} alkenylamino group, a C_{6-10} arylamino group, a di (C_{1-6} alkyl) amino group, a di (C_{2-6} alkenyl) amino group, a (C_{6-10} aryl) amino group or a 3- to 8-membered nitrogen-containing heterocyclic group,

R^4 represents a C_{1-6} alkyl group, a C_5-\chi arylic group, a C_{1-6} alkylamino group or a di (C_{1-6} alkyl) amino group, and R^5 and R^6 are the same or different and each represents a C_{1-6} alkyl group, a C_{3-8} cycloalkyl group, a C_{2-6} alkenyl group, a C_{6-10} aryl group, a C_{1-6} alkyloxy group, a C_{1-6} alkylthio group, a C_{1-6} alkylamino group or a di (C_{3-6} alkyl) amino group,

provided that any group represented by R^3, R^4, R^5 and R^6 may be substituted with at least one halogen atom, and the C_{3-8} cycloalkyl group, the C_{6-10} aryl group, the aryl moiety of the (C_{6-10} aryl)C_{1-6} alkyl group, the C_{3-8} cycloalkyloxy group, the C_{6-10} arylamino group, the aryl moiety of the (C_{6-10} aryl)C_{1-6} alkyloxy group, the aryl moiety of the C_{6-10} arylamino group and the 3- to 8-membered nitrogen-containing heterocyclic group may be substituted with at least one C_{1-6} alkyl group,

Z^1 represents a C_{1-6} alkyl group; Z^2 represents a C_{1-6} alkyl group,
n represents 0, 1, 2, 3 or 4, and when \( n \) represents an integer of two or more, each \( Z^2 \) may be the same or different, provided that the total number of carbon atoms in the groups represented by \( Z^1 \) and \( n \times Z^2 \) is two or more; one herbicide selected from the following group A (hereinafter, sometimes, referred to as the present compound); and one safener selected from the following group B.

Group A:

- pinoxaden (hereinafter, sometimes, referred to as the compound C), and
- clodinafop-propargyl (hereinafter, sometimes, referred to as the compound D)

Group B:

- fenchlorazole-ethyl (hereinafter, sometimes, referred to as the compound E)
- cloquintocet-mexyl (hereinafter, sometimes, referred to as the compound F), and
- mefenpyr-diethyl (hereinafter, sometimes, referred to as the compound G)

The herbicidal composition according to the above [1], wherein \( n \) in the general formula (I) is an integer of 1 or more.

The herbicidal composition according to the above [1], wherein \( n \) in the general formula (I) is 0, and \( Z^1 \) is a
C_{2-6} alkyl group.

[4] The herbicidal composition according to the above [1], wherein n in the general formula (I) is 1 or 2, and Z^2 is attached to the benzene ring at 4- and/or 6-positions thereof.

[5] The herbicidal composition according to the above [1], [2] or [4], wherein Z^1 in the general formula (I) is a C_{i-3} alkyl group, and Z^2 is a C_{1-3} alkyl group.

[6] The herbicidal composition according to any one of the above [1] to [5], wherein G in the general formula (I) is a hydrogen atom or any one of the groups represented by the following formulas:

\[
\begin{align*}
\text{R}^{3b} & \text{ represents a C}_{1-6} \text{ alkyl group, a C}_{3-8} \text{ cycloalkyl group, a C}_{2-6} \text{ alkenyl group, a C}_{2-6} \text{ alkynyl group, a C}_{6-10} \text{ aryl group, a } (\text{C}_{6-10} \text{ aryl}) \text{ C}_{1-6} \text{ alkyl group, a C}_{1-6} \text{ alklyoxy group, a C}_{3-8} \text{ cycloalkyloxy group, a C}_{6-10} \text{ aryloxy group, a } (\text{C}_{6-10} \text{ aryl}) \text{ C}_{1-6} \text{ alklyoxy group, a C}_{1-5} \text{ alkylamino group, a C}_{6-10} \text{ arlylamino group or a di (C}_{1-6} \text{ alkyl) amino group,}
\end{align*}
\]

\[
\text{R}^{4b} \text{ represents a C}_{1-6} \text{ alkyl group or a C}_{6-10} \text{ aryl group, and R}^{5b} \text{ and R}^{6b} \text{ are the same or different and each represents a C}_{1-6} \text{ alkyl group, a C}_{1-6} \text{ alklyoxy group, a C}_{6-10} \text{ arylyoxy group or a C}_{1-6} \text{ alklythio group,}
\]

provided that any group represented by R^{3b}, R^{4b}, R^{5b} and R^{6b}
may be substituted with at least one halogen atom, and the
C_3^-8 cycloalkyl group, the C_6^-10 aryl group, the aryl moiety
of the (C_6^-10 aryl)C_{1-6} alkyl group, the C_3^-8 cycloalkyloxy
group, the C_6^-10 aryl oxy group, the aryl moiety of the (C_6^-10
aryl)C_{1-6} alkyloxy group and the aryl moiety of the C_6^-10
arylamino group may be substituted with at least one C_{1-6}
aliphatic group.

[7] The herbicidal composition according to any one
of the above [1] to [5], wherein G in the general formula
(I) is a hydrogen atom or any one of the groups represented
by the following formulas:

\[ \begin{align*}
R^3a & = \text{a C}_{1-6} \text{ alkyl group,} \\
R^4a & = \text{a C}_{1-6} \text{ alkyl group,}
\end{align*} \]

wherein R^3a represents a C_{1-6} alkyl group, a C_3^-8 cycloalkyl
group, a C_6^-10 aryl group, a C_{1-6} alkyloxy group or a di(C_{1-6}
alkyl) amino group; and

R^4a represents a C_{1-6} alkyl group,
provided that any group represented by R^3a and R^4a may be
substituted with a halogen atom, and a C_3^-8 cycloalkyl group
and a C_6^-10 aryl group may be substituted with a C_{1-6} alkyl
group.

[8] The herbicidal composition according to any one
of the above [1] to [7], wherein R^2 in the general formula
(I) is a hydrogen atom or a C_{1-3} alkyl group.

[9] The herbicidal composition according to any one
of the above [1] to [7], wherein R² in the general formula (I) is a hydrogen atom or a methyl group.

[10] The herbicidal composition according to any one of the above [1] to [9], wherein R¹ in the general formula (I) is a C₁₋₃ alkyl group or a (C₁₋₃ alkyloxy) C₁₋₃ alkyl group.

[11] A weed control method, which comprises simultaneously or separately applying an effective amount of the pyridazinone compound according to any one of the above [1] to [10], an effective amount of an herbicide selected from the following group A, and an effective amount of a safener selected from the following group B, to weeds or soil on which the weeds grow.

Group A:

- pinoxaden,
- clodinafop-propargyl

Group B:

- fenchlorazole-ethyl,
- cloquintocet-mexyl,
- mefenpyr-diethyl

[12] Use of the pyridazinone compound according to any one of the above [1] to [10], a herbicide selected from the following group A, and a safener selected from the following group B, for weed control.

Group A:
pinoxaden, and
clodinafop-propargyl

Group B:
fenchlorazole-ethyl,
cloquintocet-mexyl, and
mefenpyr-diethyl

According to the present invention, it is made possible to provide an herbicidal composition, which has an excellent weed control and selectivity to crops.

Best Mode for Carrying Out the Invention

Specifically, the herbicidal composition of the present invention includes:

a herbicidal composition containing the pyridazinone compound represented by the general formula (I), pinoxaden and fenchlorazole-ethyl,

a herbicidal composition containing the pyridazinone compound represented by the general formula (I), pinoxaden and cloquintocet-mexyl,

a herbicidal composition containing the pyridazinone compound represented by the general formula (I), pinoxaden and mefenpyr-diethyl,

a herbicidal composition containing the pyridazinone compound represented by the general formula (I), clodinafop-propargyl and fenchlorazole-ethyl,
a herbicidal composition containing the pyridazinone compound represented by the general formula (I), clodinafop-propargyl and cloquintocet-mexyl, and a herbicidal composition containing the pyridazinone compound represented by the general formula (I), clodinafop-propargyl and mefenpyr-diethyl.

In the substituents represented by R₁, R₂, R₃, R⁴, R⁵, R⁶, Z¹ and Z² in the compound represented by the general formula (I) to be used as the active ingredient of the herbicidal composition of the present invention,

the C₁₋₆ alkyl group means an alkyl group having 1 to 6 carbon atoms and examples thereof include a methyl group, an ethyl group, a propyl group, an isopropyl group, a butyl group, an isobutyl group, a sec-butyl group, a tert-butyl group, a pentyl group, a sec-pentyl group, an isopentyl group, a neopentyl group, a hexyl group and an isohexyl group;

the C₃₋₈ cycloalkyl group means a cycloalkyl group having 3 to 8 carbon atoms and examples thereof include a cyclopropyl group, a cyclopentyl group and a cyclohexyl group;

the C₂₋₆ alkenyl group means an alkenyl group having 2 to 6 carbon atoms and examples thereof include an allyl group, a 1-buten-3-yl group and a 3-buten-1-yl group;

the C₂₋₆ alkynyl group means an alkynyl group having 2 to 6
carbon atoms and examples thereof include a propargyl group and a 2-butynyl group; the \( C_{6-10} \) aryl group means an aryl group having 6 to 10 carbon atoms and examples thereof include a phenyl group and a naphthyl group; the \((C_{6-10} \text{ aryl)}\) \( C_{6-10} \) alkyl group means a \( C_{6-10} \) alkyl group substituted with a \( C_{6-10} \) aryl group and examples thereof include a benzyl group and a phenethyl group; the \( C_{1-6} \) alkyloxy group means an alkyloxy group having 1 to 6 carbon atoms and examples thereof include a methoxy group, an ethoxy group, a propoxy group and an isopropoxy group; the \( C_{3-8} \) cycloalkyloxy group means a cycloalkyloxy group having 3 to 8 carbon atoms, e.g., a cyclopropyloxy and a cyclopentyloxy group; the \( C_{2-6} \) alkenyloxy group means an alkenyloxy group having 2 to 6 carbon atoms and examples thereof include a vinyloxy group and an allyloxy group; the \( C_{2-6} \) alkynyloxy group means an alkynyloxy group having 2 to 6 carbon atoms and examples thereof include a propargyloxy group and a 2-butynyl group; the \( C_{6-10} \) aryloxy group means an aryloxy group having 6 to 10 carbon atoms and examples thereof include a phenoxy group and a naphthoxy group; the \((C_{6-10} \text{ aryl)}\) \( C_{1-6} \) alkyloxy group means a \( C_{1-6} \) alkyloxy group substituted with a \( C_{6-10} \) aryl group and examples
thereof include a benzyloxy group and a phenethyloxy group; the \( C_{1-6} \) alkylamino group means an alkylamino group having 1 to 6 carbon atoms and examples thereof include a methylamino group and an ethylamino group; the \( C_{2-6} \) alkenylamino group means an alkenylamino group having 2 to 6 carbon atoms and examples thereof include an allylamino group and a 3-butenylamino group; the \( C_{6-10} \) arylamino group means an arylamino group having 6 to 10 carbon atoms and examples thereof include a phenylamino group and a naphthylamino group; the di(\( C_{1-6} \) alkyl) amino group means an amino group substituted with two the same or different \( C_{1-6} \) alkyl groups and examples thereof include a dimethylamino group, a diethylamino group and an N-ethyl-N-methylamino group; the di(\( C_{2-6} \) alkenyl) amino group means an amino group substituted with two the same or different \( C_{2-6} \) alkenyl groups and examples thereof include a diallylamino group and a di(3-butenyl) amino group; the (\( C_{1-6} \) alkyl) (\( C_{6-10} \) aryl) amino group means an amino group substituted with a \( C_{1-6} \) alkyl group and a \( C_{6-10} \) aryl group and examples thereof include a methylphenylamino group and an ethylphenylamino group; the \( C_{1-6} \) alkythio group means an alkythio group having 1 to 6 carbon atoms and examples thereof include a methylthio group, an ethylthio group, a propylthio group and an
isopropylthio group;
the (Ci-6 alkyloxy) Ci_6 alkyl group means a Ci_6 alkyl group
substituted with a Ci_1-6 alkyloxy group and examples thereof
include a methoxyethyl group and an ethoxyethyl group; and
the 3- to 8-membered nitrogen-containing heterocyclic group
means an aromatic or alicyclic 3- to 8-membered
heterocyclic group, which contains 1 to 3 nitrogen atoms,
and may contain 1 to 3 oxygen atoms and/or sulfur atoms and
examples thereof include a 1-pyrazolyl group, a 2-pyridyl
group, a 2-pyrimidinyl group, a 2-thiazolyl group, a
pyrrolidino group, a piperidino group and a morpholino
group.

Examples of the halogen atom, with which a group
represented by R^3, R^4, R^5 and R^6 may be substituted, include
a fluorine atom, a chlorine atom, a bromine atom and an
iodine atom.

Examples of the Ci-6 alkyl group, with which the Ci_3-8
cycloalkyl group, the C_6-10 aryl group, the aryl moiety of
the (C_6-10 aryl)Ci_6 alkyl group, the Ci_3-8 cycloalkyloxy group,
the C_6-10 aryl oxy group, the aryl moiety of the (C_6-10
aryl)Ci_6 alkoyloxy group, the aryl moiety of the C_6-10
arylamino group, the aryl moiety of the (C_1-6 aryl) (C_6-10
aryl) amino group and the 3- to 8-membered nitrogen-
containing heterocyclic group in the group represented by
R^3, R^4, R^5 and R^6 may be substituted, include a methyl group,
an ethyl group, a propyl group, a butyl group and the like.

Among the compounds represented by the general formula (I) to be used as the active ingredient of the herbicidal composition of the present invention, a compound represented by the general formula (I-a), i.e., the present compound wherein G is a hydrogen atom, may have tautomers represented by the general formulas (I-a') and (I-a''). The compound represented by the general formula (I-a) includes all of the tautomers and a mixture of any two or more of them.

Agriculturally acceptable salts of the compound represented by the general formula (I-a) to be used as the active ingredient of the herbicidal composition of the present invention include those formed by the compound represented by the general formula (I-a) and inorganic bases such as hydroxides, carbonates, hydrogen carbonates, acetates and hydrides of alkali metals (e.g., lithium, sodium and potassium), hydroxides and hydrides of alkaline earth metals (e.g., magnesium, calcium and barium), and ammonia; organic bases such as dimethylamine, triethylamine, piperazine, pyrrolidine, piperidine, 2-phenylethylamine,
benzylamine, ethanolamine, diethanolamine, pyridine and collidine; metal alkoxides such as sodium methoxide, potassium tert-butoxide and magnesium methoxide; and the like.

When the present compound has one or more asymmetric centers, there exist two or more stereoisomers (e.g., enantiomers and diastereomers) in the compound. The compound represented by the general formula (I) includes all of the stereoisomers and a mixture of any two or more of them.

When the present compound has geometric isomerism based on a double bond, there exist two or more geometric isomers (e.g., E/Z or trans/cis isomers, and S-trans/S-cis isomers) in the compound. The present compound includes all of the geometric isomers and a mixture of two or more of them.

Preferred embodiments of the present compound used as the active ingredient for the herbicidal composition of the present invention are as follows.

The pyridazinone compound represented by the general formula (I), wherein \( n \) is an integer of 1 or more.

The pyridazinone compound represented by the general formula (I), wherein \( n = 0 \), and \( Z^1 \) is a \( C_{2-6} \) alkyl group.

The pyridazinone compound represented by the general formula (I), wherein \( n = 1 \) or 2, and \( Z^2 \) is attached to the
benzene ring at 4- and/or 6-positions thereof.

The pyridazinone compound represented by the general formula (I), wherein G represents a hydrogen atom or any one of the groups represented by the following formulas:

\[
\begin{align*}
R_{3b}^b & \text{ represents a } \text{C}_{1-8} \text{ alkyl group, a } \text{C}_{3-8} \text{ cycloalkyl group, a } \text{C}_{2-6} \text{ alkenyl group, a } \text{C}_{2-6} \text{ alkynyl group, a } \text{C}_{6-10} \text{ aryl group, a } (\text{C}_{6-10} \text{ aryl}) \text{C}_{1-6} \text{ alkyl group, a } \text{C}_{1-6} \text{ alkyloxy group, a } (\text{C}_{6-10} \text{ aryl}) \text{C}_{1-6} \text{ alkyloxy group, a } \\
R_{4b}^b & \text{ represents a } \text{C}_{1-6} \text{ alkyl group or a } \text{C}_{6-10} \text{ aryl group; and } \\
R_{5b}^b \text{ and } R_{6b}^b \text{ are the same or different and each represents a } \\
& \text{C}_{1-6} \text{ alkyl group, a } \text{C}_{1-6} \text{ alkyloxy group, a } \text{C}_{6-10} \text{ aryloxy group } \\
& \text{or a } \text{C}_{1-6} \text{ alkylthio group, provided that any group represented by } R_{3b}^b, R_{4b}^b, R_{5b}^b \text{ and } R_{6b}^b \\
& \text{may be substituted with at least one halogen atom, and the } \\
& \text{C}_{3-8} \text{ cycloalkyl group, the } \text{C}_{6-10} \text{ aryl group, the aryl moiety } \\
& \text{of the } (\text{C}_{6-10} \text{ aryl}) \text{C}_{1-6} \text{ alkyl group, the } \text{C}_{3-8} \text{ cycloalkyloxy group, the } \\
& \text{C}_{6-10} \text{ aryloxy group, the aryl moiety of the } (\text{C}_{6-10} \text{ aryl}) \text{C}_{1-6} \text{ alkyloxy group and the aryl moiety of the } \text{C}_{6-10} \text{ }
\end{align*}
\]

The pyridazinone compound represented by the general
formula (I), wherein G represents a hydrogen atom or any one of the groups represented by the following formulas:

\[ \text{R}^{3a} \]

wherein \( R^{3a} \) represents a \( C_{1-6} \) alkyl group, a \( C_{3-8} \) cycloalkyl group, a \( C_{6-10} \) aryl group, a \( C_{1-6} \) alkoxy group or a di (\( C_{1-6} \) alkyl) amino group;

\[ \text{R}^{4a} \]

wherein \( R^{4a} \) represents a \( C_{1-6} \) alkyl group,

provided that any group represented by \( R^{3a} \) and \( R^{4a} \) may be substituted with a halogen atom, and a \( C_{3-8} \) cycloalkyl group and a \( C_{6-10} \) aryl group may be substituted with a \( C_{1-6} \) alkyl group.

The pyridazinone compound represented by the general formula (I), wherein \( R^1 \) represents a \( C_{1-3} \) alkyl group or a \( (C_{1-3} \) alkoxy) \( C_{1-3} \) alkyl group.

The pyridazinone compound represented by the general formula (I), wherein \( R^2 \) represents a \( C_{1-3} \) alkyl group.

The pyridazinone compound represented by the general formula (I), wherein \( R^2 \) represents a hydrogen atom or a methyl group.

The pyridazinone compound represented by the general formula (I), wherein \( Z^1 \) represents a \( C_{1-3} \) alkyl group, and \( Z^2 \) represents a \( C_{1-3} \) alkyl group.

The pyridazinone compound represented by the general formula (I), wherein \( R^1 \) represents a \( C_{1-3} \) alkyl group or a
(Cl-3 alkyloxy) C_{1-3} alkyl group, and R^2 represents a hydrogen atom or a C_{1-3} alkyl group.

The pyridazinone compound represented by the general formula (I), wherein R^1 represents a C_{1-3} alkyl group or a (Cl-3 alkyloxy) C_{1-3} alkyl group, and R^2 represents a hydrogen atom or a methyl group.

The pyridazinone compound represented by the general formula (I), wherein R^2 represents a hydrogen atom or a C_{1-3} alkyl group, and G represents a hydrogen atom or any one of the groups represented by the following formulas:

\[
\begin{align*}
\text{R}^{3b}, \quad \text{S}^{4b}, \quad \text{R}^{5b}, \quad \text{R}^{6b},
\end{align*}
\]

wherein R^{3b}, R^{4b}, R^{5b} and R^{6b} are as defined above.

The pyridazinone compound represented by the general formula (I), wherein R^2 represents a hydrogen atom or C_{1-3} alkyl group, and G represents a hydrogen atom or any one of the groups represented by the following formulas:

\[
\begin{align*}
\text{R}^{3a}, \quad \text{S}^{4a},
\end{align*}
\]

wherein R^{3a} and R^{4a} are as defined above.

The pyridazinone compound represented by the general formula (I), wherein R^2 represents a hydrogen atom or a methyl group, and G represents a hydrogen atom or any one of the groups represented by the following formulas:
wherein $R_3^b$, $R_4^b$, $R_5^b$ and $R_6^b$ are as defined above.

The pyridazinone compound represented by the general formula (I), wherein $R^2$ represents a hydrogen atom or methyl group, and $G$ represents a hydrogen atom or any one of the groups represented by the following formula.

wherein $R_3^{a}$ and $R_4^{a}$ are as defined above.

The pyridazinone compound represented by the general formula (I), wherein $R^1$ represents a $C_{1-3}$ alkyl group or a $(C_{1-3} \text{ alkyloxy})C_{1-3}$ alkyl group, $R^2$ represents a hydrogen atom or a $C_{1-3}$ alkyl group, and $G$ represents a hydrogen atom or any one of the groups represented by the following formulas:

wherein $R_3^b$, $R_4^b$, $R_5^b$ and $R_6^b$ are as defined above.

The pyridazinone compound represented by the general formula (I), wherein $R^1$ represents a $C_{1-3}$ alkyl group or a $(C_{1-3} \text{ alkyloxy})C_{1-3}$ alkyl group, $R^2$ represents a hydrogen atom or a $C_{1-3}$ alkyl group, and $G$ represents a hydrogen atom or any one of the groups represented by the following formulas:
wherein $R_{3a}$ and $R_{4a}$ are as defined above.

The pyridazinone compound represented by the general formula (I), wherein $R^1$ represents a $C_{1-3}$ alkyl group or a $(C_{1-3} \text{ alkyl group}) C_{1-3}$ alkyl group, $R^2$ represents a hydrogen atom or a methyl group, and $G$ represents a hydrogen atom or any one of the groups represented by the following formulas:

wherein $R_{3b}$, $R_{4b}$, $R_{5b}$ and $R_{6b}$ are as defined above.

The pyridazinone compound represented by the general formula (I), wherein $R^1$ represents a $C_{1-3}$ alkyl group or a $(C_{1-3} \text{ alkyl group}) C_{1-3}$ alkyl group, $R^2$ represents a hydrogen atom or a methyl group, and $G$ represents a hydrogen atom or any one of the groups represented by the following formulas:

wherein $R_{3a}$ and $R_{4a}$ are as defined above.

The pyridazinone compound represented by the general formula (I), wherein $R^1$ represents a $C_{1-3}$ alkyl group or a $(C_{1-3} \text{ alkyl group}) C_{1-3}$ alkyl group, $R^2$ represents a hydrogen atom or a $C_{1-3}$ alkyl group,
n is an integer of 0, 1 or 2 and, when \( n \) is 2, two \( Z^2 \) may be the same or different, while when \( n \) is 1 or 2, \( Z^2 \) is attached to the benzene ring at 4- and/or 6-positions thereof,

\[ Z^1 \text{ represents a } \text{Ci}_6 \text{ alkyl group (more preferably a } \text{Ci}_3 \text{ alkyl group), and} \]

\[ Z^2 \text{ represents a } \text{Ci}_6 \text{ alkyl group (more preferably a } \text{Ci}_3 \text{ alkyl group).} \]

The pyridazinone compound represented by the general formula (I), wherein \( R^1 \) represents a \( \text{C}_1-3 \) alkyl group or a \( (\text{C}_1-3 \text{ alkyl oxy}) \text{Ci}_3 \) alkyl group, \( R^2 \) represents a hydrogen atom or a \( \text{C}_1-3 \) alkyl group, \( G \) represents a hydrogen atom or any one of the groups represented by the following formulas:

\[
\begin{align*}
&\text{O} \quad R^{3b} \\
&\text{O} \quad \text{SO} \quad R^{4b} \\
&\text{O} \quad R^{5b} \quad R^{6b}
\end{align*}
\]

wherein \( R^{3b}, R^{4b}, R^{5b} \) and \( R^{6b} \) are as defined above.

n is an integer of 0, 1 or 2 and, when \( n \) is 2, two \( Z^2 \) may be the same or different, while when \( n \) is 1 or 2, \( Z^2 \) is attached to the benzene ring at 4- and/or \( \beta \)-positions thereof,

\[ Z^1 \text{ represents a } \text{Ci}_6 \text{ alkyl group (more preferably a } \text{Ci}_3 \text{ alkyl group, and} \]

\[ Z^2 \text{ represents a } \text{C}_1-6 \text{ alkyl group (more preferably a } \text{C}_1-3 \text{ alkyl group).} \]
The pyridazinone compound represented by the general formula (I), wherein R\textsuperscript{1} represents a C\textsubscript{1–3} alkyl group or a (C\textsubscript{1–3} alkyloxy) C\textsubscript{1–3} alkyl group, R\textsuperscript{2} represents a hydrogen atom or a C\textsubscript{1–3} alkyl group, G represents a hydrogen atom or any one of the groups represented by the following formulas:

\[ \begin{align*}
\text{R}^{3a} & = \text{alkyl group} \\
\text{R}^{4a} & = \text{alkyl group}
\end{align*} \]

wherein R\textsuperscript{3a} and R\textsuperscript{4a} are as defined above, n is an integer of 0, 1 or 2 and, when n is 2, two Z\textsuperscript{2} may be the same or different, while when n is 1 or 2, Z\textsuperscript{2} is attached to the benzene ring at 4- and/or β-positions thereof,

Z\textsuperscript{1} represents a C\textsubscript{6} alkyl group (more preferably a C\textsubscript{3}–C\textsubscript{6} alkyl group), and

Z\textsuperscript{2} represents a C\textsubscript{1–6} alkyl group (more preferably a C\textsubscript{1–3} alkyl group).

The pyridazinone compound represented by the general formula (I), wherein R\textsuperscript{1} represents a C\textsubscript{1–3} alkyl group or a (C\textsubscript{1–3} alkyloxy) C\textsubscript{1–3} alkyl group, R\textsuperscript{2} represents a hydrogen atom or a methyl group,

n is an integer of 0, 1 or 2 and, when n is 2, two Z\textsuperscript{2} may be the same or different, while when n is 1 or 2, Z\textsuperscript{2} is attached to the benzene ring at 4- and/or β-positions thereof,
Z\(^1\) represents a C\(_{1-6}\) alkyl group (more preferably a C\(_{1-3}\) alkyl group), and

Z\(^2\) represents a C\(_{1-6}\) alkyl group (more preferably a C\(_{1-3}\) alkyl group).

The pyridazinone compound represented by the general formula (I), wherein R\(^1\) represents a C\(_{1-3}\) alkyl group or a (C\(_{1-3}\) alkyl oxy) C\(_{1-3}\) alkyl group, R\(^2\) represents a hydrogen atom or a methyl group, G represents a hydrogen atom or any one of the groups represented by the following formulas:

\[\text{formula images}\]

wherein R\(^{3b}\), R\(^{4b}\), R\(^{5b}\) and R\(^{6b}\) are as defined above, n represents an integer of 0, 1 or 2 and, when n is 2, two Z\(^2\) may be the same or different, while when n is 1 or 2, Z\(^2\) is attached to the benzene ring at 4- and/or 6-positions thereof,

Z\(^1\) represents a C\(_{1-6}\) alkyl group (more preferably a C\(_{1-3}\) alkyl group), and

Z\(^2\) represents a C\(_{1-6}\) alkyl group (more preferably a C\(_{1-3}\) alkyl group).

The pyridazinone compound represented by the general formula (I), wherein R\(^1\) represents a C\(_{1-3}\) alkyl group or a (C\(_{1-3}\) alkyl oxy) C\(_{1-3}\) alkyl group, R\(^2\) represents a hydrogen atom or methyl group, G represents a hydrogen atom or any one of the groups represented by the following formulas:
wherein $R^3_a$ and $R^4_a$ are as defined above,
n is an integer of 0, 1 or 2 and, when n is 2, two $Z^2$ may
be the same or different, while when n is 1 or 2, $Z^2$ is
attached to the benzene ring at 4- and/or 6-positions
thereof,
$Z^1$ represents a $C_1^{-6}$ alkyl group (more preferably a $C_1^{-3}$
alkyl group), and
$Z^2$ represents a $C_1^{-6}$ alkyl group (more preferably a $C_1^{-3}$
alkyl group).

The pyridazinone compound represented by the general
formula $\text{(1-1)}$,

\[ \text{(1-1)} \]

wherein $R^{2^{-1}}$ represents a hydrogen atom or a $C_1^{-3}$ alkyl group,
$G^1$ represents a hydrogen atom, or a $C_1^{-3}$ alkylcarbonyl, $C_1^{-3}$
aloxycarbonyl or $C_6^{-io}$ arylcarbonyl group which may be
substituted with a halogen atom,
$Z^{1^{-1}}$ represents a $C_1^{-3}$ alkyl group,
$Z^{2^{-1^{-1}}}$ represents a $C_1^{-3}$ alkyl group, and
$Z^{2^{-1^{-2}}}$ represents a hydrogen atom or a $C_1^{-3}$ alkyl group.
The pyridazinone compound represented by the general formula (1-1), wherein $R^{2-1}$ represents a hydrogen atom, a methyl group or an ethyl group, $G^1$ represents a hydrogen atom, an acetyl group, a propionyl group, a methoxycarbonyl group, an ethoxycarbonyl group or a benzoyl group, $Z^{1-1}$ represents a methyl group or an ethyl group, $Z^{2-1-1}$ represents a methyl group or an ethyl group, and $Z^{2-1-2}$ represents a hydrogen atom, a methyl group or an ethyl group.

The pyridazinone compound represented by the general formula (1-2),

![Chemical Structure](image)

wherein $R^{2-2}$ represents a hydrogen atom or a $C_1$-$3$ alkyl group, $G^2$ represents a hydrogen atom, or a $C_1$-$3$ alkylcarbonyl or $C_1$-$3$ alkoxy carbonyl group which may be substituted with a halogen atom, $Z^{2-2-1}$ represents a hydrogen atom or a $C_1$-$3$ alkyl group, and $Z^{2-2-2}$ represents a hydrogen atom or a $C_1$-$3$ alkyl group.

The pyridazinone compound represented by the general formula (1-2), wherein $R^{2-2}$ represents a hydrogen atom, a methyl group or an ethyl group, $G^2$ represents a hydrogen
atom, an acetyl group, a methoxycarbonyl group or an ethoxycarbonyl group,
\[ Z^{2-2} \] represents a hydrogen atom, a methyl group or an ethyl group, and
\[ Z^{2^{2}}^{2^{2}} \] represents a hydrogen atom, a methyl group or an ethyl group.

Pinoxaden is a known compound and is commercially available. It is prepared by a method described in JP 2002-506870 A, etc.

Clodinafop-propargyl is a known compound and is commercially available. It is prepared by a method described in US Patent No. 4,713,109, etc.

Cloquintocet-mexyl is a known compound and is commercially available. It is prepared by a method described in US Patent No. 4,902,340, etc.

Mefenpyr-diethyl is a known compound and is commercially available. It is prepared by a method described in JP 5-503086 A, etc.

Fenchlorazole-ethyl is a known compound and is commercially available. It is prepared by a method described in JP 61-68474 A, etc.

The herbicidal composition of the present invention has a herbicidal activity to a wide range of weeds, and can effectively control various weeds in fields for crops, vegetables and trees or in non-crop lands, where
conventional tillage or non-tillage cultivation is carried out.

Examples of weeds that the present inventive herbicidal composition can control are as follows.

Artemisia vulgaris, Solidago altissima, Sesbania exaltata, Cassia obtusifolia, Desmodium tortuosum, Trifolium repens, Pueraria lobata, Vicia sativa, Commelina communis, Commelina benghalensis, Galium aparine, Stellaria media, Rapunulas raphanistrum, Sinapis arvensis, Capsella bursa-pastoris, Veronica persica, Veronica hederifolia, Viola arvensis, Viola tricolor, Papaver rhoeas, Myosotis arvensis, Asclepias syriaca, Euphorbia helioscopia, Euphorbia maculata, Geranium carolinianum, Erodium cicutarium and Equisetum arvense; Weeds growing in paddy fields such as Echinochloa oryzicola Vasing, Echinochloa crus-galli P. B. var. formosensis Ohwi, Cyperus difformis, Cyperus iria, Fimbristylis miliacea, Eleocharis acicularis, Scirpus juncoides, Scirpus wallichii, Cyperus serotinus, Eleocharis kuroguwai, Scirpus planiculmis, Scirpus nipponicus, Monochoria vaginalis, Lindernia procumbens, Dopatrium juncem, Rotala indica, Ammannia multiflora, Elatine triandra, Ludwigia prostrata, Sagittaria pygmaea, Alisma canaliculatum, Sagittaria trifolia, Potamogeton distinctus, Oenanth javanica, Callitriche palustris, Lindernia angustifolia, Lindernia dubia, Eclipta prostrata, Murdannia keisak, Paspalum distichum and Leersia oryzoides.

The herbicidal composition of the present invention can be used as an herbicide for farmlands or non-farmlands
such as dry field, paddy field, and turf and fruit orchard. The herbicidal composition of the present invention can control weeds growing in the farmlands for crop cultivation, without phytotoxicity to the crops. The crops are as follows.

Agricultural crops: corn, rice, wheat, barley, rye, oat, sorghum, cotton, soybean, peanut, sarrazin, sugar beet, rapeseed, sunflower, sugar cane, tobacco etc.;

Vegetables: Solanaceae vegetables (eggplant, tomato, green pepper, hot pepper, potato etc.), Cucurbitaceae vegetables (cucumber, pumpkin, zucchini, watermelon, melon etc.), Cruciferae vegetables (Japanese radish, turnip, horseradish, kohlrabi, Chinese cabbage, cabbage, brown mustard, broccoli, cauliflower etc.), Compositae vegetables (burdock, garland chrysanthemum, artichoke, lettuce etc.), Liliaceae vegetables (Welsh onion, onion, garlic, asparagus etc.), Umbelliferae vegetables (carrot, parsley, celery, parsnip etc.), Chenopodiaceae vegetables (spinach, Swiss chard etc.), Labiatae vegetables (Japanese basil, mint, basil etc.), strawberry, sweat potato, yam, aroid etc.;

Flowers and ornamental plants;

Foliage plants;

Fruit trees: pomaceous fruits (apple, common pear, Japanese pear, Chinese quince, quince etc.), stone fleshy fruits (peach, plum, nectarine, Japanese plum, cherry,
apricot, prune etc.), citrus plants (Satsuma mandarin, orange, lemon, lime, grapefruit etc.), nuts (chestnut, walnut, hazel nut, almond, pistachio, cashew nut, macadamia nut etc.), berry fruits (blueberry, cranberry, blackberry, raspberry etc.), grape, persimmon, olive, loquat, banana, coffee, date, coconut etc.;

Trees other than fruit trees: tea, mulberry, flowering trees and shrubs, street trees (ash tree, birch, dogwood, eucalyptus, ginkgo, lilac, maple tree, oak, poplar, cercis, Chinese sweet gum, plane tree, zelkova, Japanese arborvitae, fir tree, Japanese hemlock, needle juniper, pine, spruce, yew) etc.

The above "crops" include those having herbicide resistance conferred by a classical breeding method, a genetic engineering technique, or the like. Examples of the herbicide to be resisted include HPPD inhibitors such as isoxaflutole, ALS inhibitors such as imazethapyr or thifensulfuron-methyl; EPSP synthase inhibitors; glutamine synthetase inhibitors; acetyl CoA carboxylase inhibitors; bromoxynil; dicamba; and the like.

Examples of the "crops" having herbicide resistance conferred by a classical breeding method include Clearfield (registered trademark) canola resistant to imidazolinone herbicides such as imazethapyr, and STS soybean resistant to sulfonylurea herbicides such as thifensulfuron-methyl,
and the like. Similarly, examples of the crops having herbicide resistance conferred by a classical breeding method include SR corn resistant to acetyl CoA carboxylase inhibitors such as trione oxime herbicides and aryloxyphenoxypropionic acid herbicides, and the like. The crops having herbicide resistance to acetyl CoA carboxylase inhibitors are described in Proc. Natl. Acad. Sci. USA, Vol. 87, pp. 7175-7179, 1990, and the like. In addition, mutant acetyl CoA carboxylase resistant to acetyl CoA carboxylase inhibitors is reported in Weed Science 53: p. 728-746, 2005, and the like. When such a gene encoding the mutant acetyl CoA carboxylase is introduced into a crop by genetic engineering techniques or when mutations related to acetyl CoA carboxylase inhibitor-resistance are introduced into the gene encoding acetyl CoA carboxylase of the crops, the crops having the resistance to acetyl CoA carboxylase inhibitors can be produced.

Examples of the "crop" having herbicide resistance conferred by genetic engineering techniques include corn cultivars having resistance to glyphosate or glufosinate. Some of such corn cultivars are sold under the trade name of RoundupReady (registered trademark), LibertyLink (registered trademark), and the like.

The above "crops" include those having an ability to produce, for example, selective toxins originated from
Bacillus which ability has been imparted by genetic engineering techniques.

Examples of the insecticidal toxins which are produced by such genetically engineered plants include insecticidal proteins derived from Bacillus cereus and Bacillus popilliae; 8-endotoxins derived from Bacillus thuringiensis, such as Cry1Ab, Cry1Ac, Cry1F, Cry1Fa2, Cry2Ab, Cry3A, Cry3Bbl and Cry9C; insecticidal proteins derived from Bacillus thuringiensis, such as VIP 1, VIP 2, VIP 3 and VIP 3A; insecticidal proteins derived from nematodes; toxins produced by animals such as scorpion toxins, spider toxins, bee toxins and insect-specific nerve toxins; fungal toxins; plant lectins; agglutinins; protease inhibitors such as trypsin inhibitors, serine protease inhibitors, patatin, cystatin, and papain inhibitors; ribosome-inactivating proteins (RIP) such as ricins, corn-RIP, abrins, saporins, and briodin; steroid metabolizing enzymes such as 3-hydroxysteroid oxidase, ecdysteroid-UDP-glucosyltransferase, and cholesterol oxidase; ecdysone inhibitors; HMG-CoA reductase; ion channel inhibitors such as sodium channel inhibitors and calcium channel inhibitors; juvenile hormone esterase; diuretic hormone receptors; stilbene synthase; bibenzyl synthase; chitinase; and glucanase.

The insecticidal toxins produced by such genetically engineered plants also include hybrid toxins of different
insecticidal proteins, for example, δ-endotoxins such as Cry1Ab, Cry1Ac, Cry1F, Cry1Fa2, Cry2Ab, Cry3A, Cry3Bb1 and Cry9C and insecticidal proteins such as VIP 1, VIP 2, VIP 3 and VIP 3A, and toxins in which a part of amino acids constituting insecticidal proteins is deleted or modified. The hybrid toxins are made by combining different domains of the insecticidal proteins by genetic engineering techniques. An example of the toxin in which a part of amino acids constituting an insecticidal protein is deleted includes Cry1Ab in which a part of amino acids is deleted. An example of the toxin in which a part of amino acids constituting an insecticidal protein is modified includes a toxin in which one or more of amino acids of a natural toxin are substituted.


The genetically engineered crops having the ability to produce the insecticidal toxins particularly have resistance to attack by Coleopteran pests, Dipteran pests or Lepidopteran pests.

Genetically engineered crops which have one or more pest-resistance genes and thereby produce one or more
insecticidal toxins are also known, and some of them are commercially available. Examples of such genetically engineered crops include YieldGard (registered trademark) (a corn cultivar expressing Cry1Ab toxin), YieldGard Rootworm (registered trademark) (a corn cultivar expressing Cry3Bb1 toxin), YieldGard Plus (registered trademark) (a corn cultivar expressing Cry1Ab and Cry3Bb1 toxins), Herculex I (registered trademark) (a corn cultivar expressing Cry1Fa2 toxin and phosphinothricin N-acetyltransf erase (PAT) to confer resistance to glufosinate), NuCOTN33B (registered trademark) (a cotton cultivar expressing Cry1Ac toxin), Bollgard I (registered trademark) (a cotton cultivar expressing Cry1Ac toxin), Bollgard II (registered trademark) (a cotton cultivar expressing Cry1Ac and Cry2Ab toxins), VIPCOT (registered trademark) (a cotton cultivar expressing VIP toxin), NewLeaf (registered trademark) (a potato cultivar expressing Cry3A toxin), NatureGard (registered trademark), Agrisure GT Advantage (registered trademark) (GA21 glyphosate-resistance trait), Agrisure CB Advantage (registered trademark) (BtI1 corn borer (CB) trait), Protecta (registered trademark), and the like.

The above "crops" include those to which ability to produce anti-pathogen substances have been conferred by genetic engineering techniques.
Examples of the anti-pathogen substances include PR proteins (PRPs described in EP-A-0 392 225); ion channel inhibitors such as sodium channel inhibitors, and calcium channel inhibitors (e.g. KP1, KP4, KP6 toxins etc. produced by viruses); stilbene synthase; bibenzyl synthase; chitinase; glucanase; substances produced by microorganisms such as peptide antibiotics, heterocycle-containing antibiotics, and protein factors involved in plant disease-resistance described in WO 03/000906; and the like. Such anti-pathogen substances and genetically engineered crops which produce the anti-pathogen substances are described in EP-A-0 392 225, WO 05/33818, EP-A-0 353 191, and the like.

Usually, the herbicidal composition of the present invention is formulated into a form suitable for an intended purpose. That is, the active ingredients of the herbicidal composition of the present invention are dissolved or dispersed in an appropriate liquid carrier, mixed with an appropriate solid carrier, or adsorbed in an appropriate solid carrier before use to formulate into a form such as emulsifiable concentrate, liquid formulation, oil solution, aerosol, wettable powder, dust, DL (driftless) dust, granule, microgranule, microgranule \( \times \), fine granule \( \times \), water dispersible granule, water-soluble formulation, flowable formulation, dry flowable formulation, jumbo tablet which means bagged self-diffusible powder,
tablet, paste, and the like. These formulations are prepared according to a known method, if necessary, by adding auxiliary agents for formulations such as emulsifier, dispersant, spreading agent, penetrant, moistening agent, binder, thickener, preservative, antioxidant, colorant and the like.

Examples of the liquid carrier to be used for the formulation include water, alcohols (e.g. methanol, ethanol, 1-propanol, 2-propanol and ethylene glycol), ketones (e.g. acetone and methyl ethyl ketone), ethers (e.g. dioxane, tetrahydrofuran, ethylene glycol monomethyl ether, diethylene glycol monomethyl ether and propylene glycol monomethyl ether), aliphatic hydrocarbons (e.g. hexane, octane, cyclohexane, kerosene, fuel oil and machine oil), aromatic hydrocarbons (e.g. benzene, toluene, xylene, solvent naphtha and methyl naphthalene), halogenated hydrocarbons (e.g. dichloromethane, chloroform and carbon tetrachloride), acid amides (e.g. dimethylformamide, dimethylacetamide and N-methylpyrrolidone), esters (e.g. ethyl acetate, butyl acetate and fatty acid glycerin ester) and nitriles (e.g. acetonitrile and propionitrile). These liquid carriers can be used alone or in combination by mixing two or more kinds thereof in an appropriate ratio.

Examples of the solid carrier to be used for the formulation include vegetable powders (e.g. soybean powder,
tobacco powder, wheat flour and wood flour), mineral powders (e.g. clays such as kaolin, bentonite, acidic white clay and clay, talcs such as talcum powder and pyrophyllite, silicas such as diatom earth and mica), alumina, sulfur powder, active carbon, saccharides (e.g., lactose and glucose), inorganic salts (e.g., calcium carbonate and sodium bicarbonate) and glass hollow materials (prepared by subjecting natural glass to calcination processing to encapsulate bubbles therein). These solid carriers can be used alone or in combination by mixing two or more kinds thereof in an appropriate ratio.

The liquid carrier or solid carrier is usually used in a ratio of 1 to 99% by weight, preferably from about 10 to 99% by weight, based on the entire formulation.

Usually, a surfactant is used as the emulsifier, dispersant, spreading agent, penetrant and moistening agent to be used for the formulation. Examples of the surfactant include anionic surfactants such as alkyl sulfate, alkylaryl sulfonate, dialkyl sulfosuccinate, polyoxyethylene alkylaryl ether phosphate, lignin sulfonate and naphthalene sulfonate-formaldehyde polycondensate; and non-ionic surfactants such as polyoxyethylene alkyl ether, polyoxyethylene alkylaryl ether, polyoxyethylene alkyl polyoxypropylene block copolymers and sorbitan fatty acid ester. These surfactants can be used alone or in
combination with two or more kinds thereof. The surfactant
is usually used in a ratio of 0.1 to 50% by weight,
preferably from about 0.1 to 25% by weight, based on the
entire formulation.

Examples of the binder and thickener include dextrin,
sodium salts of carboxymethyl cellulose, polycarboxylic
acid-based polymer compounds, polyvinyl pyrrolidone,
polyvinyl alcohol, sodium lignin sulfonate, calcium lignin
sulfonate, sodium polyacrylate, gum arabic, sodium alginate,
mannitol, sorbitol, bentonite-based mineral substances,
polyacrylic acid and the derivatives, sodium salt of
carboxymethyl cellulose, white carbon, natural saccharide
derivatives (e.g., xanthan gum and guar gum).

The total amount of the active ingredients (including
the safeners) of the herbicidal composition of the present
invention contained in the formulation is usually from 1 to
90% by weight based on the entire formulation in the case
of the emulsifiable concentrate, wettable powder, water
dispersible granule, liquid formulation, water-soluble
formulation, flowable formulation and the like, from 0.01
to 10% by weight based on that of the entire formulation in
the case of the oil solution, dust, DL dust and the like,
and from 0.05 to 10% by weight based on that of the entire
formulation in the case of the microgranule, microgranule F,
fine granule F, granule and the like. However, these
concentrations can be appropriately adjusted depending on an intended purpose. Usually, the formulations such as emulsifiable concentrate, wettable powder, water dispersible granule, liquid formulation, water-soluble formulation and flowable formulation are appropriately diluted with water before use by about 100 to 100,000 times.

In the herbicidal composition of the present invention, a mixing ratio of the present compound to pinoxaden, one of herbicides in the group A, to be used as the active ingredients is in a range from 1 : 0.01 to 1 : 10, and preferably from 1 : 0.1 to 1 : 1 by weight.

In the herbicidal composition of the present invention, a mixing ratio of the present compound to clodinafop-propargyl being one of herbicides in the group A to be used as the active ingredients is in a range from 1 : 0.01 to 1 : 10, and preferably from 1 : 0.1 to 1 : 1 by weight.

In the herbicidal composition of the present invention, a mixing ratio of the present compound to fenchlorazole-ethyl being one of safeners in the group B to be used as the active ingredients is in a range from 1 : 0.01 to 1 : 10, and preferably from 1 : 0.1 to 1 : 1 by weight.

In the herbicidal composition of the present invention, a mixing ratio of the present compound to cloquintocet-mexyl being one of safeners in the group B to be used as the active ingredients is in a range from 1 : 0.01 to 1 :
10, and preferably from 1 : 0.1 to 1 : 1 by weight.

In the herbicidal composition of the present invention, a mixing ratio of the present compound to Mefenpyr-diethyl being one of safeners in the group B to be used as the active ingredients is in a range from 1 : 0.01 to 1 : 10, and preferably from 1 : 0.1 to 1 : 1 by weight.

The herbicidal composition of the present invention can be also prepared by preparing formulations of the respective active ingredients by means of the above formulation method, followed by mixing them.

The application method for the herbicidal composition of the present invention can be the same as that for known agrochemicals, such as aerial spray, soil spray and foliage spray.

When the herbicidal composition of the present invention is used as a herbicide for field or paddy field, the amount thereof to be used is usually about 1 to 5,000 g, preferably from 10 to 1,000 g, per hectare of the field or paddy field in terms of a total amount of the active ingredients contained in the herbicidal composition (including the safener) of the present invention. However, the amount may fluctuate depending on application area, application period, application method, variety of target weeds and cultivation crops and the like.

The herbicidal composition of the present invention is
usually used as that for pre-emergence soil incorporation.

It is usually used for flooding soil treatment or foliage and soil treatment in the case of weed control of paddy fields.

Further, it can be expected to enhance the weed control effect of the herbicidal composition of the present invention by mixing or concomitant use with one or more other herbicides. It is also possible to mix or use concomitantly with one or more of insecticides, fungicides, plant growth regulators, other safeners, fertilizers, soil conditioners, and the like.

The mixing ratio of the herbicidal composition of the present invention to a herbicide to be mixed or concomitantly used is usually from 1 : 0.01 to 1 : 100, and preferably from 1 : 0.1 to 1 : 10, in terms of the active ingredients by weight.

The mixing ratio of the herbicidal composition of the present invention to an insecticide to be mixed or concomitantly used is usually from 1 : 0.01 to 1 : 100, and preferably from 1 : 0.1 to 1 : 10, in terms of the active ingredients by weight.

The mixing ratio of the herbicidal composition of the present invention to a fungicide to be mixed or
concomitantly used is usually from 1 : 0.01 to 1 : 100, and preferably from 1 : 0.1 to 1 : 10, in terms of the active ingredients by weight.

The mixing ratio of the herbicidal composition of the present invention to a plant growth regulator to be mixed or concomitantly used is usually from 1 : 0.0001 to 1 : 100, and preferably from 1 : 0.001 to 1 : 1, in terms of the active ingredients by weight.

The mixing ratio of the herbicidal composition of the present invention to another safener to be mixed or concomitantly used is usually from 1 : 0.001 to 1 : 100, and preferably from 1 : 0.01 to 1 : 10, in terms of the active ingredients by weight.

The mixing ratio of the herbicidal composition of the present invention to a fertilizer to be mixed or concomitantly used is usually from 1 : 0.1 to 1 : 1000, and preferably from 1 : 1 to 1 : 200, in terms of the active ingredients by weight.

Examples of active ingredients of other herbicides that can be used in or together with the herbicidal composition of the present invention include:

(1) herbicidal phenoxyfatty acid compounds (e.g. MCP, MCPB, phenothiol, mecoprop, fluroxypyr, triclopyr, clomeprop, naphoanilide, etc.),

(2) herbicidal benzoate compounds (e.g. 2,3,6-TBA,
clopyrald, picloram, aminopyralid, quinclorac, quinmerac, etc.),
(3) herbicidal urea compounds (diuron, linuron, chlortoluron, isoproturon, fluometuron, isouron, tebuthiuron, methabenzthiazuron, cumyluron, daimuron, methyl-dairyuron, etc.),
(4) herbicidal triazine compounds (e.g. ametoryn, cyanazine, simazine, propazine, simetryn, dimethametryn, prometryn, metribuzin, triaziflam, etc.),
(5) herbicidal bipyridinium compounds (e.g. paraquat, diquat, etc.),
(6) herbicidal hydroxybenzonitrile compounds (e.g. bromoxynil, ioxynil, etc.),
(7) herbicidal dinitroaniline compounds (e.g. pendimethalin, prodiamine, trifluralin, etc.),
(8) herbicidal organophosphorous compounds (e.g. amipros-methyl, butamifos, bensulide, piperophos, anilofos, glufosinate, bialaphos, etc.),
(9) herbicidal carbamate compounds (e.g. di-allate, tri-allate, EPTC, butylate, benthiocarb, esprocarb, molinate, dimepiperate, swep, chlorpropham, phenmedipham, phenisopham, pyributicarb, asulam, etc.),
(10) herbicidal acid amide compounds (e.g. propanil, propyzamide, bromobutide, etobenzenid, etc.),
(11) herbicidal chloroacetanilide compounds (e.g. alachlor,
butachlor, dimethenamid, propachlor, metazachlor, pretilachlor, thenylchlor, pethoxamid, etc.),
(12) herbicidal diphenylether compounds (e.g. acifluorfen-sodium, bifenox, oxyfluorfen, lactofen, fomesafen, chlomethoxyxil, aclonifen, etc.),
(13) herbicidal cyclicimide compounds (e.g. oxadiazon, cinidon-ethyl, carfentrazone-ethyl, surfentrazone, flumiclorac-pentyl, pyraflufen-ethyl, oxadiargyl, pentoxazone, fluthiacet-methyl, butafenacil, benzfendizone, etc.),
(14) herbicidal pyrazole compounds (e.g. benzofenap, pyrazolate, pyrazoxyfen, topramezone, pyrasulfotole, etc.),
(15) herbicidal triketone compounds (e.g. isoxaflutole, benzobicyclon, sulcotrione, mesotrione, tembotrione, tefuryltrione, etc.),
(16) herbicidal aryloxyphenoxypropionate compounds (e.g. cyhalofop-butyl, diclofop-methyl, fenoxaprop-ethyl, fluazifop-butyl, haloxyfop-methyl, quialofop-ethyl, metamifop, etc.),
(17) herbicidal trioneoime compounds (e.g. alloxoydim-sodium, sethoxydim, butroxydim, clethodim, cloproxydim, cycloxydim, tepraloxydim, tralkoxydim, prooxydim, etc.),
(18) herbicidal sulfonylurea compounds (e.g. chlorsulfuron, sulfometuron-methyl, metsulfuron-methyl, tripronuron-methyl, triasulfuron, bensulfuron-methyl, thifensulfuron-methyl,
pyrazosulfuron-ethyl, primisulfuron-methyl, nicosulfuron, amidosulfuron, cinosulfuron, imazosulfuron, rimsulfuron, halosulfuron-methyl, prosulfuron, ethametsulfuron-methyl, triflusulfuron-methyl, flazasulfuron, cyclosulfaruron, flupyrssulfuron, sulfosulfuron, azimsulfuron, ethoxysulfuron, oxasulfuron, iodosulfuron-methyl-sodium, foramsulfuron, mesosulfuron-methyl, trifloxysulfuron, tritosulfuron, orthosulfamuron, flucetosulfuron, etc.),

(19) herbicidal imidazolinone compounds (e.g. imazamethabenz-methyl, imazamethapyr, imazamox, imazapyr, imazaquin), imazethapyr, etc.),

(20) herbicidal sulfoneamide compounds (e.g. flumetsulam, metosulam, diclosulam, florasulam, penoxsulam, pyroxsulam, etc.),

(21) herbicidal pyrimidinyloxybenzoate compounds (e.g. pyrithiobac-sodium, bispyribac-sodium, pyriminobac-methyl, pyribenoxim, pyrifitalid, pyrimisulfan, etc.), and

(22) other herbicidal compounds (e.g. bentazon, bromacil, terbacil, chlorthiamid, isoxaben, dinoseb, amitrole, cinmethylin, tridiphane, dalapon, diflufenopyr-sodium, dithiopyr, thiazopyr, flucarbazone-sodium, propoxycarbazone-sodium, mefenacet, flufenacet, fentrazamide, cafenstrole, indanofan, oxaziclomefone, benfuresate, ACN, pyridate, chloridazon, norfluazon, flurtamone, diflufenican, picolinafen, beflubutamid,
clomazone, amicarbazone, pyraclonil, pyroxasulfone, thiencarbazone-methyl, etc.) and the like.

Examples of active ingredients of plant growth regulators include hymexazol, paclobutrazol, uniconazole-P, inabenfide, prohexadione-calcium, and the like.

Examples of active ingredients of fungicides include:

(1) fungicidal polyhaloalkylthio compounds (e.g. captan, etc.),

(2) fungicidal organophosphorous compounds (e.g. IBP, EDDP, tolclofos-methyl, etc.),

(3) fungicidal benzimidazole compounds (e.g. benomyl, carbendazim, thiophanate-methyl, etc.),

(4) fungicidal carboxamide compounds (e.g. carboxin, mepronil, flutolanil, thifluzamid, furametpyr, boscalid, penthiopyrad, etc.),

(5) fungicidal dicarboxyiridole compounds (e.g. procymidone, iprodione, vinclozolin, etc.),

(6) fungicidal acylalanine compounds (e.g. metalaxyl, etc.),

(7) fungicidal azole compounds (e.g. triadimefon, triadimenol, propiconazole, tebuconazole, cyproconazole, epoxiconazole, prothioconazole, ipconazole, triflumizole, prochloraz, etc.),

(8) fungicidal morphorine compounds (e.g. dodemorph, tridemorph, fenpropimorph, etc.),

(9) fungicidal strobilphosphorus compounds (e.g.
Examples of active ingredients of fungicides include:

1. Fungicidal antibiotic compounds (e.g. validamycin A, blasticidin S, kasugamycin, polyoxin, etc.),
2. Fungicidal sithiocarbamate compounds (e.g. mancozeb, maneb, etc.), and
3. Other fungicidal compounds (e.g. fthalide, probenazole, isoprothiolane, tricyclazole, pyroquilon, ferimzone, acibenzolar S-methyl, carpropamid, diclocymet, fenoxanil, tiadinil, diclomezine, teclofthalam, pencycuron, oxolinic acid, TPN, triforine, fenpropidin, spiroxamine, fluazinam, iminoctadine, fenpiclonil, fludioxonil, quinoxyfen, fenhexamid, silthiofam, proquinazid, cyflufenamid, basic calcium copper sulfate (bordeaux mixture, etc.), and the like.

Examples of active ingredients of insecticides include:

1. Insecticidal organophosphorous compounds (e.g. fenthion, fenitrothion, pirimiphos-methyl, diazinon, quinalphos), isoxathion, pyridafenthion, chlorpyrifos-methyl, vamidothion, malathion, phenthoate, dimethoate, disulfoton, monocrotophos, tetrachlorvinphos, chlorfenvinphos, propaphos, acephate, trichlorfon, EPN, pyraclofos, etc.),
2. Insecticidal carbamate compounds (e.g. carbaryl, metolcarb, isoprocarb, BPMC, propoxur, XMC, carbofuran, carbosulfan, benfuracarb, furathiocarb, methomyl,
thiodicarb, etc.),

(3) insecticidal synthetic pyrethroid compounds (e.g. tefluthrin, bifenthrin, cycloprothrin, ethofenprox, etc.),

(4) insecticidal nereistoxin compounds (e.g. cartap, bensultap, thiocyclam, etc.),

(5) insecticidal neonicotinoid compounds (e.g. imidacloprid, nitenpyram, acetamiprid, thiamethoxam, thiacloprid, dinotefuran, clothianidin, etc.),

(6) insecticidal benzoylphenyurea compounds (e.g. chlorfluazuron, flufenoxuron, hexaflumuron, lufenuron, novaluron, etc.),

(7) insecticidal macrolide compounds (e.g. emamectin, spinosad, etc.), and

(8) other insecticidal compounds (e.g. buprofezin, tebufenozide, fipronil, ethiprole, pymetrozine, diafenthiuron, indoxacarb, tolfenpyrad, pyridalyl, flonicamid, flubendiamide, rynaxypyr, cyazypyr, etc.), and the like.

Examples of acaricides include hexythiazox, pyridaben, fenpyroximate, tebufenpyrad, chlorfenapyr, etoxazole, pyrimidifen, acequinocyl, bifenazate, spirodiclofen, and the like.

Examples of active ingredients of nematocides include fosthiazate, cadusafos, and the like.

Examples of fertilizers include nitrogen fertilizers
such as urea, and the like.

Herbicides containing the composition of the present invention as an active ingredient may further appropriately contain other safeners (e.g. furilazole, dichlormid, benoxacor, alldochlor, isoxadifen-ethyl, fenclorim, cyprosulfamide, cyometrinil, oxabetrinil, fluxofenim, flurazole, 1,8-naphthalic anhydride, etc.), pigments, and the like.

The present compound can be prepared, for example, by the following production methods.

Production Method 1

Among the present compounds, the compound represented by the general formula (I-a), i.e., the present compound wherein G is a hydrogen atom, can be prepared by reacting a compound represented by the general formula (II) with a metal hydroxide.

\[
\begin{align*}
\text{(E)} & \quad \text{Metal hydroxide} \\
\text{(I-a)}
\end{align*}
\]

wherein \(R^7\) represents a \(\text{C}_{1-6}\) alkyl group (e.g., a methyl or ethyl group); and \(R^1, R^2, Z^1, Z^2\) and \(n\) are as defined above.

This reaction is usually carried out in a solvent. Examples of the solvent include water; ether solvents such as tetrahydrofuran and dioxane; and a mixed solvent thereof.
Examples of the metal hydroxide to be used in this reaction include alkali metal hydroxides such as sodium hydroxide and potassium hydroxide. The amount of the metal hydroxide to be used is usually from 1 to 120 molar equivalents, preferably from 1 to 40 molar equivalents relative to the compound represented by the general formula (I-D).

The reaction temperature of this reaction is usually in a range from room temperature to a boiling point of a solvent to be used, and preferably a boiling point of the solvent. This reaction can be also carried out in a sealed tube or a pressure-resistant airtight container with heating. The reaction time of this reaction is usually from 5 minutes to a few of weeks.

The completion of this reaction can be confirmed by sampling the reaction mixture and identifying the product by an analytic means such as thin layer chromatography (TLC), high performance liquid chromatography (HPLC), etc. After completion of the reaction, the compound represented by the general formula (I-a) can be isolated, for example, by neutralizing the reaction mixture with an acid, mixing with water and extracting with an organic solvent, followed by subjecting the resultant organic layer to operations such as drying and concentration.

Production Method 2
Among the present compounds, a compound represented by the general formula (I-b), i.e. the present compound wherein G is a group other than a hydrogen atom, can be prepared by reacting the compound represented by the general formula (I-a) with a compound represented by the general formula (III).

\[ \text{G}^3-\text{X} \]

(I-a) \[ \rightarrow \]

(I-b)

wherein G\(^3\) represents a group defined by G excluding a hydrogen atom; X represents a halogen atom (e.g., a chlorine atom, a bromine atom or an iodine atom) or a group represented by O\(G^3\); and R\(^1\), R\(^2\), Z\(^1\), Z\(^2\) and n are as defined above.

This reaction can be carried out in a solvent. Examples of the solvent to be used include aromatic hydrocarbons such as benzene and toluene; ethers such as diethyl ether, diisopropyl ether, dioxane, tetrahydrofuran and dimethoxyethane; halogenated hydrocarbons such as dichloromethane, chloroform and 1,2-dichloroethane; amides such as dimethyl formamide and dimethylacetamide; sulfoxides such as dimethyl sulfoxide; sulfones such as sulfolane; and a mixed solvent thereof.

Examples of the compound represented by the general
formula (III) to be used in this reaction include carboxylic acid halides such as acetyl chloride, propionyl chloride, isobutyryl chloride, pivaloyl chloride, benzoyl chloride and cyclohexane carboxylic acid chloride; carboxylic anhydrides such as acetic anhydride and trifluoroacetic anhydride; carbonic half ester halides such as chloroformic acid methyl, chloroformic acid ethyl and chloroformic acid phenyl; carbamic acid halides such as dimethylcarbamoyl chloride; sulfonic acid halides such as methanesulf onyl chloride and p-toluenesulf onyl chloride; sulfonic anhydrides such as methanesulf onic anhydride and trifluoromethanesulf onic anhydride; and phosphoric ester halides such as dimethyl chlorophosphate. The amount of the compound represented by the general formula (III) to be used in this reaction is usually 1 molar equivalent or more, preferably from 1 to 3 molar equivalents relative to the compound represented by the general formula (I-a).

This reaction is usually carried out in the presence of a base. Examples of the base to be used in this reaction include organic bases such as triethylamine, tripropylamine, pyridine, dimethylaminopyridine and 1,8-diazabicyclo[5.4.0]-7-undecene; and inorganic bases such as sodium hydroxide, potassium hydroxide, calcium hydroxide, sodium carbonate, potassium carbonate, sodium hydrogen carbonate, calcium carbonate and sodium hydride. The
amount of the base to be used in this reaction is usually from 0.5 to 10 molar equivalents, and preferably from 1 to 5 molar equivalents relative to the compound represented by the general formula (I-a).

The reaction temperature of this reaction is usually from -30 to 180°C, preferably from -10 to 50°C, and the reaction time is usually from 10 minutes to 30 hours.

The completion of this reaction can be confirmed by sampling the reaction mixture and identifying the product by an analytic means such as TLC, HPLC, etc. After completion of the reaction, the compound represented by the general formula (I-b) can be isolated, for example, by mixing the reaction mixture with water and extracting with an organic solvent, followed by subjected to the resulting organic layer to operations such as drying and concentration.

The compound represented by the general formula (III) is a known compound, or can be prepared from a known compound.

Production Method 3

Among the present compounds, the compound represented by the general formula (I-a), i.e., the present compound wherein G is a hydrogen atom, can be also prepared by the following production method. That is, the compound represented by the general formula (I-a) can be prepared by
reacting a compound represented by the general formula (VI) with a base.

wherein $R^9$ represents a $C_{1-6}$ alkyl group (e.g., a methyl group or an ethyl group; and $R^1, R^2, Z^1, Z^2$ and $n$ are as defined above.

This reaction is usually carried out in a solvent. Examples of the solvent to be used include aromatic hydrocarbons such as benzene, toluene and xylene; ethers such as diethyl ether, diisopropyl ether, dioxane, tetrahydrofuran and dimethoxyethane; halogenated hydrocarbons such as dichloromethane, chloroform and 1,2-dichloroethane; amides such as dimethylformamide and dimethylacetamide; sulfones such as sulfolane; and a mixed solvent thereof.

Examples of the base to be used in this reaction include metal alkoxides such as potassium tert-butoxide; alkali metal hydride such as sodium hydride; and organic bases such as triethylamine, tributylamine and N,N-diisopropylethylamine. The amount of the base to be used in this reaction is usually from 1 to 10 molar equivalents, and preferably from 2 to 5 molar equivalents relative to
the compound represented by the general formula (VI).

The reaction temperature of this reaction is usually from -60 to 180°C, and preferably from -10 to 100°C, and the reaction time is usually from 10 minutes to 30 hours.

The completion of the present reaction can be confirmed by sampling the reaction mixture and identifying the product by an analytic means such as TLC, HPLC, etc. After completion of the reaction, the compound represented by the general formula (I-a) can be isolated, for example, by neutralizing the reaction mixture with an acid, mixing with water, and extracted with an organic solvent, followed by subjecting the resultant organic layer to operations such as drying and concentration.

Reference Production Method 1

The compound represented by the general formula (II) can be prepared, for example, by the following production method.

\[
\begin{align*}
\text{Q-B(OH)}_2 & \quad (V-a), \\
\text{Q-MgX}^2 & \quad (V-b), \\
\text{Q-Sn(R^3)}_3 & \quad (V-c)
\end{align*}
\]

\[\begin{array}{c}
\text{Q:} \\
\text{X}^1 \\
\text{Z}^1 \\
\end{array}
\]

\[\begin{array}{c}
\text{Z}^2 \\
\text{(Z}^2)_n \\
\end{array}
\]

wherein \(X^1\) represents a leaving group (e.g., a halogen atom such as a chlorine atom, a bromine atom or an iodine atom); \(X^2\) represents a halogen atom (e.g., a chlorine atom, a
bromine atom or an iodine atom); R_8 represents a C_{i-6} alkyl group (e.g., a methyl group or a butyl group); and R^1, R^2, R^7, Z^1, Z^2 and n are as defined above.

In this reaction, the compound represented by the general formula (IV) is subjected to coupling reaction with an organic metal reagent represented by the general formula (V-a), (V-b) or (V-c) in an amount of 1 molar equivalent or more (preferably from 1 to 3 molar equivalents) relative to the compound represented by the general formula (IV) to prepare the compound represented by the general formula (H).

The reaction using the compound represented by the general formula (V-a) is usually carried out in a solvent. Examples of the solvent to be used include aromatic hydrocarbons such as benzene and toluene; alcohols such as methanol, ethanol and propanol; ethers such as diethyl ether, diisopropyl ether, dioxane, tetrahydrofuran and dimethoxyethane; ketones such as acetone and methyl ethyl ketone; amides such as dimethylformamide and dimethylacetamide; sulfoxides such as dimethyl sulfoxide; sulfones such as sulfolane; water; and a mixed solvent thereof.

The reaction using the compound represented by the general formula (V-a) is carried out in the presence of a base. Examples of the base to be used include organic...
bases such as triethylamine, tripropylamine, pyridine, dimethylaniline, dimethylaminopyridine and 1,8-diazabicyclo [5.4.0] -7-undecene; and inorganic bases such as sodium hydroxide, potassium hydroxide, calcium hydroxide, sodium carbonate, potassium carbonate, sodium hydrogen carbonate, calcium carbonate, cesium carbonate and potassium phosphate. The amount of the base to be used is usually from 0.5 to 10 molar equivalents, and preferably from 1 to 5 molar equivalents relative to the compound represented by the general formula (IV).

Further, the reaction using the compound represented by the general formula (V-a) is carried out in the presence of a catalyst. Examples of the catalyst to be used include palladium catalysts such as tetrakis (triphenylphosphine) palladium and dichlorobis (triphenylphosphine) palladium. The amount of the catalyst to be used is usually from 0.001 to 0.5 molar equivalent, and preferably from 0.01 to 0.2 molar equivalent relative to the compound represented by the general formula (IV). It is preferred to add a quaternary ammonium salt to the reaction using the compound represented by the general formula (V-a). Examples of the quaternary ammonium salt to be used include tetrabutylammonium bromide.

The reaction temperature of the reaction using the compound represented by the general formula (V-a) is...
usually from 20 to 180°C, and preferably from 60 to 150°C. The reaction time is usually from 30 minutes to 100 hours. The completion of the present reaction can be confirmed by sampling the reaction mixture and identifying the product by an analytic means such as TLC, HPLC, etc. After completion of the reaction, the compound represented by the general formula (II) can be isolated, for example, by mixing the reaction mixture with water and extracting with an organic solvent, followed by subjecting the resultant organic layer to operations such as drying and concentration.

The reaction using the compound represented by the general formula (V-b) is carried out in a solvent. Examples of the solvent to be used include aromatic hydrocarbons such as benzene and toluene; ethers such as diethyl ether, diisopropyl ether, dioxane, tetrahydrofuran and dimethoxyethane; and a mixed solvent thereof.

The reaction using the compound represented by the general formula (V-b) is carried out in the presence of a catalyst. Examples of the catalyst to be used include nickel catalysts such as dichlorobis (1,3-diphenylphosphino) propane nickel and dichlorobis (triphenylphosphine) nickel; and palladium catalysts such as tetrakis (triphenylphosphine) palladium and dichlorobis (triphenylphosphine) palladium. The amount of
the catalyst to be used is usually from 0.001 to 0.5 molar equivalent, and preferably from 0.01 to 0.2 molar equivalent relative to the compound represented by the general formula (IV).

The reaction temperature of the reaction using the compound represented by the general formula (V-b) is usually from -80 to 180°C, and preferably from -30 to 150°C, and the reaction time is usually from 30 minutes to 100 hours. The completion of the present reaction can be confirmed by sampling the reaction mixture and identifying the product by an analytic means such as TLC, HPLC, etc. After completion of the reaction, the compound represented by the general formula (II) can be isolated, for example, by mixing the reaction mixture with water and extracting with an organic solvent, followed by subjecting the resultant organic layer to operations such as drying and concentration.

The reaction using the compound represented by the general formula (V-c) is carried out in a solvent. Examples of the solvent to be used include aromatic hydrocarbons such as benzene and toluene; ethers such as diethyl ether, diisopropyl ether, dioxane, tetrahydrofuran and dimethoxyethane; halogenated hydrocarbons such as chloroform and 1,2-dichloroethane; amides such as dimethyl formamide and dimethylacetamide; and a mixed
solvent thereof.

The reaction using the compound represented by the general formula (V-c) is carried out in the presence of a catalyst. Examples of the catalyst to be used include palladium catalysts such as tetrakis (triphenylphosphine) palladium and dichlorobis (triphenylphosphine) palladium. The amount of the catalyst to be used is usually from 0.001 to 0.5 molar equivalent, and preferably from 0.01 to 0.2 molar equivalent relative to the compound represented by the general formula (IV).

The reaction temperature of the reaction using the compound represented by the general formula (V-c) is usually from -80 to 180°C, and preferably from -30 to 150°C, and the reaction time is usually from 30 minutes to 100 hours. The completion of the present reaction can be confirmed by sampling the reaction mixture and identifying the product by an analytic means such as TLC, HPLC, etc. After completion of the reaction, the compound represented by the general formula (II) can be isolated, for example, by mixing the reaction mixture with water and extracting with an organic solvent, followed by subjecting the resultant organic layer to operations such as drying and concentration.

The compound represented by the general formula (II) is prepared, for example, in accordance with a method

The organic metal reagent represented by the general formula (V-a), (V-b) or (V-c) can be a known compound, or can be prepared from a known compound in accordance with a known method.

The compound represented by the general formula (IV) is a known compound, or can be prepared from a known compound. For example, it can be prepared by a method described in *J. Heterocycl. Chem.*, Vol. 33, pp. 1579-1582 (1996), or in accordance with methods similar thereto.

Reference Production Method 2

The compound represented by the general formula (VI) can be prepared, for example, by the following production method.

\[
(VII) \quad (VIII) \quad (VI)
\]

wherein \(X^3\) represents a halogen atom (e.g., a chlorine atom, a bromine atom or an iodine atom); and \(R^1, R^2, R^9, Z^1, Z^2\) and \(n\) are as defined above.

This reaction is usually carried out in a solvent.

Examples of the solvent to be used include nitriles such as acetonitrile; ketones such as acetone; aromatic hydrocarbons such as benzene and toluene; ethers such as diethyl ether, diisopropyl ether, dioxane, tetrahydrofuran
and dimethoxyethane; halogenated hydrocarbons such as dichloromethane, chloroform and 1,2-dichloroethane; amides such as dimethylformamide and dimethylacetamide; sulfones such as sulfolane; and a mixed solvent thereof.

This reaction is usually carried out by reacting the compound represented by the general formula (VII) with the compound represented by the general formula (VIII) in the presence of a base. Examples of the base to be used in this reaction include organic bases such as triethylamine, tripropylamine, pyridine, dimethylaminopyridine, 1,8-diazabicyclo[5.4.0]-7-undecene and 1,4-diazabicyclo[2.2.2]octane; and inorganic bases such as sodium hydroxide, potassium hydroxide, calcium hydroxide, sodium carbonate, potassium carbonate, sodium hydrogen carbonate, calcium carbonate and sodium hydride.

In this reaction, the amount of the compound represented by the general formula (VIII) is usually 1 molar equivalent or more, and preferably from 1 to 3 molar equivalents relative to the compound represented by the general formula (VII). The amount of the base to be used is usually from 0.5 to 10 molar equivalents, and preferably from 1 to 5 molar equivalents.

The reaction temperature of this reaction is usually from -30 to 180°C, and preferably from -10 to 50°C, and the reaction time is usually from 10 minutes to 30 hours.
The completion of the present reaction can be confirmed by sampling the reaction mixture and identifying the product by an analytic means such as TLC, HPLC, etc. After completion of the reaction, the compound represented by the general formula (VI) can be isolated, for example, by mixing the reaction mixture with water and extracted with an organic solvent, followed by subjecting the resultant organic layer to operations such as drying and concentration.

The compound represented by the general formula (VII) is prepared by reacting a compound represented by the general formula (IX):

\[
\text{(IX)}
\]

wherein \(Z^1, Z^2\) and \(n\) are as defined above, with a halogenating agent (e.g., thionyl chloride, thionyl bromide, phosphorus oxychloride and oxalyl chloride).

The compound represented by the general formula (IX) is a known compound, or can be prepared from a known compound. For example, it is prepared by the methods described in Organic Syntheses Collective, vol. 3, pp. 557-560 (1955), J. Am. Chem. Soc, Vol. 63, pp. 2643-2644 (1941) or International Publication No. 2006/056282 Pamphlet (WO2006/056282), or in accordance with methods similar.
Examples of the compound represented by the general formula (IX) include 2,4,6-trimethylphenylacetic acid, 2,4,β-triethylphenylacetic acid, 2,6-diethyl-4-methylphenylacetic acid, 2-ethylphenylacetic acid, 2-ethyl-4-methylphenylacetic acid, 2-ethyl-4,6-dimethylphenylacetic acid, 2,4-diethylphenylacetic acid, 2,β-diethylphenylacetic acid and 2,4-diethyl-β-methylphenylacetic acid.

The compound represented by the general formula (VIII) is a known compound, or can be prepared from a known compound.

The respective compounds prepared by the Production Methods 1 to 3 and Reference Production Methods 1 and 2 can also be isolated and purified by a known method such as concentration, concentration under reduced pressure, extraction, solvent substitution, crystallization, recrystallization and chromatography, in some cases.

Specific examples of the compound represented by the general formula (I) to be used as the active ingredient of the herbicidal composition of the present invention are shown below.
The pyridazinone compounds represented by the general formulas (I_{25}) to (I_{30}), wherein Ar represents a 2-ethylphenyl group; and G represents a hydrogen atom, an acetyl group, a trifluoroacetyl group, a propionyl group, a butyryl group, an isobutyryl group, an isovaleryl group, a pivaloyl group, a cyclohexylcarbonyl group, a benzoyl group, a benzylcarbonyl group, a methoxycarbonyl group, an ethoxycarbonyl group, a phenoxycarbonyl group, a dimethylaminocarbonyl group, a methanesulfonl group, a trifluoromethanesulfonl group, a benzenesulfonl group or a p-toluenesulfonl group.

The pyridazinone compounds represented by the general formulas (I_{1}) to (I_{30}), wherein Ar represents a 2-propylphenyl group; and G represents a hydrogen atom, an acetyl group, a trifluoroacetyl group, a propionyl group, a butyryl group, an isobutyryl group, an isovaleryl group, a pivaloyl group, a cyclohexylcarbonyl group, a benzoyl group, a benzylcarbonyl group, a methoxycarbonyl group, an ethoxycarbonyl group, a phenoxycarbonyl group, a dimethylaminocarbonyl group, a methanesulfonl group, a trifluoromethanesulfonl group, a benzenesulfonl group or a p-toluenesulfonl group.
pivaloyl group, a cyclohexylcarbonyl group, a benzoyl group, a benzylcarbonyl group, a methoxycarbonyl group, an ethoxycarbonyl group, a phenoxy carbonyl group, a dimethylaminocarbonyl group, a methanesulfonyl group, a trifluoromethanesulfonyl group, a benzenesulfonyl group or a p-toluenesulfonyl group.

3) The pyridazinone compounds represented by the general formulas (I) to (I), wherein Ar represents a 2,4-dimethylphenyl group; and G represents a hydrogen atom, an acetyl group, a trifluoroacetyl group, a propionyl group, a butyryl group, an isobutyryl group, an isovaleryl group, a pivaloyl group, a cyclohexylcarbonyl group, a benzoyl group, a benzylcarbonyl group, a methoxycarbonyl group, an ethoxycarbonyl group, a phenoxy carbonyl group, a dimethylaminocarbonyl group, a methanesulfonyl group, a trifluoromethanesulfonyl group, a benzenesulfonyl group or a p-toluenesulfonyl group.

4) The pyridazinone compounds represented by the general formulas (I) to (I), wherein Ar represents a 2,6-dimethylphenyl group; and G represents a hydrogen atom, an acetyl group, a trifluoroacetyl group, a propionyl group, a butyryl group, an isobutyryl group, an isovaleryl group, a pivaloyl group, a cyclohexylcarbonyl group, a benzoyl group, a benzylcarbonyl group, a methoxycarbonyl group, an ethoxycarbonyl group, a phenoxy carbonyl group, a
dimethylaminocarbonyl group, a methanesulf onyl group, a trifluoromethanesulf onyl group, a benzenesulf onyl group or a p-toluencesulf onyl group.

5) The pyridazinone compounds represented by the general formulas (I<sup>1</sup>) to (I<sup>30</sup>), wherein Ar represents a 2-ethyl-4-methylphenyl group; and G represents a hydrogen atom, an acetyl group, a trifluoroacetyl group, a propionyl group, a butyryl group, an isobutyryl group, an isovaleryl group, a pivaloyl group, a cyclohexylcarbonyl group, a benzoyl group, a benzylcarbonyl group, a methoxycarbonyl group, an ethoxycarbonyl group, a phenoxy carbonyl group, a dimethylaminocarbonyl group, a methanesulf onyl group, a trifluoromethanesulf onyl group, a benzenesulf onyl group or a p-toluencesulf onyl group.

6) The pyridazinone compounds represented by the general formulas (I<sup>1</sup>) to (I<sup>30</sup>), wherein Ar represents a 2-ethyl-6-methylphenyl group; and G represents a hydrogen atom, an acetyl group, a trifluoroacetyl group, a propionyl group, a butyryl group, an isobutyryl group, an isovaleryl group, a pivaloyl group, a cyclohexylcarbonyl group, a benzoyl group, a benzylcarbonyl group, a methoxycarbonyl group, an ethoxycarbonyl group, a phenoxy carbonyl group, a dimethylaminocarbonyl group, a methanesulf onyl group, a trifluoromethanesulf onyl group, a benzenesulf onyl group or a p-toluencesulf onyl group.
7) The pyridazinone compounds represented by the general formulas (I) to (III), wherein Ar represents a 2,6-diethylphenyl group; and G represents a hydrogen atom, an acetyl group, a trifluoroacetyl group, a propionyl group, a butyryl group, an isobutryl group, an isovaleryl group, a pivaloyl group, a cyclohexylcarbonyl group, a benzoyl group, a benzylcarbonyl group, a methoxycarbonyl group, an ethoxycarbonyl group, a phenoxy carbonyl group, a dimethylaminocarbonyl group, a methanesulfonyl group, a trifluoromethanesulfonyl group, a benzenesulfonyl group or a p-toluenesulfonyl group.

8) The pyridazinone compounds represented by the general formulas (I) to (III), wherein Ar represents a 2,4,6-trimethylphenyl group; and G represents a hydrogen atom, an acetyl group, a trifluoroacetyl group, a propionyl group, a butyryl group, an isobutryl group, an isovaleryl group, a pivaloyl group, a cyclohexylcarbonyl group, a benzoyl group, a benzylcarbonyl group, a methoxycarbonyl group, an ethoxycarbonyl group, a phenoxy carbonyl group, a dimethylaminocarbonyl group, a methanesulfonyl group, a trifluoromethanesulfonyl group, a benzenesulfonyl group or a p-toluenesulfonyl group.

9) The pyridazinone compounds represented by the general formulas (I) to (III), wherein Ar represents a 2-ethyl-4,6-dimethylphenyl group; and G represents a hydrogen atom, an
acetyl group, a trifluoroacetyl group, a propionyl group, a butyryl group, an isobutyryl group, an isovaleryl group, a pivaloyl group, a cyclohexylcarbonyl group, a benzoyl group, a benzylicarbonyl group, a methoxycarbonyl group, an ethoxycarbonyl group, a phenoxy carbonyl group, a dimethylaminocarbonyl group, a methanesulfonyl group, a trifluoromethanesulfonyl group, a benzenesulfonyl group or a p-toluenesulfonyl group.

10) The pyridazinone compounds represented by the general formulas (I) to (I₃₀), wherein Ar represents a 2,6-diethyl-4-methylphenyl group; and G represents a hydrogen atom, an acetyl group, a trifluoroacetyl group, a propionyl group, a butyryl group, an isobutyryl group, an isovaleryl group, a pivaloyl group, a cyclohexylcarbonyl group, a benzoyl group, a benzylicarbonyl group, a methoxycarbonyl group, an ethoxycarbonyl group, a phenoxy carbonyl group, a dimethylaminocarbonyl group, a methanesulfonyl group, a trifluoromethanesulfonyl group, a benzenesulfonyl group or a p-toluenesulfonyl group.

11) The pyridazinone compounds represented by the general formulas (I) to (I₃₀), wherein Ar represents a 2,4,6-triethylphenyl group; and G represents a hydrogen atom, an acetyl group, a trifluoroacetyl group, a propionyl group, a butyryl group, an isobutyryl group, an isovaleryl group, a pivaloyl group, a cyclohexylcarbonyl group, a benzoyl group,
a benzylcarbonyl group, a methoxycarbonyl group, an ethoxycarbonyl group, a phenoxy carbonyl group, a dimethylaminocarbonyl group, a methanesulf onyl group, a trifluoromethanesulf onyl group, a benzenesulf onyl group or a p-toluenesulf onyl group.

12) The pyridazinone compounds represented by the general formulas (I) to (I₃₀), wherein Ar represents a 2,4-diethylphenyl group; and G represents a hydrogen atom, an acetyl group, a trifluoroacetyl group, a propionyl group, a butyryl group, an isobutyryl group, an isovaleryl group, a pivaloyl group, a cyclohexylcarbonyl group, a benzoyl group, a benzylcarbonyl group, a methoxycarbonyl group, an ethoxycarbonyl group, a phenoxy carbonyl group, a dimethylaminocarbonyl group, a methanesulf onyl group, a trifluoromethanesulf onyl group, a benzenesulf onyl group or a p-toluenesulf onyl group.

13) The pyridazinone compounds represented by the general formulas (I) to (I₃₀), wherein Ar represents a 2,4-diethyl-6-methylphenyl group; and G represents a hydrogen atom, an acetyl group, a trifluoroacetyl group, a propionyl group, a butyryl group, an isobutyryl group, an isovaleryl group, a pivaloyl group, a cyclohexylcarbonyl group, a benzoyl group, a benzylcarbonyl group, a methoxycarbonyl group, an ethoxycarbonyl group, a phenoxy carbonyl group, a dimethylaminocarbonyl group, a methanesulf onyl group, a
trifluoromethanesulfonyl group, a benzenesulfonyl group or a p-toluenesulfonyl group.

Hereinafter, the present invention will be explained in more detail by Production Examples, Formulation Examples and Test Examples. However, the present invention is not limited thereto.

In Production Examples, room temperature usually represents from 10 to 30°C. $^1$H NMR denoted a proton nuclear magnetic resonance spectrum, tetramethylsilane was used as the internal standard, and the chemical shift (δ) was represented by ppm.

The symbols used in Production Examples have the following meanings.

$\text{CDCl}_3$: chloroform-$d$, $s$: singlet, $d$: doublet, $t$: triplet, $q$: quartet, $dt$: doublet triplet, $dq$: doublet quartet, $m$: multiplet, $br.$: broad, $J$: coupling constant, $\text{Me}$: methyl group, $\text{Et}$: ethyl group, $\text{Pr}$: propyl group, $i$-$\text{Pr}$: isopropyl group, $t$-$\text{Bu}$: tertiary-butyl group, $\text{c-Hex}$: cyclohexyl group, $\text{Ph}$: phenyl group

Production Example 1

4-(2-Ethylphenyl)-5-hydroxy-2-methyl-3-(2H)-pyridazinone (compound I-a-1)

To 3.193 g of 4-(2-ethylphenyl)-5-methoxy-2-methyl-3-(2H)-pyridazinone (compound II-1) were added 50 mL of water, 4.657 g of potassium hydroxide (85% content) and 5
mL of 1,4-dioxane, and the mixture was stirred with heating under reflux for 36 hours. After cooling, concentrated hydrochloric acid was added to the reaction mixture to make it acidic, and then 10 mL of water and 100 mL of ethyl acetate were added thereto. Insoluble matters in the reaction mixture were filtered off, and the filtrate was separated. The organic layer was washed with water and then saturated brine. The organic layer was dried over anhydrous magnesium sulfate, and the solvent was distilled off. The resultant solid was washed with an ethyl acetate-hexane mixed solvent (1:2) to obtain 2.050 g of the titled compound as colorless crystals.

The compounds prepared in accordance with Production Example 1 together with the compound I-a-1 are shown in Table 1.

The compound represented by the general formula (I-a):
Table 1

<table>
<thead>
<tr>
<th>Compounds</th>
<th>R¹</th>
<th>R²</th>
<th>Z¹</th>
<th>(Z²)ₙ</th>
<th>Melting point/°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-a-1</td>
<td>Me</td>
<td>H</td>
<td>Et</td>
<td>-</td>
<td>218-220</td>
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<td>I-a-2</td>
<td>Et</td>
<td>H</td>
<td>Et</td>
<td>-</td>
<td>190-192</td>
</tr>
<tr>
<td>I-a-3</td>
<td>i-Pr</td>
<td>H</td>
<td>Et</td>
<td>-</td>
<td>226-227</td>
</tr>
<tr>
<td>I-a-4</td>
<td>MeOCH₂CH₂</td>
<td>H</td>
<td>Et</td>
<td>-</td>
<td>137-139</td>
</tr>
<tr>
<td>I-a-5</td>
<td>Me</td>
<td>H</td>
<td>Pr</td>
<td>-</td>
<td>210-211</td>
</tr>
<tr>
<td>I-a-6</td>
<td>Me</td>
<td>H</td>
<td>Me</td>
<td>6-Me</td>
<td>267-271</td>
</tr>
<tr>
<td>I-a-7</td>
<td>Me</td>
<td>H</td>
<td>Et</td>
<td>6-Me</td>
<td>239-242</td>
</tr>
<tr>
<td>I-a-8</td>
<td>Me</td>
<td>H</td>
<td>Et</td>
<td>6-Et</td>
<td>247-249</td>
</tr>
<tr>
<td>I-a-9</td>
<td>Me</td>
<td>H</td>
<td>Me</td>
<td>4-Me</td>
<td>219-220</td>
</tr>
<tr>
<td>I-a-10</td>
<td>Me</td>
<td>H</td>
<td>Me</td>
<td>4-Me, 6-Me</td>
<td>272-275</td>
</tr>
<tr>
<td>I-a-11</td>
<td>Et</td>
<td>H</td>
<td>Me</td>
<td>4-Me, 6-Et</td>
<td>&gt;300</td>
</tr>
<tr>
<td>I-a-12</td>
<td>Me</td>
<td>H</td>
<td>Et</td>
<td>4-Me, 6-Et</td>
<td>254-255</td>
</tr>
</tbody>
</table>

Production Example 2

4- (2, 6-Diethyl-4-methylphenyl) -5-hydroxy-2, 6-dimethyl-3 (2H) -pyridazinone (compound I-a-14)

A solution of potassium tert-butoxide in 13 mL of tetrahydrofuran (1 mol/L) was stirred at room temperature under a nitrogen atmosphere, to which a solution of 1.9 g of ethyl 2-[(2- (2, 6-diethyl-4-methylphenylacetyl) -2- methylhydrazono] propanoate (compound VI-2) in 55 mL of toluene was added dropwise over one hour, followed by stirring at room temperature for 30 minutes. Then, the reaction mixture was concentrated under reduced pressure. Ice water (30 mL) was added to the resultant residue, and the mixture was extracted with tert-butyldimethyl ether (20 mL x 2). Next, 1.6 g of 35% hydrochloric acid was added to
the aqueous layer to make it acidic, and the mixture was extracted with ethyl acetate (20 mL x 3). The ethyl acetate extracts were combined, washed with saturated brine (20 mL x 2), dried over anhydrous magnesium sulfate, and concentrated under reduced pressure. The resultant residue was subjected to silica gel column chromatography (ethyl acetate : hexane = 1 : 3) to obtain 0.76 g of solid. The solid was washed with cold hexane, and air dried to obtain 0.59 g of the titled compound as a white powder.

The compounds prepared in accordance with Production Example 2 together with the compound I-a-14 are shown in Table 2.

The compound represented by the general formula (I-a):
Table 2

<table>
<thead>
<tr>
<th>Compounds</th>
<th>R¹</th>
<th>R²</th>
<th>Z¹</th>
<th>(Z²)n</th>
<th>Melting point/°C</th>
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<tbody>
<tr>
<td>I-a-13</td>
<td>Me</td>
<td>Me</td>
<td>Me</td>
<td>4-Me, 6-Me</td>
<td>199-201</td>
</tr>
<tr>
<td>I-a-14</td>
<td>Me</td>
<td>Me</td>
<td>Et</td>
<td>4-Me, 6-Et</td>
<td>205-206</td>
</tr>
<tr>
<td>I-a-15</td>
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<td>Et</td>
<td>-</td>
<td>171-172</td>
</tr>
<tr>
<td>I-a-16</td>
<td>Me</td>
<td>Me</td>
<td>Et</td>
<td>4-Me</td>
<td>187-188</td>
</tr>
<tr>
<td>I-a-17</td>
<td>Me</td>
<td>Me</td>
<td>Et</td>
<td>4-Et, 6-Et</td>
<td>188-190</td>
</tr>
<tr>
<td>I-a-18</td>
<td>Me</td>
<td>Me</td>
<td>Et</td>
<td>4-Me, 6-Me</td>
<td>176-177</td>
</tr>
<tr>
<td>I-a-19</td>
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<td>Et</td>
<td>Et</td>
<td>4-Me, 6-Et</td>
<td>194-195</td>
</tr>
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<td>I-a-20</td>
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<td>Et</td>
<td>Et</td>
<td>4-Me</td>
<td>148-149</td>
</tr>
<tr>
<td>I-a-21</td>
<td>Me</td>
<td>Et</td>
<td>Et</td>
<td>4-Me, 6-Me</td>
<td>188-189</td>
</tr>
<tr>
<td>I-a-22</td>
<td>Me</td>
<td>Et</td>
<td>Me</td>
<td>4-Me, 6-Me</td>
<td>210-211</td>
</tr>
<tr>
<td>I-a-23</td>
<td>Me</td>
<td>i-Pr</td>
<td>Et</td>
<td>4-Me, 6-Et</td>
<td>208-210</td>
</tr>
<tr>
<td>I-a-24</td>
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<td>Pr</td>
<td>Et</td>
<td>4-Me, 6-Et</td>
<td>175-176</td>
</tr>
<tr>
<td>I-a-25</td>
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<td>Et</td>
<td>Et</td>
<td>4-Me, 6-Et</td>
<td>170-171</td>
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<tr>
<td>I-a-26</td>
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<td>Pr</td>
<td>Et</td>
<td>4-Me, 6-Et</td>
<td>174-175</td>
</tr>
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<td>I-a-27</td>
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<td>Me</td>
<td>Et</td>
<td>4-Et</td>
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<td>I-a-28</td>
<td>Me</td>
<td>Et</td>
<td>Et</td>
<td>4-Et</td>
<td>163-164</td>
</tr>
<tr>
<td>I-a-29</td>
<td>Me</td>
<td>Me</td>
<td>Et</td>
<td>4-Et, 6-Me</td>
<td>168-169</td>
</tr>
<tr>
<td>I-a-30</td>
<td>Me</td>
<td>Me</td>
<td>Et</td>
<td>6-Et</td>
<td>187-188</td>
</tr>
</tbody>
</table>

Production Example 3

5-Benzoyloxy-4- (2-ethylphenyl) -2-methyl-3 (2H) -pyridazinone
(compound I-b-1)

To 0.326 g of the compound I-a-1 prepared in Production Example 1 were added 12 mL of tetrahydrofuran and 0.40 mL of triethylamine. The mixture was ice-cooled, and then 0.25 mL of benzoyl chloride was added thereto.

The mixture was stirred with ice-cooling for 10 minutes, followed by stirring at room temperature for 3 hours. To the reaction mixture was added with 30 mL of water, and the
mixture was extracted twice with 30 mL of ethyl acetate. The extracts were combined, washed with saturated brine, and dried over anhydrous magnesium sulfate. The solvent was distilled off. The residue was subjected to silica gel column chromatography (ethyl acetate : hexane = 1:2 → 2:1) to obtain 0.463 g of the titled compound as colorless oil.

The compounds prepared in accordance with Production Example 3 together with the compound I-b-1 are shown in Table 3.

The compound represented by the general formula (I-b):

(I-b)
### Table 3

<table>
<thead>
<tr>
<th>No.</th>
<th>( R^1 )</th>
<th>( R^2 )</th>
<th>( Z^1 )</th>
<th>( (Z^2)_n )</th>
<th>( G^3 )</th>
<th>Melting point, °C</th>
</tr>
</thead>
<tbody>
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<td>I-b-1</td>
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<td>H</td>
<td>Et</td>
<td></td>
<td>COPh</td>
<td>*</td>
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<td>Me</td>
<td>H</td>
<td>Et</td>
<td></td>
<td>COMe</td>
<td>69-70</td>
</tr>
<tr>
<td>I-b-3</td>
<td>Me</td>
<td>H</td>
<td>Et</td>
<td></td>
<td>COEt</td>
<td>*</td>
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<tr>
<td>I-b-4</td>
<td>Me</td>
<td>H</td>
<td>Et</td>
<td></td>
<td>COi-Pr</td>
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</tr>
<tr>
<td>I-b-5</td>
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<td>H</td>
<td>Et</td>
<td></td>
<td>Cot-Bu</td>
<td>56-59</td>
</tr>
<tr>
<td>I-b-6</td>
<td>Me</td>
<td>H</td>
<td>Et</td>
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<td>Coc-Hex</td>
<td>*</td>
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<td>H</td>
<td>Et</td>
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<td>81-82</td>
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<td>I-b-8</td>
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<td>CONMe₂</td>
<td>*</td>
</tr>
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<td>I-b-9</td>
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<td>H</td>
<td>Et</td>
<td></td>
<td>SO₂Me</td>
<td>*</td>
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<td>Pr</td>
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<td>Et</td>
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<td>Et</td>
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<td>COMe</td>
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<td>Et</td>
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<td>COMe</td>
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<td>Me</td>
<td>Et</td>
<td>4-Me, 6-Me</td>
<td>COMe</td>
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</tr>
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<td>I-b-23</td>
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<td>Me</td>
<td>Et</td>
<td>4-Me, 6-Et</td>
<td>COEt</td>
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<td>Et</td>
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<td>COMe</td>
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<td>Et</td>
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<td>Et</td>
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<td>COMe</td>
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<td>Et</td>
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<td>Et</td>
<td>4-Me, 6-Me</td>
<td>CO₂Et</td>
<td>65-67</td>
</tr>
</tbody>
</table>
Regarding the compounds with asterisk (*) in the column of boiling point in Table 3, the $^1$H NMR data are shown below.

**Compound I-b-1**

1. $^1$H NMR (CDCl$_3$) δ ppm: 1.14 (3H, t, J = 7.7Hz), 2.45-2.62 (2H, m), 3.88 (3H, s), 7.09-7.12 (IH, m), 7.15-7.20 (IH, m), 7.28-7.30 (2H, m), 7.37-7.42 (2H, m), 7.55-7.60 (IH, m), 7.81-7.84 (2H, m), 7.95 (IH, s).

**Compound I-b-3**

2. $^1$H NMR (CDCl$_3$) δ ppm: 0.94 (3H, t, J = 7.6Hz), 1.13 (3H, t, J = 7.7Hz), 2.27 (2H, dq, J = 1.4, 7.6Hz), 2.38-2.56 (2H, m), 3.84 (3H, s), 7.00-7.03 (IH, m), 7.18-7.23 (IH, m), 7.30-7.35 (2H, m), 7.75 (IH, s).

**Compound I-b-6**

3. $^1$H NMR (CDCl$_3$) δ ppm: 1.13 (3H, t, J = 7.7Hz), 1.10-1.22 (5H, m), 1.5-1.7 (5H, m), 2.28 (IH, br.), 2.38-2.55 (2H, m), 3.84 (3H, s), 6.99-7.02 (IH, m), 7.17-7.22 (IH, m), 7.29-7.36 (2H, m), 7.72 (IH, s).

**Compound I-b-8**

4. $^1$H NMR (CDCl$_3$) δ ppm: 1.11 (3H, t, J = 7.7Hz), 2.40-2.57 (2H, m), 2.64 (3H, s), 2.85 (3H, s), 3.83 (3H, s), 7.05-7.08 (IH, m), 7.19-7.24 (IH, m), 7.30-7.36 (2H, m), 7.95 (IH, s).

**Compound I-b-9**

5. $^1$H NMR (CDCl$_3$) δ ppm: 1.18 (3H, t, J = 7.6Hz), 2.43-2.57
A typical production example of the compound represented by the general formula (II) is shown in Reference Example 1.

Reference Example 1

4- (2-Ethylphenyl) -5-methoxy-2-methyl-3 (2H) -pyridazinone (compound II-1)

To a mixture of 2.516 g of 4-chloro-5-methoxy-2-methyl-3 (2H) -pyridazinone, 2.575 g of 2-ethylphenylboronic acid and 3.333 g of sodium carbonate were added 30 mL of 1,4-dioxane and 20 mL of water. Further, 2.417 g of tetrabutylammonium bromide and 0.657 g of tetrakis (triphenylphosphine) palladium were added thereto, and the mixture was then stirred with heating under reflux for 17 hours under a nitrogen atmosphere. The reaction mixture was cooled, 50 mL of water was added thereto, and extracted with 100 mL, followed by 30 mL of ethyl acetate. The extracts were combined, washed with saturated brine, and dried over anhydrous magnesium sulfate. The solvent was distilled off. The resultant residue was washed with an ethyl acetate-hexane mixture solvent (1:2) to obtain 3.238 g of the titled compound as yellow crystals.

The compounds represented by the general formula (II) prepared in accordance with Reference Example 1 together
with the compound II-1 are shown in Table 4.

The compound represented by the general formula (II):

![Chemical Structure](image)

Table 4

<table>
<thead>
<tr>
<th>No.</th>
<th>R¹</th>
<th>R²</th>
<th>Z¹</th>
<th>(Z²)ₙ</th>
<th>R⁷</th>
<th>Melting point/°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>II-1</td>
<td>Me</td>
<td>H</td>
<td>Et</td>
<td>-</td>
<td>Me</td>
<td>127-130</td>
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<tr>
<td>II-2</td>
<td>Et</td>
<td>H</td>
<td>Et</td>
<td>-</td>
<td>Me</td>
<td>*</td>
</tr>
<tr>
<td>II-3</td>
<td>i-Pr</td>
<td>H</td>
<td>Et</td>
<td>-</td>
<td>Me</td>
<td>121-123</td>
</tr>
<tr>
<td>II-4</td>
<td>MeOCH₂CH₂</td>
<td>H</td>
<td>Et</td>
<td>-</td>
<td>Me</td>
<td>*</td>
</tr>
<tr>
<td>II-5</td>
<td>Me</td>
<td>H</td>
<td>Pr</td>
<td>-</td>
<td>Me</td>
<td>86-88</td>
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<tr>
<td>II-6</td>
<td>Me</td>
<td>H</td>
<td>Me</td>
<td>6-Me</td>
<td>Me</td>
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<td>H</td>
<td>Et</td>
<td>6-Me</td>
<td>Me</td>
<td>*</td>
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<td>II-8</td>
<td>Me</td>
<td>H</td>
<td>Et</td>
<td>6-Et</td>
<td>Me</td>
<td>165-166</td>
</tr>
<tr>
<td>II-9</td>
<td>Me</td>
<td>H</td>
<td>Me</td>
<td>4-Me</td>
<td>Me</td>
<td>141-142</td>
</tr>
<tr>
<td>II-10</td>
<td>Me</td>
<td>H</td>
<td>Me</td>
<td>4-Me, 6-Me</td>
<td>Me</td>
<td>186-192</td>
</tr>
<tr>
<td>II-11</td>
<td>Et</td>
<td>H</td>
<td>Me</td>
<td>4-Me, 6-Me</td>
<td>Me</td>
<td>100-102</td>
</tr>
<tr>
<td>II-12</td>
<td>Me</td>
<td>H</td>
<td>Et</td>
<td>4-Me, 6-Et</td>
<td>Me</td>
<td>147-149</td>
</tr>
</tbody>
</table>

Regarding the compounds with asterisk (*) in the column of boiling point in Table 4, the ¹H NMR data are shown below.

**Compound II-2:**

¹H NMR (CDCl₃) δ ppm: 1.12 (3H, t, J = 7.7Hz), 1.39 (3H, t, J = 7.3Hz), 2.40-2.53 (2H, m), 3.81 (3H, s), 4.19-4.30 (2H, m), 7.10 (IH, d, J = 7.6Hz), 7.21-7.26 (IH, m), 7.30-7.33
(2H, m), 7.88 (IH, s).

Compound II-4:

$^1$H NMR (CDCl$_3$) $\delta$ ppm: 1.12 (3H, t, $J = 7.7$Hz), 2.38-2.52 (2H, m), 3.38 (3H, s), 3.82 (3H, s), 3.77-3.84 (2H, m), 4.40 (2H, t, $J = 5.6$Hz), 7.11 (IH, d, $J = 7.6$Hz), 7.21-7.26 (IH, m), 7.30-7.34 (2H, m), 7.90 (IH, s).

Compound II-7:

$^1$H NMR (CDCl$_3$) $\delta$ ppm: 1.08 (3H, t, $J = 7.7$Hz), 2.07 (3H, s), 2.30-2.45 (2H, m), 3.81 (3H, s), 3.82 (3H, s), 7.10 (IH, d, $J = 7.6$Hz), 7.13 (IH, d, $J = 7.6$Hz), 7.24 (IH, t, $J = 7.6$Hz), 7.85 (IH, s).

A typical production example of the compound represented by the general formula (V-a) is shown by Reference Example 2.

Reference Example 2

2-Propylphenylboronic acid

In a reaction vessel, 15.5 mL of butyl lithium (1.6 mol/L in hexane solution) was placed, and cooled in a dry ice-acetone bath. A solution of 4.412 g of 2-propylbromobenzene in 45 mL of tetrahydrofuran was added dropwise into the reaction vessel at $-70^\circ$C under a nitrogen atmosphere over 85 minutes. The resultant mixture was stirred at $-70^\circ$C for 30 minutes, and to the mixture was added dropwise 3.75 mL of trimethyl borate at $-70^\circ$C over 15 minutes. The mixture was stirred at $-70^\circ$C for one hour,
taken out of the dry ice-acetone bath, and stirred at room temperature for 18 hours. To the reaction mixture was added dropwise 33 mL of 2N hydrochloric acid over 10 minutes, and the mixture was then stirred for 4 hours at room temperature. To the resultant mixture was added 20 mL of water, and the mixture was extracted with 70 mL of ethyl acetate. The extract was washed with saturated brine, and dried over anhydrous magnesium sulfate. The solvent was distilled off. The residue was subjected to silica gel column chromatography (ethyl acetate : hexane = 1:2 → 2:1) to obtain 1.641 g of the titled compound as colorless crystals.

\[ ^1H \text{NMR (CDCl}_3 \text{)} \delta \text{ ppm: 1.01 (3H, t, J = 7.4Hz), 1.69-1.79 (2H, m), 3.15-3.20 (2H, m), 4.0-6.0 (2H, br.), 7.28-7.33 (2H, m), 7.47 (1H, dt, J = 1.5, 7.6Hz), 8.20-8.23 (1H, m).} \]

The compounds shown by the following general formula (V-a) were prepared in accordance with Reference Example 2.

2-Ethyl-6-methylphenylboronic acid: mp 90 to 91°C

\[ ^1H \text{NMR (CDCl}_3 \text{)} \delta \text{ ppm: 1.22 (3H, t, J = 7.6Hz), 2.35 (3H, s), 2.64 (2H, q, J = 7.6Hz), 4.0-5.5 (2H, br.), 6.98 (1H, d, J = 7.7Hz), 7.01 (1H, d, J = 7.7Hz), 7.18 (1H, t, J = 7.7Hz).} \]

2,6-Diethyl-4-methylphenylboronic acid: mp 111 to 113°C

\[ ^1H \text{NMR (CDCl}_3 \text{)} \delta \text{ ppm: 1.23 (6H, t, J = 7.7Hz), 2.31 (3H, s), 2.63 (4H, q, J = 7.7Hz), 4.0-5.0 (2H, br.), 6.88 (2H, s).} \]

A typical production example of the compound
represented by the general formula (VI) is shown by—

Reference Example 3

Reference Example 3

2- [2- (2, β-Diethyl-4-methylphenylacetyl) -2-methylhydrazono] ethyl propanoate (compound VI-2)

Potassium carbonate (1.5 g) was added to a solution of 2.0 g of ethyl 2- (methylhydrazono) propanoate in 35 mL of acetonitrile. The mixture was stirred with ice-cooling, to the mixture was added dropwise a solution of 2.6 g of 2,6-diethyl-4-methylphenylacetyl chloride in 10 mL of acetonitrile over 20 minutes, and the mixture was further stirred for 3.5 hours at room temperature. The reaction mixture was concentrated under reduced pressure. To the resultant residue was added 20 mL of ice water and the mixture was extracted with ethyl acetate (20 mL x 3). The extracts were combined, washed with saturated brine (20 mL x 2), dried over anhydrous magnesium sulfate, and concentrated under reduced pressure. The resultant residue was subjected to basic alumina column chromatography (ethyl acetate : hexane = 1:3) to obtain 1.9 g of the titled compound as white crystals.

The compounds represented by the general formula (VI) prepared in accordance with Reference Example 3 together with the compound VI-2 are shown in Table 5.

The compound represented by the general formula (VI):
Regarding the compounds with asterisk (*) in the column of boiling point in Table 5, the $^1$H NMR data are shown below.

**Compound VI-3:**

$^1$H NMR (CDCl$_3$) δ ppm: 1.19 (3H, t, $J = 7.6$Hz), 1.37 (3H, t, $J = 7.2$Hz), 2.20 (3H, br.s), 2.67 (2H, q, $J = 7.7$Hz), 3.37
Compound VI-4:
$^1$H NMR (CDCl$_3$) $\delta$ ppm: 1.18 (3H, t, $J = 7.6$Hz), 1.37 (3H, t, $J = 7.2$Hz), 2.20 (3H, br.s), 2.30 (3H, s), 2.63 (2H, q, $J = 7.7$Hz), 3.36 (3H, br.s), 3.99 (2H, br.s), 4.33 (2H, q, $J = 7.1$Hz), 6.93 (IH, br.d, $J = 7.1$Hz), 7.00 (IH, br.s), 7.12 (IH, br.d, $J = 7.8$Hz).

Compound VI-6:
$^1$H NMR (CDCl$_3$) $\delta$ ppm: 1.16 (3H, t, $J = 7.7$Hz), 1.36 (3H, t, $J = 7.2$Hz), 2.22 (3H, s), 2.27 (3H, s), 2.30 (3H, br.s), 2.56 (2H, q, $J = 7.7$Hz), 3.39 (3H, br.s), 4.02 (2H, br.s), 4.32 (2H, q, $J = 7.1$Hz), 6.86 (2H, br.s).

Compound VI-7 (mixture of E/Z isomers):
$^1$H NMR (CDCl$_3$) $\delta$ ppm: 1.13-1.25 (9H, m), 1.31-1.41 (3H, m), 2.29 (3H, s), 2.50-2.81 (6H, m), 3.23, 3.43 (3H, each br.s), 4.05 (2H, br.s), 4.27-4.39 (2H, m), 6.89 (2H, s).

Compound VI-8 (mixture of E/Z isomers):
$^1$H NMR (CDCl$_3$) $\delta$ ppm: 1.06-1.22 (6H, m), 1.31-1.40 (3H, m), 2.30, 2.31 (3H, each s), 2.50-2.70 (4H, m), 3.22, 3.38 (3H, each s), 4.00 (2H, br.s), 4.27-4.37 (2H, m), 6.90-6.98 (IH, m), 6.98-7.02 (IH, m), 7.02-7.14 (IH, m).

Compound VI-9 (mixture of E/Z isomers):
$^1$H NMR (CDCl$_3$) $\delta$ ppm: 1.12-1.25 (6H, m), 1.31-1.41 (3H, m), 2.22 (3H, s), 2.27 (3H, s), 2.50-2.81 (4H, m), 3.23, 3.43
(3H, each br.s), 4.02 (2H, br.s), 4.26-4.37 (2H, m), 6.87 (2H, br.s).

Compound VI-10 (mixture of E/Z isomers):
$^1$H NMR (CDCl$_3$) $\delta$ ppm: 1.16-1.24 (3H, m), 1.32-1.40 (3H, m),
2.22 (6H, s), 2.25 (3H, s), 2.55-2.80 (2H, m), 3.23, 3.43 (3H, each br.s), 4.00 (2H, br.s), 4.27-4.38 (2H, m), 6.85 (2H, s).

Compound VI-11:
$^1$H NMR (CDCl$_3$) $\delta$ ppm: 1.18 (6H, t, $J = 7.6$Hz), 1.24 (6H, d, $J = 6.8$Hz), 1.37 (3H, t, $J = 7.1$Hz), 2.29 (3H, s), 2.55 (4H, q, $J = 7.6$Hz), 2.85 (1H, septet, $J = 6.8$Hz), 3.22 (3H, s), 4.04 (2H, s), 4.34 (2H, q, $J = 7.2$Hz), 6.88 (2H, s).

Compound VI-12 (mixture of E/Z isomers):
$^1$H NMR (CDCl$_3$) $\delta$ ppm: 1.01 (3H, t, $J = 7.4$Hz), 1.17 (6H, t, $J = 7.6$Hz), 1.31-1.40 (3H, m), 1.57-1.74 (2H, m), 2.30 (3H, s), 2.50-2.76 (6H, m), 3.22, 3.42 (3H, each s)-, 4.03, 4.05 (2H, each br.s), 4.26-4.36 (2H, m), 6.89 (2H, s).

Compound VI-13 (mixture of E/Z isomers):
$^1$H NMR (CDCl$_3$) $\delta$ ppm: 1.13-1.28 (12H, m), 1.30-1.40 (3H, m),
2.50-2.80 (8H, m), 3.23, 3.44 (3H, each s), 4.06 (2H, br.s), 4.28-4.39 (2H, m), 6.91 (2H, s).

Compound VI-14 (mixture of E/Z isomers):
$^1$H NMR (CDCl$_3$) $\delta$ ppm: 1.01 (3H, br.t, $J = 7.2$Hz), 1.13-1.26 (9H, m), 1.30-1.40 (3H, m), 1.56-1.73 (2H, m), 2.50-2.76 (8H, m), 3.22, 3.42 (3H, each s), 4.03, 4.06 (2H, each
Compound VI-15:
$^1$H NMR (CDCl$_3$) δ ppm: 1.15-1.25 (6H, m), 1.37 (3H, t, $J = 7.2$Hz), 2.20 (3H, br.s), 2.55-2.70 (4H, m), 3.36 (3H, br.s), 3.99 (2H, br.s), 4.33 (2H, q, $J = 7.1$Hz), 6.91 (2H, s).

Compound VI-16 (mixture of E/Z isomers):
$^1$H NMR (CDCl$_3$) δ ppm: 1.05-1.25 (9H, m), 1.32-1.40 (3H, m), 2.50-2.69 (6H, m), 3.22, 3.38 (3H, each s), 4.00 (2H, br.s), 4.26-4.36 (2H, m), 6.93-7.00 (IH, m), 7.00-7.04 (IH, m), 7.06-7.18 (IH, m).

Compound VI-17:
$^1$H NMR (CDCl$_3$) δ ppm: 1.17 (3H, t, $J = 7.6$Hz), 1.22 (3H, t, $J = 7.6$Hz), 1.36 (3H, t, $J = 7.1$Hz), 2.24 (3H, s), 2.30 (3H, br.s), 2.58 (4H, q, $J = 7.6$Hz), 3.40 (3H, br.s), 4.03 (2H, br.s), 4.32 (2H, q, $J = 7.2$Hz), 6.89 (2H, s).

Compound VI-18:
$^1$H NMR (CDCl$_3$) δ ppm: 1.19 (6H, t, $J = 7.6$Hz), 1.36 (3H, t, $J = 7.2$Hz), 2.32 (3H, br.s), 2.60 (4H, q, $J = 7.7$Hz), 3.40 (3H, br.s), 4.09 (2H, br.s), 4.33 (2H, q, $J = 7.2$Hz), 7.07 (2H, d, $J = 7.6$Hz), 7.18 (IH, t, $J = 7.6$Hz).

Hereinafter, Formulation Examples will be shown.

Formulation Example 1
Flowable formulation

Compound I-a-1 10% by weight
Compound C 10% by weight
Compound E 5% by weight
Polyoxyethylene sorbitan monoolate 3% by weight
CMC (carboxymethyl cellulose) 3% by weight
Water 69% by weight

The above ingredients are mixed and the mixture is finely ground by a wet grinding method until the particle size becomes 5 micron or less to obtain a flowable formulation.

According to the same manner, respective flowable formulations of the compounds I-a-2 to I-a-30 and compounds I-b-1 to I-b-35 are obtained except that these compounds are used instead of the compound I-a-1.

Formulation Example 2

Wettable powder

Compound I-b-2 20% by weight
Compound D 10% by weight
Compound E 10% by weight
Lignin sodium sulfonate 5% by weight
Polyoxyethylene alkyl ether 5% by weight
White carbon 5% by weight
Clay 45% by weight

The above ingredients are mixed and the mixture is ground to obtain a wettable powder. The wettable powder thus prepared is appropriately diluted before use.
According to the same manner, respective wettable powders of the compounds I-a-1 to I-a-30 and compounds I-b-1 and I-b-3 to I-b-35 are obtained.

Formulation Example 3

5 Granules

- Compound I-b-20: 1% by weight
- Compound C: 1% by weight
- Compound E: 1% by weight
- Lignin sodium sulfonate: 2% by weight
- Talc: 40% by weight
- Bentonite: 55% by weight

The above ingredients are mixed and water is added thereto. The mixture is kneaded and granulated to obtain granules.

According to the same manner, respective granules of the compounds I-a-1 to I-a-30 and compounds I-b-1 to I-b-19, and I-b-21 to I-b-35 are obtained.

Formulation Example 4

Flowable formulation

20 Compound I-a-17: 5% by weight
- Compound C: 10% by weight
- Compound F: 5% by weight
- Polyoxyethylene sorbitan monoolate: 3% by weight
- CMC (carboxymethyl cellulose): 3% by weight

25 Water: 74% by weight
The above ingredients are mixed and the mixture is ground by a wet grinding method until the particle size becomes 5 micron or less to obtain a flowable formulation.

According to the same manner, respective flowable formulations of the compounds I-a-1 to I-a-1β, I-a-18 to I-a-30 and I-b-1 to I-b-35 are obtained except that these compounds are used instead of the compound I-a-17.

Formulation Example 5

Wettable powder

<table>
<thead>
<tr>
<th>Compound</th>
<th>Percentage by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compound I-b-14</td>
<td>10%</td>
</tr>
<tr>
<td>Compound C</td>
<td>5%</td>
</tr>
<tr>
<td>Compound F</td>
<td>5%</td>
</tr>
<tr>
<td>Lignin sodium sulfonate</td>
<td>5%</td>
</tr>
<tr>
<td>Polyoxyethylene alkyl ether</td>
<td>5%</td>
</tr>
<tr>
<td>White carbon</td>
<td>5%</td>
</tr>
<tr>
<td>Clay</td>
<td>65%</td>
</tr>
</tbody>
</table>

The above ingredients are mixed and the mixture is ground to obtain a wettable powder. The wettable powder is appropriately diluted before use.

According to the same manner, respective wettable powders of the compounds I-a-1 to I-a-30, I-b-1 to I-b-13 and I-b-15 to I-b-35 are obtained.

Formulation Example 6

Granules

<table>
<thead>
<tr>
<th>Compound</th>
<th>Percentage by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compound I-b-23</td>
<td>2%</td>
</tr>
</tbody>
</table>
Compound D 2% by weight
Compound F 1% by weight
Lignin sodium sulfonate 2% by weight
Talc 40% by weight
Bentonite 53% by weight

The above ingredients are mixed and water is added to the mixture. The mixture is kneaded and granulated to obtain granules.

According to the same manner, respective granules of the compounds I-a-1 to I-a-30 and compounds I-b-1 to I-b-22, and I-b-24 to I-b-35 are obtained.

Formulation Example 7
Flowable formulation

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Weight Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compound I-b-18</td>
<td>20%</td>
</tr>
<tr>
<td>Compound D</td>
<td>5%</td>
</tr>
<tr>
<td>Compound G</td>
<td>2%</td>
</tr>
<tr>
<td>Polyoxyethylene sorbitan monololate</td>
<td>3%</td>
</tr>
<tr>
<td>CMC (carboxymethyl cellulose)</td>
<td>3%</td>
</tr>
<tr>
<td>Water</td>
<td>67%</td>
</tr>
</tbody>
</table>

The above ingredients are mixed and the mixture is ground by a wet grinding method until the particle size becomes 5 micron or less to obtain a flowable formulation.

According to the same manner, respective flowable formulations of the compounds I-a-1 to I-a-30, I-b-1 to I-b-17 and I-b-19 to I-b-35 are obtained.
Formulation Example 8

Wettable powder

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compound I-a-18</td>
<td>20% b/w</td>
</tr>
<tr>
<td>Compound C</td>
<td>2% b/w</td>
</tr>
<tr>
<td>Compound G</td>
<td>10% b/w</td>
</tr>
<tr>
<td>Lignin sodium sulfonate</td>
<td>5% b/w</td>
</tr>
<tr>
<td>Polyoxylethylene alkyl ether</td>
<td>5% b/w</td>
</tr>
<tr>
<td>White carbon</td>
<td>5% b/w</td>
</tr>
<tr>
<td>Clay</td>
<td>53% b/w</td>
</tr>
</tbody>
</table>

The above ingredients are mixed and the mixture is ground to obtain a wettable powder. The wettable power thus prepared is appropriately diluted before use.

According to the same manner, respective wettable powders of the compounds I-a-1 to I-a-17, I-a-19 to I-a-30 and I-b-1 to I-b-35 are obtained.

Formulation Example 9

Granules

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compound I-a-14</td>
<td>10% b/w</td>
</tr>
<tr>
<td>Compound D</td>
<td>5% b/w</td>
</tr>
<tr>
<td>Compound G</td>
<td>5% b/w</td>
</tr>
<tr>
<td>Lignin sodium sulfonate</td>
<td>2% b/w</td>
</tr>
<tr>
<td>Talc</td>
<td>40% b/w</td>
</tr>
<tr>
<td>Bentonite</td>
<td>38% b/w</td>
</tr>
</tbody>
</table>

The above ingredients are mixed and water is added to the mixture. The mixture is kneaded and granulated to
obtain granules.

According to the same manner, respective granules of the compounds I-a-1 to I-a-13, I-a-15 to I-a-30 and I-b-1 to I-b-35 are obtained.

5  Formulation Example 10

Five parts of the present compound (I-a-12), 5 parts of the compound C, 5 parts of the compound E and 10 parts of any one of compounds selected from the following group C are added to a mixture of 4 parts of sodium laurylsulfate, 2 parts of lignin calcium sulfonate, 20 parts of synthetic hydrated silicon hydroxide fine powders and 49 parts of diatomite. The resulting mixture is thoroughly mixed with stirring to obtain a wettable powder.

According to the same manner, respective wettable powders of the compounds I-a-1 to I-a-11, I-a-13 to I-a-30 and I-b-1 to I-b-35 are obtained except that these compounds are used instead of the compound I-a-12.

Group C:
herbicidal phenoxyfatty acid compounds (MCP, MCPB, phenothiol, mecoprop, fluoxypyr, triclopyr, clomeprop, naproanilide),
herbicidal benzoate compounds (2,3,6-TBA, clopyrald, picloram, aminopyralid, quinclorac, quinmerac),
herbicidal urea compounds (diuron, linuron, chlortoluron, isoproturon, fluometuron), isouron,
tebuthuron, methabenzthiazuron, cumyluron, daimuron, methyl-daimuron),
herbicidal triazine compounds (ametoryn, cyanazine, simazine, propazine, simetryn, dimethametryn, prometryn, metribuzin, triaziflam),
herbicidal bipyridinium compounds (paraquat, diquat),
herbicidal hydroxybenzonitrile compounds (bromoxynil, ioxynil),
herbicidal dinitroaniline compounds (pendimethalin, prodiamine, trifluralin),
herbicidal organophosphorous compounds (amiprophos-methyl, butamifos, bensulide, piperophos, anilofos, glufosinate, bialaphos),
herbicidal carbamate compounds (di-allate, tri-allate, EPTC, butylate, benthiocarb, esprocarb, molinate, dimepiperate, swep, chlorpropham, phenmedipham, phenisopham, pyributicarb, asulam),
herbicidal acid amide compounds (propanil, propyzamide, bromobutide, etobenzanid),
herbicidal chloroacetanilide compounds (alachlor, butachlor, dimethenamid, propachlor, metazachlor, pretilachlor, thenylchlor, pethoxamid),
herbicidal diphenylether compounds (acifluorfen-sodium, bifenox, oxyfluorfen, lactofen, fomesafen, chlomethoxynil, aclonifen),
herbicidal cyclicimide compounds (oxadiazon, cinidon-ethyl, carfentrazone-ethyl, surfentrazone, flumiclorac-pentyl, pyraflufen-ethyl, oxadiargyl, pentoxazone, fluthiacet-methyl, butafenacil, benzflendizone),

herbicidal pyrazole compounds (benzofenap, pyrazolate, pyrazoxyfen, topramezone, pyrasulf otole),

herbicidal triketone compounds (isoxaflutole, benzobicyclon, sulcotrione, mesotrione, tembotrione, tefuryltrione),

herbicidal aryloxyphenoxypropionate compounds (cyhalofop-butyl, diclofop-methyl, fenoxaprop-ethyl, fluazifop-butyl, haloxyfop-methyl, quizalofop-ethyl, metamifop),

herbicidal trioneoime compounds (alloxydim-sodium, sethoxydim, butroxydim, clethodim, cloproxydim, cycloxydim, tepraloxydim, tralkoxydim, profoxydim),

herbicidal sulfonylurea compounds (chlorsulfuron, sulfometuron-methyl, metsulfuron-methyl, triibenuron-methyl, triasulfuron, bensulfuron-methyl, thifensulfuron-methyl, pyrazosulfuron-ethyl, primisulfuron-methyl, nicosulfuron, amidosulfuron, cinosulfuron, imazosulfuron, rimsulfuron, halosulfuron-methyl, prosulfuron, ethametsulfuron-methyl, triflusulfuron-methyl, flazasulfuron, cyclosulf amuron, flupyrsulfuron, sulfosulfuron, azimsulfuron, ethoxysulfuron, oxasulfuron, iodosulfuron-methyl-sodium, foramsulfuron,
mesosulfuron-methyl, trifloxsulfuron, tritosulfuron, orthosulf amuron, flucetosulfuron

herbicidal imidazolinone compounds (imazamethabenz-methyl, imazamethapyr, imazamox, imazapyr, imazaquin),
imazethapyr),

herbicidal sulfoneamide compounds (flumetsulam, metosulam, diclosulam, florasulam, penoxsulam, pyroxsulam),
herbicidal pyrimidinloxybenzoate compounds (pyrithiobac-sodium, bispyribac-sodium, pyriminobac-methyl, pyribenzoxim, pyrificatalid, pyrimisulf an),

Other herbicidal compounds (bentazon, bromacil, terbacil, chlorthiamid, isoxaben, dinoseb, amitrole, cinmethylin, tridiphane, dalapon, diflufenzopyr-sodium, dithiopyr, thiazopyr, flucarbazone-sodium, propoxycarbazone-sodium, mfenacet, flufenacet, fentrazamide, cafenstrole, indanofan, oxaziclomef one, benfuresate, ACN, pyridate, chloridazon, norflurazon, flurtamone, diflufenican, picolinafen, beflubutamid, clomazone, amicarbazone, pyraclonil, pyroxasulf one, thiencarbazone-methyl), and

safeners (furilazole, dichlormid, benoxacor, allidochlor, isoxadifen-ethyl, fenclorim, cyprosulf amide, cyometrinil, oxabetrinil, fluxofenim, flurazole, 1,8-naphthalic anhydride).

Formulation Example 11
Five parts of the present compound (I-b-14), 1 part of
the compound D, 10 parts of the compound E and 5 parts of
any one of compounds selected from the above group C are
added to a mixture of 3 parts of polyoxyethylene sorbitan
monoolate, 3 parts of CMC (carboxymethyl cellulose) and 73
parts of water, followed by wet-grinding until the particle
size becomes 5 micron or less to obtain a flowable
formulation.

According to the same manner, respective flowable
formulations of the compounds I-a-1 to I-a-30, I-b-1 to I-
b-13 and I-b-15 to I-b-35 are prepared.

Formulation Example 12

One part of the present compound (I-a-1), 2 parts of
the compound D, 1 part of the compound E and 2 parts of any
one of compounds selected from the above group C are added
to a mixture of 2 parts of lignin sodium sulfonate, 40
parts of talc and 52 parts of bentonite, followed by mixing,
addition of water, kneading and further granulation to
obtain granules.

According to the same manner, respective granules of
the compounds I-a-2 to I-a-30 and I-b-1 to I-b-35 are
obtained.

Formulation Example 13

Five parts of the present compound (I-b-1), 1 part of
the compound C, 10 parts of the compound F and 5 parts of
any one of compounds selected from the above group C are added to a mixture of 4 parts of sodium laurylsulfate, 2 parts of lignin calcium sulfonate, 20 parts of synthetic hydrated silicon hydroxide fine powders and 53 parts of diatomite, followed by fully mixing with stirring to obtain a wettable powder.

In the same manner, hydrating agents of the respective compounds I-a-1 to I-a-30 and I-b-2 to I-b-35 were prepared.

Formulation Example 14

Two parts of the present compound (I-a-12), 10 parts of the compound C, 3 parts of the compound F and 15 parts of any one of compounds selected from the above group C were added to a mixture of 3 parts of polyoxyethylene sorbitan monoolate, 3 parts of CMC (carboxymethyl cellulose) and 64 parts of water, followed by wet-grinding until the particle size becomes 5 micron or less to obtain a flowable formulation.

According to the same manner, respective flowable formulations of the compounds I-a-1 to I-a-11, I-a-13 to I-a-30 and I-b-1 to I-b-35 are obtained.

Formulation Example 15

Five parts of the present compound (I-a-30), 1 part of the compound D, 5 parts of the compound F and 5 parts of any one of compounds selected from the above group C are added to a mixture of 2 parts of lignin sodium sulfonate,
35 parts of talc and 47 parts of bentonite, followed by mixing, addition of water, kneading and further granulation to obtain granules.

According to the same manner, respective granules of the compounds I-a-1 to I-a-29 and I-b-1 to I-b-35 are obtained.

Formulation Example 16

Ten parts of the present compound (I-b-28), 1 part of the compound D, 5 parts of the compound G and 1 part of any one of compounds selected from the above group C are added to a mixture of 4 parts of sodium laurylsulfate, 2 parts of lignin calcium sulfonate, 20 parts of synthetic hydrated silicon hydroxide fine powders and 57 parts of diatomite, followed by fully mixing with stirring to obtain a wettable powder.

According to the same manner, respective wettable powders of the compounds I-a-1 to I-a-30, I-b-1 to I-b-27 and I-b-29 to I-b-35 are obtained.

Formulation Example 17

Ten parts of the present compound (I-a-19), 5 parts of the compound D, 10 parts of the compound G and 5 parts of any one of compounds selected from the above group C are added to a mixture of 3 parts of polyoxyethylene sorbitan monoolate, 3 parts of CMC (carboxymethyl cellulose) and 64 parts of water, followed by wet-grinding until the particle
size becomes 5 micron or less to obtain a flowable formulation.

According to the same manner, respective flowable formulations of the compounds I-a-1 to I-a-18, I-a-20 to I-a-30 and I-b-1 to I-b-35 are obtained.

Formulation Example 18

Two parts of the present compound (I-b-12), 1 part of the compound C, 2 parts of the compound G and 2 parts of any one of compounds selected from the above group C are added to a mixture of 2 parts of lignin sodium sulfonate, 40 parts of talc and 51 parts of bentonite, followed by mixing, addition of water, kneading and further granulation to obtain granules.

According to the same manner, respective granules of the compounds I-a-1 to I-a-30, I-b-1 to I-b-11 and I-b-13 to I-b-35 are obtained.

Test Examples will be described below.

Test Example 1

Post-emergence Treatment

Field soil was filled in a plastic cup (8 cm in diameter and 6.5 cm in depth), seeds of Triticum aestivum (wheat) and Alopecurus myosuroides (blackgrass) were sown thereon, and the seeds were covered with soil about 0.5 cm of thickness and then cultured in a greenhouse for a predetermined period. When Alopecurus myosuroides grew at
1st to 2nd leaf stage, a diluent of the formulation
containing the compound I-a-14, a herbicide selected from
the group A (i.e., pinoxaden (compound C) and clodinafop-
propargyl (compound D)) and one safener selected from the
group B (i.e., fenchlorazole-ethyl (compound E),
cloquintocet-mexyl (compound F) and mefenpyr-diethyl
(compound G)) was sprayed over the entire plants uniformly
in a predetermined treatment amount. The diluent of the
formulation was prepared by dissolving a predetermined
amount of the respective compounds in a dimethylformamide
solution containing Tween 20 (polyoxyethylene sorbitan
fatty acid ester; manufactured by MP Biomedicals Ink Corp.)
(2%), followed by diluting the solution with deionized
water. The plant treated with the formulation was cultured
in the greenhouse. 21 days after treatment, the
phytotoxicity and herbicidal effects were evaluated
according to the criteria in Table 6.

The post-emergence treatment test was carried out for
the other herbicidal compositions of the present invention
in the same manner, except for using the compound I-a-16,
I-a-17, I-a-18, I-b-19, I-b-20 or I-b-23 instead of the
compound I-a-14. The results are shown in Tables 7 to 13.
<table>
<thead>
<tr>
<th>Index</th>
<th>Phytotoxicity and herbicidal effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>100% (complete killing) phytotoxicity and herbicidal effects</td>
</tr>
<tr>
<td>9</td>
<td>90-100% phytotoxicity and herbicidal effects</td>
</tr>
<tr>
<td>8</td>
<td>80-90% phytotoxicity and herbicidal effects</td>
</tr>
<tr>
<td>7</td>
<td>70-80% phytotoxicity and herbicidal effects</td>
</tr>
<tr>
<td>6</td>
<td>60-70% phytotoxicity and herbicidal effects</td>
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<td>5</td>
<td>50-60% phytotoxicity and herbicidal effects</td>
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<td>4</td>
<td>40-50% phytotoxicity and herbicidal effects</td>
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<td>3</td>
<td>30-40% phytotoxicity and herbicidal effects</td>
</tr>
<tr>
<td>2</td>
<td>20-30% phytotoxicity and herbicidal effects</td>
</tr>
<tr>
<td>1</td>
<td>10-20% phytotoxicity and herbicidal effects</td>
</tr>
<tr>
<td>0</td>
<td>0 (no effect)-10% phytotoxicity and herbicidal effects</td>
</tr>
</tbody>
</table>

Table 7

<table>
<thead>
<tr>
<th>Herbicidal composition of the present invention</th>
<th>Dosage (g/ha)</th>
<th>Phytotoxicity</th>
<th>Herbicidal effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Wheat</td>
<td>Black grass</td>
</tr>
<tr>
<td>I-a-14 + Compound C + Compound E</td>
<td>120+60+15</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>I-a-14 + Compound C + Compound F</td>
<td>120+30+60</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>I-a-14 + Compound C + Compound G</td>
<td>120+60+30</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>I-a-14 + Compound D + Compound E</td>
<td>120+60+15</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-a-14 + Compound D + Compound F</td>
<td>120+30+60</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-a-14 + Compound D + Compound G</td>
<td>120+60+30</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>
### Table 8

<table>
<thead>
<tr>
<th>Herbicidal composition of the present invention</th>
<th>Dosage (g/ha)</th>
<th>Phytotoxicity</th>
<th>Herbicidal effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-a-16 + Compound C + Compound E</td>
<td>60+60+6</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-a-16 + Compound C + Compound F</td>
<td>60+60+60</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-a-16 + Compound C + Compound G</td>
<td>60+30+30</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-a-16 + Compound D + Compound E</td>
<td>60+60+6</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-a-16 + Compound D + Compound F</td>
<td>60+60+60</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-a-16 + Compound D + Compound G</td>
<td>60+30+30</td>
<td>0</td>
<td>9</td>
</tr>
</tbody>
</table>

### Table 9

<table>
<thead>
<tr>
<th>Herbicidal composition of the present invention</th>
<th>Dosage (g/ha)</th>
<th>Phytotoxicity</th>
<th>Herbicidal effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-a-17 + Compound C + Compound E</td>
<td>120+30+120</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-a-17 + Compound C + Compound F</td>
<td>120+24+120</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>I-a-17 + Compound C + Compound G</td>
<td>120+60+60</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>I-a-17 + Compound D + Compound E</td>
<td>120+30+120</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>I-a-17 + Compound D + Compound F</td>
<td>120+24+120</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-a-17 + Compound D + Compound G</td>
<td>120+60+60</td>
<td>0</td>
<td>9</td>
</tr>
</tbody>
</table>
Table 10

<table>
<thead>
<tr>
<th>Herbicidal composition of the present invention</th>
<th>Dosage (g/ha)</th>
<th>Phytotoxicity</th>
<th>Herbicidal effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-a-18 + Compound C + Compound E</td>
<td>120+60+60</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>I-a-18 + Compound C + Compound F</td>
<td>120+30+120</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-a-18 + Compound C + Compound G</td>
<td>120+12+12</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-a-18 + Compound D + Compound E</td>
<td>120+60+60</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-a-18 + Compound D + Compound F</td>
<td>120+30+120</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-a-18 + Compound D + Compound G</td>
<td>120+12+12</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 11

<table>
<thead>
<tr>
<th>Herbicidal composition of the present invention</th>
<th>Dosage (g/ha)</th>
<th>Phytotoxicity</th>
<th>Herbicidal effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-b-19 + Compound C + Compound E</td>
<td>240+60+60</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-b-19 + Compound C + Compound F</td>
<td>240+60+30</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-b-19 + Compound C + Compound G</td>
<td>240+60+60</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>I-b-19 + Compound D + Compound E</td>
<td>240+60+60</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-b-19 + Compound D + Compound F</td>
<td>240+60+30</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-b-19 + Compound D + Compound G</td>
<td>240+60+60</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>
Industrial Applicability

According to the present invention, it is possible to control weeds without any serious phytotoxicity by applying an effective amount of the herbicidal composition of the present invention to weeds or soil on which the weeds grow.
1. A herbicidal composition comprising a pyridazinone compound represented by the formula (I):

wherein \( R^1 \) represents a \( \text{Ci-s} \) alkyl group or a \( \text{Ci-s} \) alkyl group,

\( R^2 \) represents a hydrogen atom or a \( \text{Ci-s} \) alkyl group,

\( G \) represents a hydrogen atom or any one of the groups

represented by the following formulas:

\[
\begin{align*}
L & \quad \text{or} \quad S \quad \text{or} \quad P \\
R^3 & \quad \text{or} \quad \text{a C3-8 cycloalkyl group, a C2-6 alkenyl group, a C2-6 alkynyl group, a C6-i6 aryl group, a (C6-i6 aryl) Ci-s alkyl group, a Ci-s alkoxy group, a C3-8 cycloalkyloxy group, a C2-6 alkenyloxy group, a C2-6 alkynyl group, a C6-i6 aryloxyl group, a (C6-i6 aryl) C1-s alkoxy group, an amino group, a C1-s alkylamino group, a C2-6 alkenylamino group, a C6-i6 arylamino group, a di (C1-s alkyl) amino group, a di (C2-6 alkenyl) amino group, a (C1-s alkyl) amino group, a di (C2-6 alkenyl) amino group, a (C1-s alkyl) amino group.}
\end{align*}
\]
alkyl) (C₆-aryl) amino group or a 3 to 8-membered nitrogen-containing heterocyclic group,

R⁴ represents a Ci₆ alkyl group, a C₆-aryl group, a C₁-B alkylamino group or a di (Ci₆ alkyl) amino group, and

R⁵ and R⁶ are the same or different and each represents a Ci₆ alkyl group, a C₃-8 cycloalkyl group, a C₂-6 alkenyl group, a C₆-aryl group, a Ci₆ alkoxy group, a C₃-8 cycloalkyloxy group, a C₆-aryl arloxy group, a (C₆-aryl) Ci₆ alkoxy group, a Ci₆ alkylthio group, a Ci₆ alkylamino group or a di (Ci₆ alkyl) amino group,

provided that any group represented by R³, R⁴, R⁵ and R⁶ may be substituted with at least one halogen atom, and the C₃-8 cycloalkyl group, the C₆-aryl group, the aryl moiety of the (C₆-aryl) Ci₆ alkyl group, the C₃-8 cycloalkyloxy group, the C₆-aryl arloxy group, the aryl moiety of the (C₆-aryl) Ci₆ alkoxy group, the aryl moiety of the (Ci₆ alkyl) (C₆-aryl) amino group and the 3- to 8-membered nitrogen-containing heterocyclic group may be substituted with at least one Ci₆ alkyl group,

Z¹ represents a Ci₆ alkyl group; Z² represents a Ci₆ alkyl group,

n represents 0, 1, 2, 3 or 4, and when n represents an integer of two or more, each Z² may be the same or different, provided that the total number of carbon atoms
in the groups represented by $Z_1$ and $n \times Z_2$ is two or more; one herbicide selected from the following group A; and one safener selected from the following group B.

Group A:

5  pinoxaden, and
    clodinafop-propargyl

Group B:

fenchlorazole-ethyl
    cloquintocet-mexyl, and
mefenpyr-diethyl

2. The herbicidal composition according to claim 1, wherein $n$ in the formula (I) is an integer of 1 or more.

3. The herbicidal composition according to claim 1, wherein $n$ in the formula (I) is 0, and $Z_1$ is a C$_2$-6 alkyl group.

4. The herbicidal composition according to claim 1, wherein $n$ in the formula (I) is 1 or 2, and $Z_2$ is attached to the benzene ring at 4- and/or 6-positions thereof.

5. The herbicidal composition according to claim 1, 2 or 4, wherein $Z_1$ in the formula (I) is a C$_1$-3 alkyl group, and $Z_2$ is a C$_1$-3 alkyl group.

6. The herbicidal composition according to claim 1, wherein $G$ in the formula (I) is a hydrogen atom or any one of the groups represented by the following formulas:
wherein $R_{3b}$ represents a C$\chi_6$ alkyl group, a C$_{3-8}$ cycloalkyl group, a C$_{2-6}$ alkenyl group, a C$_{2-6}$ alkynyl group, a C$_6$-io aryl group, a (C$_6$-io aryl) C$_{1-6}$ alkyl group, a C$_{1-6}$ alkyloxy group, a C$_{3-8}$ cycloalkyloxy group, a (C$_6$-io aryl) C$_{1-6}$ alkyloxy group, a C$_6$-io arylamino group or a di (C$_{1-6}$ alkyl) amino group, $R_{4b}$ represents a C$_{1-6}$ alkyl group or a C$_6$-io aryl group, and $R_{5b}$ and $R_{6b}$ are the same or different and each represents a C$_{1-6}$ alkyl group, a C$_{1-6}$ alkyloxy group, a C$_6$-io arlyloxy group or a C$_{1-6}$ alkylthio group, provided that any group represented by $R_{3b}$, $R_{4b}$, $R_{5b}$ and $R_{6b}$ may be substituted with at least one halogen atom, and the C$_{3-8}$ cycloalkyl group, the C$_6$-io aryl group, the aryl moiety of the (C$_6$-io aryl) C$_{1-6}$ alkyl group, the C$_{3-8}$ cycloalkyloxy group, the C$_{5-10}$ arlyloxy group, the aryl moiety of the (C$_6$-io aryl) C$_{1-6}$ alkyloxy group, and the aryl moiety of the C$_6$-io arylamino group may be substituted with at least one C$_{1-6}$ alkyl group.

7. The herbicidal composition according to claim 1, wherein $G$ in the formula (I) is a hydrogen atom or any one of the groups represented by the following formulas:
wherein \( R_{3a} \) represents a \( C_{1-6} \) alkyl group, a \( C_{3-8} \) cycloalkyl group, a \( C_{6-10} \) aryl group, a \( C_{\chi-6} \) alkyloxy group or a \( (C_{1-6} \) alkyl) amino group; and

\( R_{4a} \) represents a \( C_{1-6} \) alkyl group,

provided that any group represented by \( R_{3a} \) and \( R_{4a} \) may be substituted with a halogen atom, and a \( C_{3-8} \) cycloalkyl group and a \( C_{6-10} \) aryl group may be substituted with a \( C_{1-6} \) alkyl group.

8. The herbicidal composition according to claim 1, wherein \( R^2 \) in the formula (I) is a hydrogen atom or a \( C_{1-3} \) alkyl group.

9. The herbicidal composition according to claim 1, wherein \( R^2 \) in the formula (I) is a hydrogen atom or a methyl group.

10. The herbicidal composition according to claim 1, wherein \( R^1 \) in the formula (I) is a \( C_{1-3} \) alkyl group or a \( (C_{1-3} \) alkyloxy) \( C_{1-3} \) alkyl group.

11. A weed control method, which comprises simultaneously or separately applying an effective amount of the pyridazinone compound represented by the formula (I) according to claim 1, an effective amount of a herbicide selected from the following group A, and an effective amount of a safener selected from the following group B, to weeds or soil on which the weeds grow.

Group A:
pinoxaden, and
clodinafop-propargyl
Group B:
fenchlorazole-ethyl,
cloquintocet-mexyl, and
mefenpyr-diethyl

12. Use of the pyridazinone compound represented by the formula (I) according to claim 1, a herbicide selected from the following group A, and a safener selected from the following group B, for weed control.

Group A:
pinoxaden, and
clodinafop-propargyl

Group B:
fenchlorazole-ethyl,
cloquintocet-mexyl, and
mefenpyr-diethyl