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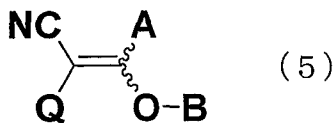
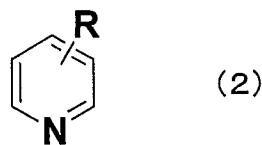
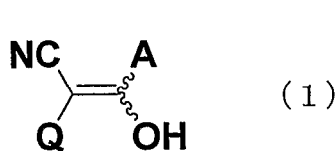
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ance Notes on Codes and Abbreviations" appearing at the begin-
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(54) Title: METHOD FOR PREFERENTIAL PRODUCTION OF GEOMETRIC ISOMERS AND ISOLATION METHOD

(57) Abstract: A method for the
preferential production of the Z form of
a compound represented by the formula
(5) [in the formula (5), Q, A and B have
the same meanings as stated below],
by reacting an acrylonitrile compound
represented by the formula (1) [in the
formula (1), Q represents unsubstituted
or substituted phenyl or heterocyclyl, in
particular 4-thiazolyl, 1- or 3-pyrazolyl,
1,3-oxazolyl-4-yl, phenyl, pyridyl or the
like, A represents pyrazolyl, thiazolyl or
the like, and B represents alkylcarbonyl or
the like] with a compound represented by
formula (3) [in the formula (3), B represents
alkylcarbonyl or the like] or a compoundrepresented by the formula (4) [in the formula (4), B has the same meaning as aforesaid], in the presence of a compound represented
by the formula (2) [in the formula (2) R represents H, dimethylamino and the like], and a method for the isolation of geometric
isomers, wherein, by dissolving or suspending a geometric isomer mixture of an acrylonitrile compound represented by the formula
(5) in an alcohol or a solvent containing an alcohol, the E form is preferentially decomposed and the Z form is isolated, and wherein
the decomposition product can be simply recovered by normal operations and reutilized.

Description

Method for preferential production of geometric isomers and isolation method

Technological Field

The present invention concerns a method for the production of one of two geometric isomers as the main product, and a method for isolating one isomer from a mixture of the isomers.

Background Art

In compounds having a double bond in the molecule, geometric isomers referred to as the cis isomer and trans isomer, or the E isomer and Z isomer, can be present. The properties of such compounds, with regard to physiological activity, safety, physical properties and the like, often differ between the isomers. Because of this, in the development of physiologically active substances such as pesticides and pharmaceuticals, it is in many cases necessary selectively to produce only the useful one.

Concerning acrylonitrile compounds, methods of producing one of two geometric isomers as the main product, and methods of isolating one isomer from a mixture of the isomers had been studied; see, Japanese Patent Laid-Open 2004-182601, WO 2003/031421 and Japanese Patent Laid-Open 2003-267959.

Disclosure of Invention

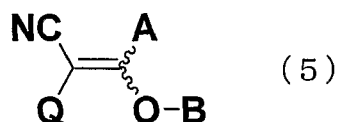
The purpose of the present invention is to provide a method for the preferential production of the Z form of an acrylonitrile compound.

A further purpose of the present invention is to provide a method for isolation of geometric isomers whereby it is possible simply to isolate the Z form from a geometric isomer mixture, and at the same time to make reutilization of the E form possible by decomposing and reconverting it to starting material, and to recover two or more starting materials for reutilization simply and in high purity from the decomposition products.

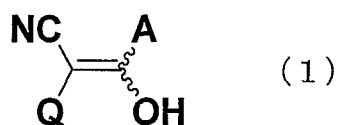
The present inventors, in the light of this situation and as a result of diligent research, discovered that the Z form can be preferentially produced either by producing the acrylonitrile compound in the presence of a pyridine compound, or by reacting a pyridine compound with the acrylonitrile compound. Further, the present inventors discovered that if a mixture of the E form and Z form is dissolved

or suspended in an alcohol or a solvent containing an alcohol, the E form only is selectively decomposed to the starting substances, and the Z form that remains can be simply isolated.

In other words, the present invention concerns a method for the production of the Z form of a compound represented by the formula (5):



[in the formula (5), A, B and Q have the same meanings as stated below], wherein an acrylonitrile compound represented by the formula (1):



[in the formula, A and Q each independently are optionally G-substituted phenyl group, optionally G-substituted naphthyl group or optionally G-substituted heterocyclic group (provided that this heterocyclic group is thienyl, furyl, pyrrolyl, oxazolyl, thiazolyl, imidazolyl, isoxazolyl, isothiazolyl, pyrazolyl, 1,3,4-oxadiazolyl, 1,3,4-thiadiazolyl, 1,2,4-oxadiazolyl, 1,2,4-thiadiazolyl, 1,2,4-triazolyl, 1,2,3-thiadiazolyl, 1,2,3-triazolyl, 1,2,3,4-tetrazolyl, pyridyl, pyrimidinyl, pyrazinyl, pyridazinyl, 1,3,5-triazinyl, 1,2,4-triazinyl, 1,2,4,5-tetrazinyl, pyrazolinyl, imidazolinyl, oxazolinyl, isoxazolinyl, thiazolinyl, imidazolidinonyl, imidazolinonyl, 3(2H)-pyridazinonyl, benzothiazolyl, benzimidazolyl, indazolyl, benzoxazolyl, quinolyl, isoquinolyl, quinoxaliny, phthalazinyl, cinnolinyl or quinazolinyl), provided that if Q is an optionally G-substituted phenyl group, optionally G-substituted pyridyl group or optionally G-substituted thienyl group, A is an optionally substituted naphthyl group or optionally G-substituted heterocyclic group (provided that this heterocyclic group is thienyl, furyl, pyrrolyl, oxazolyl, thiazolyl, imidazolyl, isoxazolyl, isothiazolyl, pyrazolyl, 1,3,4-oxadiazolyl, 1,3,4-thiadiazolyl, 1,2,4-oxadiazolyl, 1,2,4-thiadiazolyl, 1,2,4-triazolyl, 1,2,3-thiadiazolyl, 1,2,3-triazolyl, 1,2,3,4-tetrazolyl, pyridyl, pyrimidinyl, pyrazinyl, pyridazinyl, 1,3,5-triazinyl, 1,2,4-triazinyl, 1,2,4,5-tetrazinyl, pyrazolinyl, imidazolinyl, oxazolinyl, isoxazolinyl, thiazolinyl, imidazolidinonyl, imidazolinonyl, 3(2H)-pyridazinonyl, benzothiazolyl, benzimidazolyl, indazolyl, benzoxazolyl, quinolyl, isoquinolyl, quinoxaliny, phthalazinyl, cinnolinyl or quinazolinyl),

G is any substituent group selected from halogen atom, C₁-C₁₀ alkyl, C₂-C₄ cyanoalkyl, optionally halogen atom- or C₁-C₄ alkyl-substituted phenyl-substituted C₁-C₄ alkyl, C₂-C₅ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₆ halocycloalkyl, optionally C₁-C₃ alkyl-substituted C₃-C₆ cycloalkyl, C₁-C₁₀ alkoxy, C₂-C₆ alkenyloxy, C₂-C₆ alkynyloxy, C₁-C₄ haloalkoxy, C₂-C₆ haloalkenyloxy, C₂-C₆ haloalkynyloxy, C₁-C₄ alkylsulfenyl, C₁-C₄ alkylsulfinyl, C₁-C₄ alkyl-sulfonyl, C₂-C₆ alkenylsulfenyl, C₂-C₆ alkenylsulfinyl, C₂-C₆ alkenylsulfonyl, C₂-C₆ alkynylsulfenyl, C₂-C₆ alkynylsulfinyl, C₂-C₆ alkynylsulfonyl, C₁-C₄ haloalkyl-sulfenyl, C₁-C₄ haloalkylsulfinyl, C₁-C₄ haloalkyl-sulfonyl, C₂-C₆ haloalkenylsulfenyl, C₂-C₆ haloalkenylsulfinyl, C₂-C₆ haloalkenylsulfonyl, C₂-C₆ haloalkynyl-sulfenyl, C₂-C₆ haloalkynylsulfinyl, C₂-C₆ haloalkynylsulfonyl, CHO, NO₂, CN, OH, naphthyl, optionally halogen atom- or C₁-C₄ alkyl-substituted phenyl-substituted methoxy, C₂-C₇ alkoxycarbonyl, C₂-C₄ alkoxyalkyl, C₂-C₄ alkylcarbonyl, C₂-C₄ haloalkylcarbonyl, C₂-C₅ alkyl-carbonyloxy, C₂-C₅ haloalkylcarbonyloxy, C₃-C₇ dialkyl-aminocarbonyloxy, optionally Y-substituted phenyl, optionally Y-substituted phenoxy, optionally Y-substituted benzoyl, optionally Y-substituted pyridyl, optionally Y-substituted pyridyloxy, optionally Y-substituted thienyl, methylenedioxy linked to an adjacent substitution site, halomethylenedioxy linked to an adjacent substitution site and -N=CT²T³ (provided that T² and T³ each independently are H, phenyl, benzyl or C₁-C₆ alkyl or else both T² and T³ together with the linking carbon atom may form a 5-membered ring, 6-membered ring, 7-membered ring or 8-membered ring), (provided that if there are 2 or more such substituent groups, they may be the same or different), and the number of such substituent groups is 1, 2, 3 or 4 or else it is a 5-membered ring, 6-membered ring, 7-membered ring or 8-membered ring formed via an alkylene group linked to an adjacent substitution site,

Y is any substituent group selected from halogen atom, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, C₁-C₄ alkylsulfenyl, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₂-C₅ alkenylsulfenyl, C₂-C₅ alkenylsulfinyl, C₂-C₅ alkenylsulfonyl, C₁-C₄ haloalkylsulfonyl, NO₂, CN, CHO, OH, -NU¹U², phenyl, phenoxy or C₂-C₅ alkoxycarbonyl (provided that, if there are 2 or more such substituent groups, they may be the same or different) and the number of such substituent groups is 1, 2, 3, 4 or 5, and

U¹ and U² each independently represent H, C₁-C₆ alkyl, C₂-C₅ alkylcarbonyl, phenyl or benzyl, or else both U¹ and U² together with the linking carbon atom may form a 5-membered ring, 6-membered ring, 7-membered ring or 8-membered ring] is reacted with a compound of the formula (3):

B-X (3)

[in the formula (3), B is C₁-C₄ alkylsulfonyl, optionally halogen atom- or C₁-C₄ alkyl-substituted phenylsulfonyl, -SO₂CF₃, C₁-C₄ monoalkylaminosulfonyl, C₂-C₈ dialkylaminosulfonyl, phenylaminosulfonyl, C₂-C₅ mono-alkylaminothiocarbonyl, C₃-C₉ dialkylaminothiocarbonyl, C₂-C₅ cyanoalkyl, C₃-C₉ alkoxycarbonylalkyl, or -C(=O)T¹, T¹ is C₁-C₂₀ alkyl, C₂-C₆ alkenyl, C₁-C₆ haloalkyl, C₁-C₄ alkoxy-C₁-C₄ alkyl, C₃-C₆ halocycloalkyl, optionally halogen atom- or C₁-C₄ alkyl-substituted phenyl-substituted C₁-C₄ alkyl, optionally C₁-C₃ alkyl-substituted phenyl-substituted cycloalkyl, optionally halogen atom- or C₁-C₄ alkyl-substituted phenyl- and C₁-C₄ alkyl-substituted cyclopropyl group, optionally halogen atom- or C₁-C₄ alkoxy-substituted phenyl- and halogen atom-substituted C₃-C₄ cycloalkyl group, optionally halogen atom-substituted C₂-C₄ alkenyl- and C₁-C₄ alkyl-substituted cyclopropyl group, optionally halogen atom- or C₁-C₄ alkyl substituted phenyl-substituted C₂-C₄ alkenyl group, C₁-C₁₂ alkoxy, C₁-C₄ haloalkoxy, C₂-C₅ alkenyloxy, optionally C₁-C₃ alkyl-substituted C₃-C₆ cycloalkoxy, benzyloxy, C₂-C₅ alkoxycarbonyl, NU¹U², phenylamino, optionally Y-substituted phenyl, optionally Y-substituted phenylthio, optionally Y-substituted naphthyl or optionally Y-substituted 5-membered or 6-membered heterocyclic group (provided that these heterocyclic groups are selected from thienyl, furyl, pyrrolyl, oxazolyl, isoxazolyl, thiazolyl, isothiazolyl, pyrazolyl, imidazolyl, 1,3,4-oxadiazolyl, 1,2,4-oxadiazolyl, 1,3,4-thiadiazolyl, 1,2,4-thiadiazolyl, 1,2,4-triazolyl, 1,2,3-thia-diazolyl, 1,2,3-triazolyl, 1,2,3,4-tetrazolyl, pyridyl, pyrimidinyl, pyrazinyl, pyridazinyl, 1,3,5-triazinyl, 1,2,4-triazinyl, pyrazolinyl, imidazolinyl, oxazolinyl, isoxazolinyl, thiazolinyl and 3(2H)-pyridazinonyl),

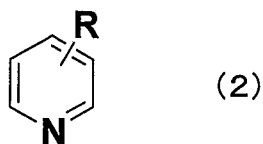
X is a halogen atom,

Y is any substituent group selected from halogen atom, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, C₁-C₄ alkylsulfenyl, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₂-C₅ alkenylsulfenyl, C₂-C₅ alkenyl-sulfinyl, C₂-C₅ alkenylsulfonyl, C₁-C₄ haloalkylsulfonyl, NO₂, CN, CHO, OH, -NU¹U², phenyl, phenoxy or C₂-C₅ alkoxycarbonyl (provided that, if there are 2 or more such substituent groups, they may be the same or different) and the number of such substituent groups is 1, 2, 3, 4 or 5] or a compound represented by the formula (4):

B-O-B (4)

[in the formula (4), B has the same meaning as aforesaid]

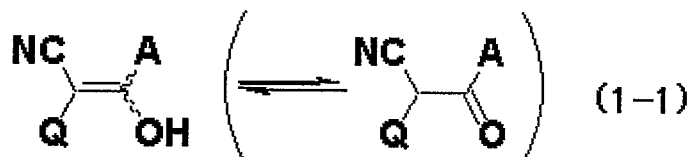
in the presence of a pyridine compound represented by the formula (2):



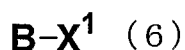
[in the formula (2), R represents H or $-\text{NU}^3\text{U}^4$ (provided that U^3 and U^4 each independently represent H or $\text{C}_1\text{-C}_8$ alkyl or else both U^3 and U^4 together with the linking nitrogen atom may form a 5-membered ring, 6-membered ring, 7-membered ring or 8-membered ring)].

The present invention also concerns a method for preferential production of the Z form of a compound represented by the said formula (5) by reacting a compound represented by the said formula (2) with the E form thereof.

The present invention further concerns a method for the isolation of the Z form of an acrylonitrile compound, wherein a geometric isomer mixture of an acrylonitrile compound represented by the said formula (5) is dissolved or suspended in a $\text{C}_1\text{-C}_{10}$ alcohol or a solvent containing a $\text{C}_1\text{-C}_{10}$ alcohol, the E form in the resulting solution or suspension is preferentially decomposed, and the Z form that remains and both the compound represented by the formula (1-1):



and the compound represented by the formula (6):

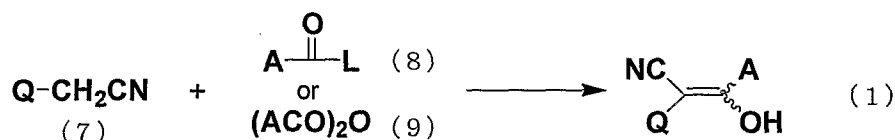


(in formula (1-1) and formula (6), A, B and Q have the same meanings as aforesaid and X^1 represents a $\text{C}_1\text{-C}_{10}$ alkyl group), which are the main decomposition products, are separated.

By means of the present invention, it is possible selectively to obtain, by simple methods, one geometric isomer of an acrylonitrile compound valuable as a pesticide and pharmaceutical.

Best Mode for carrying out the Invention

Compounds represented by the formula (1) can for example be produced by the method described in WO97/40009, as in the following reaction scheme.

Scheme 1

[in Scheme 1, Q, A and B have the same meanings as aforesaid, and L is a good leaving group, for example a chlorine atom, bromine atom, iodine atom, 1-4 carbon alkoxy, phenoxy, 1-4 carbon alkylsulfonyloxy, benzene-sulfonyloxy, toluenesulfonyloxy, 1-pyrazolyl or 1-imidazolyl or the like]

In other words, compounds represented by the general formula (1) can be obtained by reacting acetonitrile compounds represented by the general formula (7) and acid chlorides, esters or amides represented by the general formula (8) or acid anhydrides represented by the general formula (9).

The preferable ranges for Q, A, B, G, T, U¹, U², U³, U⁴, X or Y in the present invention are shown.

Heterocyclic group in Q, A or B has the following meanings.

Namely, thienyl is thiophen-2-yl or thiophen-3-yl, furyl is furan-2-yl or furan-3-yl, pyrrolyl is pyrrol-1-yl, pyrrol-2-yl or pyrrol-3-yl, oxazolyl is oxazol-2-yl, oxazol-4-yl or oxazol-5-yl, thiazolyl is thiazol-2-yl, thiazol-4-yl or thiazol-5-yl, imidazolyl is imidazol-1-yl, imidazol-2-yl or imidazol-4-yl, isoxazolyl is isoxazol-3-yl, isoxazol-4-yl or isoxazol-5-yl, isothiazolyl is isothiazol-3-yl, isothiazol-4-yl or isothiazol-5-yl, pyrazolyl is pyrazol-1-yl, pyrazol-3-yl, pyrazol-4-yl or pyrazol-5-yl, 1,3,4-oxadiazolyl is 1,3,4-oxadiazol-2-yl, 1,3,4-thiadiazolyl is 1,3,4-thiadiazol-2-yl, 1,2,4-oxadiazolyl is 1,2,4-oxadiazol-3-yl or 1,2,4-oxadiazol-5-yl, 1,2,4-thiadiazolyl is 1,2,4-thiadiazol-3-yl or 1,2,4-thiadiazol-5-yl, 1,2,4-triazolyl is 1,2,4-triazol-1-yl, 1,2,4-triazol-3-yl or 1,2,4-triazol-4-yl, 1,2,3-thiadiazolyl is 1,2,3-thia-diazol-4-yl or 1,2,3-thiadiazol-5-yl, 1,2,3-triazolyl is 1,2,3-triazol-1-yl, 1,2,3-triazol-2-yl or 1,2,3-triazol-4-yl, 1,2,3,4-tetrazolyl is 1,2,3,4-tetrazol-1-yl, 1,2,3,4-tetrazol-2-yl or 1,2,3,4-tetrazol-5-yl, pyridyl is pyridin-2-yl, pyridin-3-yl or pyridin-4-yl, pyrimidinyl is pyrimidin-2-yl, pyrimidin-4-yl or pyrimidin-5-yl, pyrazinyl is pyrazin-2-yl, pyridazinyl is pyridazin-3-yl or pyridazin-

4-yl, 1,3,5-triazinyl is 1,3,5-triazin-2-yl, 1,2,4-triazinyl is 1,2,4-triazin-2-yl, 1,2,4-triazin-3-yl, 1,2,4-triazin-5-yl or 1,2,4-triazin-6-yl, 1,2,4,5-tetrazinyl is 1,2,4,5-tetrazin-3-yl, pyrazolinyl is 3-pyrazolin-yl, 3-pyrazolin-3-yl, 3-pyrazolin-4-yl or 3-pyrazolin-5-yl, imidazolinyl is 1-imidazolin-3-yl, 1-imidazolin-2-yl, 1-imidazolin-4-yl or 4-imidazolin-2-yl, oxazolinyl is 2-oxazolin-2-yl, 2-oxazolin-4-yl or 2-oxazolin-5-yl, isoxazolinyl is 2-isoxazolin-3-yl, 2-isoxazolin-4-yl or 2-isoxazolin-5-yl, thiazolinyl is 2-thiazolin-2-yl, 2-thiazolin-4-yl or 3-thiazolin-2-yl, imidazolidinonyl is imidazolidin-2-on-1-yl, imidazolinonyl is 2-imidazolinon-1-yl, and 3(2H)-pyridazinonyl is 3(2H)-pyridazinon-2-yl, 3(2H)-pyridazinon-4-yl, 3(2H)-pyridazinon-5-yl or 3(2H)-pyridazinon-6-yl.

Examples of Q, A, B, G, T¹, T², T³, U¹, U², U³, U⁴, X and Y are shown.

As the halogen atom in the definition of G, a fluorine atom, chlorine atom, bromine atom and iodine atom are mentioned.

As the halogen atom in the definition of X, a fluorine atom, chlorine atom, bromine atom and iodine atom are mentioned and a chlorine atom is preferred.

As alkyl in the definitions of G, T¹, T², T³, U¹, U², U³, U⁴ or Y, as linear or branched alkyl, methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, tert-butyl, sec-butyl, 1-pentyl, 2-pentyl, 3-pentyl, 2-methyl-1-butyl, 2-methyl-2-butyl, 2-methyl-3-butyl, 3-methyl-1-butyl, 2,2-dimethyl-1-propyl, 1-hexyl, 2-hexyl, 3-hexyl, 1-methylpentyl, 2-methylpentyl, 3-methylpentyl, 4-methylpentyl, 1,1-dimethylbutyl, 1,2-dimethylbutyl, 1,3-dimethylbutyl, 2,2-dimethylbutyl, 2,3-dimethylbutyl, 3,3-dimethylbutyl, 1-ethylbutyl, 2-ethylbutyl, 1,1,2-trimethylpropyl, 1,2,2-trimethylpropyl, 1-ethyl-1-methylpropyl, 1-ethyl-2-methylpropyl, n-heptyl, n-octyl, n-nonyl, n-undecyl, n-dodecyl, n-tridecyl, n-tetradecyl, n-pentadecyl, n-hexadecyl, n-heptadecyl, n-octadecyl, n-nonadecyl, n-icosyl and the like are mentioned and these are selected within the respective specified carbon number ranges, and C₁-C₄ alkyl is preferred.

As alkenyl in the definitions of G or T¹, as linear or branched alkenyl, ethenyl, 1-propenyl, 2-propenyl, 1-butenyl, 2-butenyl, 3-butenyl, 1-methyl-2-propenyl, 2-methyl-2-propenyl, 1-pentenyl, 2-pentenyl, 3-pentenyl, 4-pentenyl, 1-methyl-2-butenyl, 2-methyl-2-butenyl, 3-methyl-2-butenyl, 1-methyl-3-butenyl, 2-methyl-3-butenyl, 3-methyl-3-butenyl, 1,1-dimethyl-2-propenyl, 1,2-dimethyl-2-propenyl, 1-ethyl-2-propenyl, 1-hexenyl, 2-hexenyl, 3-hexenyl, 4-hexenyl, 5-hexenyl, 1-methyl-2-pentenyl, 2-methyl-2-pentenyl, 3-methyl-2-pentenyl, 4-methyl-2-pentenyl, 1-

methyl-3-pentenyl, 2-methyl-3-pentenyl, 3-methyl-3-pentenyl, 4-methyl-3-pentenyl, 1-methyl-4-pentenyl, 2-methyl-4-pentenyl, 3-methyl-4-pentenyl, 4-methyl-4-pentenyl, 1,1-dimethyl-2-butenyl, 1,1-dimethyl-3-butenyl, 1,2-dimethyl-2-butenyl, 1,2-dimethyl-3-butenyl, 1,3-dimethyl-2-butenyl, 1,3-dimethyl-3-butenyl, 2,3-dimethyl-2-butenyl, 2,3-dimethyl-3-butenyl, 3,3-dimethyl-2-butenyl, 1-ethyl-2-butenyl, 1-ethyl-3-butenyl, 2-ethyl-2-butenyl, 2-ethyl-3-butenyl, 1,1,2-trimethyl-2-propenyl, 1-ethyl-1-methyl-2-propenyl and the like are mentioned and these are selected within the respective specified carbon number ranges.

As alkynyl in the definition of G, as linear or branched alkynyl, ethynyl, 1-propynyl, 2-propynyl, 1-butyne, 2-butyne, 3-butyne, 1-methyl-2-propynyl, 1-pentyne, 2-pentyne, 3-pentyne, 4-pentyne, 1-methyl-2-butyne, 1-methyl-3-butyne, 2-methyl-3-butyne, hexynyl, 1-methyl-3-pentyne, 1-methyl-4-pentyne, 2-methyl-3-pentyne, 2-methyl-4-pentyne, 3-methyl-4-pentyne, 4-methyl-2-pentyne, 1,1-dimethyl-2-butyne, 1,1-dimethyl-3-butyne, 1,2-dimethyl-3-butyne, 2,2-dimethyl-3-butyne, 1-ethyl-2-butyne, 1-ethyl-3-butyne, 2-ethyl-3-butyne and the like are mentioned and are these selected within the respective specified carbon number ranges.

As haloalkyl in the definitions of G, T¹ or Y, as linear or branched haloalkyl, fluoromethyl, chloro-methyl, bromomethyl, fluoroethyl, chloroethyl, bromo-ethyl, fluoro-n-propyl, chloro-n-propyl, difluoromethyl, chlorodifluoromethyl, trifluoromethyl, dichloromethyl, trichloromethyl, difluoroethyl, trifluoroethyl, trichloroethyl, chlorodifluoroethyl, bromodifluoromethyl, trifluorochloroethyl, hexafluoro-n-propyl, chlorobutyl, fluorobutyl, chloro-n-pentyl, fluoro-n-pentyl, chloro-n-hexyl, fluoro-n-hexyl and the like are mentioned and are these selected within the respective specified carbon number ranges.

As optionally C₁-C₃ alkyl-substituted C₃-C₆ cycloalkyl in the definitions of G, cyclopropyl, 1-methyl-cyclopropyl, 2,2,3,3-tetramethylcyclopropyl, cyclo-butyl, 1-ethylcyclobutyl, 1-n-butylcyclobutyl, cyclopentyl, 1-methylcyclopentyl, cyclohexyl, 1-methyl-cyclohexyl, 4-methylcyclohexyl and the like are mentioned.

As optionally halogen atom- or C₁-C₄ alkyl-substituted phenyl-substituted C₁-C₄ alkyl in the definitions of G or T¹, benzyl, 2-chlorobenzyl, 3-bromobenzyl, 4-chlorobenzyl, 4-methylbenzyl, 4-tert-butylbenzyl, 1-phenylethyl, 1-(3-chlorophenyl)ethyl, 2-phenylethyl, 1-methyl-1-phenylethyl, 1-(4-chloro-phenyl)-1-methyl-ethyl, 1-(3-chlorophenyl)-1-methyl-ethyl, 1-phenyl-propyl, 2-phenylpropyl, 3-phenylpropyl, 1-phenylbutyl, 2-phenylbutyl, 3-phenylbutyl, 4-phenyl-butyl, 1-methyl-

1-phenylpropyl, 1-methyl-2-phenyl-propyl, 1-methyl-3-phenylpropyl, 2-methyl-2-phenyl-propyl, 2-(4-chloro-phenyl)-2-methyl-propyl, 2-methyl-2-(3-methylphenyl)-propyl and the like are mentioned.

As optionally halogen atom- or C₁-C₃ alkyl-substituted phenyl-substituted C₃-C₆ cycloalkyl in the definition of T¹, 1-phenylcyclopropyl, 1-(3-chlorophenyl)cyclopropyl, 1-(4-chlorophenyl)cyclopropyl, 1-(4-bromophenyl)cyclo-propyl, 1-(4-fluorophenyl)-cyclopropyl, 1-(4-ethylphenyl)cyclopropyl, 1-(4-propylphenyl)cyclopropyl, 2-phenylcyclopropyl, 1-phenylcyclobutyl, 2-phenylcyclo-butyl, 1-phenylcyclopentyl, 1-(4-chlorophenyl)cyclo-pentyl, 2-phenylcyclopentyl, 3-phenylcyclopentyl, 1-phenylcyclohexyl, 1-(4-chlorophenyl)cyclohexyl, 1-(4-tert-butylphenyl)cyclohexyl, 2-phenylcyclohexyl, 3-phenylcyclohexyl, 4-phenylcyclohexyl and the like are mentioned.

As optionally halogen atom- or C₁-C₄ alkyl-substituted phenyl and C₁-C₄ alkyl-substituted cyclopropyl in the definition of T¹, 2,2-dimethyl-1-phenylcyclopropyl, 1-(4-chlorophenyl)-2,2-dimethylcyclopropyl, 2,2-di-methyl-3-phenylcyclopropyl, 3-(3-chlorophenyl)-2,2-dimethylcyclopropyl, (4-chlorophenyl)-2,2-dimethyl-3-phenylcyclopropyl, 2,2-dimethyl-3-(4-methylphenyl)-cyclopropyl, (4-tert-butylphenyl)-2,2-dimethyl-3-phenylcyclopropyl and the like are mentioned.

As optionally halogen atom- or C₁-C₄ alkoxy-substituted phenyl and halogen atom-substituted C₃-C₄ cycloalkyl in the definition of T¹, 2,2-dichloro-1-phenylcyclopropyl, 2,2-dichloro-1-(4-methoxyphenyl)-cyclopropyl, 2,2-di-chloro-1-(4-methoxyphenyl)-cyclopropyl, 2,2-dichloro-1-(4-ethoxyphenyl)cyclopropyl, 2,2-dichloro-1-(4-iso-propoxyphenyl)cyclopropyl, 2,2-dichloro-1-(4-tert-butoxyphenyl)cyclopropyl, 2,2-dichloro-1-(4-methoxy-phenyl)-3-phenylcyclopropyl, 1-(4-ethoxyphenyl)- 2,2,3,3-tetrafluorocyclobutyl and the like are mentioned.

As optionally halogen atom-substituted C₂-C₄ alkenyl- and C₁-C₄ alkyl-substituted cyclopropyl in the definition of T¹, 2,2-dimethyl-3-(2,2-dimethylethenyl)-cyclopropyl, 3-(2,2-dibromoethenyl)-2,2-dimethylcyclo-propyl, 3-(2,2-dichloroethenyl)-2,2-dimethylcyclo-propyl, 3-(2,2-chlorotrifluoroethenyl)-2,2-dimethyl-cyclopropyl and the like are mentioned.

As optionally C₁-C₃ alkyl-substituted C₃-C₆ cycloalkoxy in the definition of T¹, cyclopropoxy, cyclobutoxy, cyclopentoxo, cyclohexyloxy, 1-methyl-cyclopropoxy and the like are mentioned.

As optionally halogen atom- or C₁-C₄ alkyl-substituted phenyl-substituted C₂-C₄ alkenyl in the definition of T¹, 1-phenylethenyl, 2-phenylethenyl, 2-(2-chlorophenyl)ethenyl, 2-(3-chlorophenyl)ethenyl, 2-(4-chlorophenyl)ethenyl, 2-(4-methylphenyl)ethenyl, 2-(2,6-difluorophenyl)ethenyl, 2-(2,5-dimethylphenyl)ethenyl, 1-methyl-2-phenylethenyl, 2-phenyl-1-propenyl, 2-(4-bromophenyl)-1-propenyl, 2-(2,4,6-trimethylphenyl)-1-propenyl and the like are mentioned.

As alkoxy in the definitions of G, T¹, X or Y, as linear or branched alkoxy, methoxy, ethoxy, n-propoxy, isopropoxy, n-butoxy, isobutoxy, sec-butoxy, tert-butoxy, n-pentyloxy, 1-methylbutoxy, 2-methylbutyl-oxy, 3-methylbutoxy, 1,1-dimethylpropoxy, 1,2-di-methylpropoxy, 2,2-dimethylpropoxy, 1-ethylpropoxy, n-hexyloxy, 1-methylpentyloxy, 2-methylpentyloxy, 3-methylpentyloxy, 4-methylpentyloxy, 1,1-dimethylbutoxy, 1,2-dimethylbutoxy, 1,3-dimethylbutoxy, 2,2-dimethylbutoxy, 2,3-dimethylbutoxy, 3,3-di-methylbutoxy, 1-ethylbutoxy, 2-ethylbutoxy, 1,1,2-trimethylpropoxy, 1,2,2-trimethylpropoxy, 1-ethyl-1-methylpropoxy, 1-ethyl-2-methylpropoxy, n-heptyloxy, n-octyloxy, n-nonyloxy, n-decyloxy and the like are mentioned and these are selected within the respective specified carbon number ranges.

As C₃-C₆ halocycloalkyl in the definitions of G or T¹, fluorocyclopropyl, difluorocyclopropyl, chlorocyclo-propyl, dichlorocyclopropyl, 1-methyl-2,2-dichlorocyclopropyl, chlorocyclobutyl, dichlorocyclobutyl, chlorocyclopentyl, dichlorocyclopentyl, chlorocyclo-hexyl, dichlorocyclohexyl, tetrafluorocyclobutyl and the like are mentioned.

As -NU¹U² in the definitions of T¹ or Y, methylamino, ethylamino, n-propylamino, isopropylamino, n-butyl-amino, isobutylamino, sec-butylamino, tert-butyl-amino, n-pentylamino, 1-methylbutylamino, 2-methyl-butylamino, 3-methylbutylamino, 1,1-dimethylpropyl-amino, 1,2-dimethylpropylamino, 2,2-dimethylpropyl-amino, 1-ethylpropylamino, n-hexylamino, 1-methyl-pentylamino, 2-methylpentylamino, 3-methylpentylamino, 4-methylpentylamino, 1,1-dimethylbutylamino, 1,2-dimethylbutyl-amino, 1,3-dimethylbutylamino, 2,2-dimethyl-butylamino, 2,3-dimethyl-butylamino, 3,3-dimethylbutyl-amino, 1-ethylbutylamino, 2-ethylbutylamino, 1,1,2-trimethylpropylamino, 1,2,2-trimethylpropylamino, 1-ethyl-1-methylpropylamino, 1-ethyl-2-methylpropylamino, dimethylamino, diethylamino, di-n-propylamino, diisopropylamino, di-n-butylamino, di-sec-butylamino, diisobutylamino, di-n-pentylamino, di-n-hexylamino, methylethylamino, methylpropylamino, methyl-isopropylamino, methylbutylamino, methyl-sec-butylamino, methyl-isobutylamino, methyl-tert-

butylamino, methylpentylamino, methylhexylamino, ethylpropylamino, ethylisopropylamino, ethylbutylamino, ethyl-sec-butylamino, ethylisobutylamino, ethylpentylamino, ethylhexylamino, phenylamino, benzylamino, N-methylacetamido, N-ethylacetamido, N-phenylacetamido, N-acetylacetamido and the like are mentioned and these are selected within the respective specified carbon number ranges.

As C₂-C₅ alkoxy-carbonyl in the definitions of G, T¹ and Y, methoxycarbonyl, ethoxycarbonyl, n-propoxycarbonyl, isopropoxycarbonyl, n-butoxycarbonyl, sec-butoxy-carbonyl, isobutoxycarbonyl, tert-butoxycarbonyl and the like are mentioned.

As C₁-C₄ haloalkoxy in the definition of G, T¹ or Y, the respective C₁-C₄ linear or branched haloalkoxy are mentioned and fluoromethoxy, difluoromethoxy, trifluoromethoxy, chlorodifluoromethoxy, bromodifluoro-methoxy, dichlorofluoromethoxy, chloromethoxy, dichloromethoxy, trichloromethoxy, bromomethoxy, fluoroethoxy, chloroethoxy, bromoethoxy, difluoroethoxy, trifluoroethoxy, tetrafluoroethoxy, pentafluoroethoxy, trichloroethoxy, trifluorochloroethoxy, fluoropropoxy, chloropropoxy, bromopropoxy, fluorobutoxy, chlorobutoxy, fluoroisopropoxy and chloroisopropoxy and the like are mentioned.

As C₁-C₄ alkylsulfinyl in the definitions of G and Y, methylsulfinyl, ethylsulfinyl, n-propylsulfinyl, isopropylsulfinyl, n-butylsulfinyl, isobutylsulfinyl, sec-butylsulfinyl and tert-butylsulfinyl are mentioned.

As C₁-C₄ alkylsulfonyl in the definitions of B, G or Y, methylsulfonyl, ethylsulfonyl, n-propylsulfonyl, isopropylsulfonyl, n-butylsulfonyl, isobutylsulfonyl, sec-butylsulfonyl and tert-butylsulfonyl are mentioned.

As C₂-C₄ alkoxyalkyl in the definitions of G or T¹, C₁-C₃ alkoxymethyl, C₁-C₂ alkoxyethyl, methoxyethoxymethyl, methoxypropyl and the like are mentioned.

As C₂-C₄ alkylcarbonyl in the definitions of G, U¹ or U², acetyl, propionyl, butanoyl and isobutanoyl are mentioned.

As C₂-C₆ haloalkylcarbonyl in the definition of G, chloroacetyl, trifluoroacetyl, 3,3,3-trifluoropropionyl, pentafluoropropionyl and the like are mentioned.

As C₂-C₅ haloalkylcarbonyloxy in the definition of G, chloroacetyloxy, trifluoroacetyloxy, 3,3,3-trifluoro-propionyloxy, pentafluoropropionyloxy and the like are mentioned.

As C₃-C₇ dialkylaminocarbonyloxy in the definition of G, dimethylaminocarbonyloxy, diethylaminocarbonyloxy, diisopropylaminocarbonyloxy and the like are mentioned.

As naphthyl in the definitions of T¹ or G, 1-naphthyl and 2-naphthyl are mentioned.

As optionally Y-substituted pyridyl in the definitions of G or T¹, optionally Y-substituted 2-pyridyl, optionally Y-substituted 3-pyridyl or optionally Y-substituted 4-pyridyl are mentioned and it is preferably optionally Y-substituted 2-pyridyl or optionally Y-substituted 3-pyridyl, more preferably optionally Y-substituted 2-pyridyl.

As optionally Y-substituted pyridyloxy in the definitions of G, optionally Y-substituted 2-pyridyloxy, optionally Y-substituted 3-pyridyloxy and optionally Y-substituted 4-pyridyloxy are mentioned.

As optionally Y-substituted thienyl in the definition of G, optionally Y-substituted 2-thienyl group and optionally Y-substituted 3-thienyl group are mentioned.

In the definition of G, -N=CT²T³ means alkylideneamino, benzylideneamino, arylideneamino or cycloalkylidene-amino, and methylenediamino, 4-methyl-2-pentylidene-amino, cyclopentylideneamino and the like are mentioned.

As C₁-C₄ monoalkylaminosulfonyl in the definition of B, methylaminosulfonyl, ethylaminosulfonyl, n-propylaminosulfonyl, isopropylaminosulfonyl, n-butylaminosulfonyl and the like are mentioned.

As C₂-C₈ dialkylaminosulfonyl in the definition of B, dimethylaminosulfonyl, diethylaminosulfonyl, di-n-propylaminosulfonyl, diisopropylaminosulfonyl, di-n-butylaminosulfonyl and the like are mentioned.

As C₂-C₅ monoalkylaminothiocarbonyl in the definition of B, methylaminothiocarbonyl, ethylaminothiocarbonyl, n-propylaminothiocarbonyl, isopropylaminothiocarbonyl, n-butylaminothiocarbonyl and the like are mentioned.

As C₃-C₉ dialkylaminothiocarbonyl in the definition of B, dimethylaminothiocarbonyl,

diethylaminothiocarbonyl, di-n-propylaminothiocarbonyl, diisopropylaminothiocarbonyl, di-n-butylaminothiocarbonyl and the like are mentioned.

As optionally halogen atom- or C₁-C₄ alkyl-substituted phenylsulfonyl in the definition of B, 2-fluorophenylsulfonyl, 4-fluorophenylsulfonyl, 2-chlorophenylsulfonyl, 4-chlorophenylsulfonyl, 4-bromophenylsulfonyl, 2,5-dichlorophenylsulfonyl, pentafluoro-phenylsulfonyl, 4-methylphenylsulfonyl, 2-methylphenylsulfonyl, 4-tert-butylphenylsulfonyl, 2,5-dimethylphenylsulfonyl, 2,4-dimethylphenylsulfonyl, 2,4,6-trimethylphenylsulfonyl, 2,4,6-triisopropylphenylsulfonyl and the like are mentioned.

As C₂-C₅ cyanoalkyl in the definitions of G or B, cyano-methyl, 2-cyanoethyl, 3-cyanopropyl, 1-cyano-1-methyl-ethyl and the like are mentioned.

As optionally halogen atom- or C₁-C₄ alkyl-substituted phenyl-substituted methoxy in the definition of G, benzyloxy, 2-chlorobenzyloxy, 3-chlorobenzyloxy, 4-chlorobenzyloxy, 3-methylbenzyloxy, 4-tert-butylbenzyloxy, 2,6-difluorobenzyloxy, 2-fluoro-4-chlorobenzyloxy and the like are mentioned.

As haloalkylsulfenyl in the definitions of G, as C₁-C₄ linear or branched haloalkyl thio, fluoromethyl-thio, chlorodifluoromethylthio, bromodifluoromethyl-thio, trifluoromethylthio, trichloromethylthio, 2,2,2-trifluoroethylthio, 1,1,2,2-tetrafluoroethylthio, fluoroethylthio, pentafluoroethylthio, fluoroisopropylthio and the like are mentioned.

As haloalkylsulfinyl in the definitions of G, as C₁-C₄ linear or branched haloalkylsulfinyl, fluoro-methylsulfinyl, chlorodifluoromethylsulfinyl, bromodifluoromethylsulfinyl, trifluoromethylsulfinyl, trichloromethylsulfinyl, 2,2,2-trifluoroethylsulfinyl, 1,1,2,2-tetrafluoroethylsulfinyl, fluoroethylsulfinyl, pentafluoroethylsulfinyl, fluoroisopropylsulfinyl and the like are mentioned.

As haloalkylsulfonyl in the definitions of G or Y, as C₁-C₄ linear or branched haloalkylsulfonyl, fluoro-methylsulfonyl, chlorodifluoromethylsulfonyl, bromodifluoromethylsulfonyl, trifluoromethylsulfonyl, trichloromethylsulfonyl, 2,2,2-trifluoroethylsulfonyl, 1,1,2,2-tetrafluoroethylsulfonyl, fluoroethylsulfonyl, pentafluoroethylsulfonyl, fluoroisopropylsulfonyl and the like are mentioned.

As haloalkenyl in the definitions of G, as C₂-C₄ linear or branched haloalkenyl, 2-chloroethenyl, 2-bromoethenyl, 2,2-dichloroethenyl and the like are mentioned.

As alkenyloxy in the definitions of G or T¹, as C₂-C₄ linear or branched alkenyloxy, allyloxy, 2-propenyloxy, 2-butenyloxy, 2-methyl-2-propenyloxy and the like are mentioned.

As haloalkenyloxy in the definition of G, 3-chloro-2-propenyloxy, 3,3-dichloro-2-propenyloxy, 4-chloro-2-butenyloxy, 4,4-dichlorobutenyloxy, 4,4-difluoro-3-butenyloxy and the like are mentioned.

As alkenylsulfenyl in the definitions of G or Y, as C₂-C₄ linear or branched alkenylsulfenyl, allylsulfenyl, 2-propenylsulfenyl, 2-butenylsulfenyl, 2-methyl-2-propenylsulfenyl and the like are mentioned.

As alkenylsulfinyl in the definitions of G or Y, as C₂-C₄ linear or branched alkenylsulfinyl, allylsulfinyl, 2-propenylsulfinyl, 2-butenylsulfinyl, 2-methyl-2-propenylsulfinyl and the like are mentioned.

As alkenylsulfonyl in the definitions of G or Y, as C₂-C₄ linear or branched alkenylsulfonyl, allylsulfonyl, 2-propenylsulfonyl, 2-butenylsulfonyl, 2-methyl-2-propenylsulfonyl and the like are mentioned.

As haloalkenylsulfenyl in the definition of G, as C₂-C₄ linear or branched haloalkenylsulfenyl, 3-chloro-2-propenylsulfenyl, 4-chloro-2-propenylsulfenyl, 3,3-dichloro-2-propenylsulfenyl, 4,4-dichloro-3-butenylsulfenyl, 4,4-difluoro-3-butenylsulfenyl and the like are mentioned.

As haloalkenylsulfinyl in the definition of G, as C₂-C₄ linear or branched haloalkenylsulfinyl, 3-chloro-2-propenylsulfinyl, 4-chloro-2-butenylsulfinyl, 4,4-dichloro-3-butenylsulfinyl, 4,4-difluoro-3-butenylsulfinyl and the like are mentioned.

As haloalkenylsulfonyl in the definition of G, as C₂-C₄ linear or branched haloalkenylsulfonyl, 3-chloro-2-propenylsulfonyl, 3,3-dichloro-2-propenylsulfonyl, 4-chloro-2-butenylsulfonyl, 4,4-dichloro-3-butenylsulfonyl, 4,4-difluoro-3-butenylsulfonyl and the like are mentioned.

As C₂-C₄ haloalkynyl in the definition of G, chloro-ethynyl, bromoethynyl, iodoethynyl, 3-chloro-1-propynyl, 3-bromo-1-butynyl and the like are mentioned.

As the C₂-C₄ alkynyloxy group in the definition of G, 2-propynyloxy, 2-butyloxy, 1-methyl-2-propynyloxy and the like are mentioned.

As C₂-C₄ haloalkynyloxy in the definition of G, 3-chloro-2-propynyloxy, 3-bromo-2-propynyloxy, 3-iodo-2-propynyloxy and the like are mentioned.

As C₂-C₆ alkynylsulfenyl in the definition of G, 2-propynylsulfenyl, 2-butylnylsulfenyl, 1-methyl-2-propynylsulfenyl and the like are mentioned.

As C₂-C₆ alkynylsulfinyl in the definition of G, 2-propynylsulfinyl, 2-butylnylsulfinyl, 1-methyl-2-propynylsulfinyl and the like are mentioned.

As C₂-C₆ alkynylsulfonyl in the definition of G, 2-propynylsulfonyl, 2-butylnylsulfonyl, 1-methyl-2-propynylsulfonyl and the like are mentioned.

As C₂-C₆ haloalkynylsulfenyl in the definition of G, 3-chloro-2-propynylsulfenyl, 3-bromo-2-propynylsulfenyl, 3-iodo-2-propynylsulfenyl and the like are mentioned.

As C₂-C₆ haloalkynylsulfinyl in the definition of G, 3-chloro-2-propynylsulfinyl, 3-bromo-2-propynylsulfinyl, 3-iodo-2-propynylsulfinyl and the like are mentioned.

As C₂-C₆ haloalkynylsulfonyl in the definition of G, 3-chloro-2-propynylsulfonyl, 3-bromo-2-propynylsulfonyl, 3-iodo-2-propynylsulfonyl and the like are mentioned.

As optionally Y-substituted benzoyl in the definition of G, benzoyl, 2-chlorobenzoyl, 3-chlorobenzoyl, 4-chlorobenzoyl, 4-bromobenzoyl, 4-fluorobenzoyl, 3-methylbenzoyl, 4-methylbenzoyl, 4-tert-butylbenzoyl, 3,4-dichlorobenzoyl and the like are mentioned.

As the heterocyclic group in Q, the 2-thiazolyl group and 4-thiazolyl group are preferred, and as substituent groups of Q, the methyl group, ethyl group, tert-butyl group, trifluoromethyl group and phenyl group are preferred.

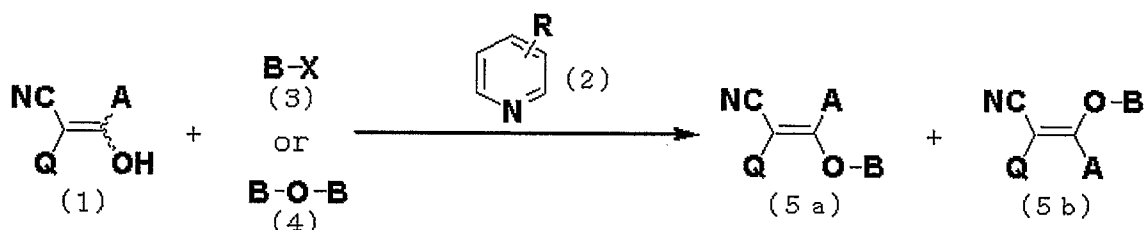
As the heterocyclic group in A, the 5-thiazolyl group and 5-pyrazolyl group are preferred, and as substituent groups of A, the methyl group, ethyl group, trifluoromethyl group and phenyl group are preferred.

As B, the acetyl group, phenylcarbonyl group or pivaloyl group are preferred.

As R, H and the 4-dimethylamino group are preferred.

The geometric isomers of compounds represented by the formula (5) which are not obtained as the main product by the usual methods can be produced by the method of the following reaction scheme.

Scheme 2



[in Scheme 2, Q, A, B and R have the same meanings as aforesaid]

In other words, by addition of a compound represented by the formula (3) or a compound represented by the formula (4) to a compound represented by the formula (1) in the presence of a pyridine compound represented by the formula (2), among the E form (5a) and Z form (5b), the Z form can be produced as the main product. Further, the E form can also be isomerized to the Z form by reacting with a pyridine compound represented by the formula (2).

The reaction temperature is preferably 0°C to 150°C, more preferably 20°C to 100°C.

The reaction is preferably performed in an unreactive gas atmosphere.

As the unreactive gas, nitrogen, argon and xenon are mentioned.

The reaction is performed in an organic solvent or in a heterogenous system of organic solvent and water. There is no particular restriction as to the organic solvent, provided that it is a solvent wherein the aforesaid compound represented by the formula (1) and compound represented by the formula (5) can be dissolved or suspended, and the Z form as the main product is stably present in the reaction liquid. For example, ethers such as diethyl ether, tetrahydrofuran, dimethoxyethane, dioxan and methyl cyclopentyl ether; aromatic hydrocarbons such as benzene,

xylene and toluene; aliphatic hydrocarbons such as pentane, hexane, cyclohexane and petroleum ether; halogenated hydrocarbons such as dichloromethane, chloroform,

1,2-dichloroethane and carbon tetrachloride; esters such as ethyl acetate and butyl acetate; ketones such as acetone and methyl ethyl ketone; nitriles such as acetonitrile and propionitrile; amides such as N,N-dimethylformamide, N,N-dimethylacetamide, N-methylpyrrolidone and N,N'-dimethylimidazolinone; or dimethyl sulfoxide; or mixtures of these solvents and the like are mentioned, and in particular aromatic solvents such as for example toluene and nitriles such as acetonitrile are preferred. Further, it can also be performed in a 2-phase system of water and a solvent which separates, in particular, with regard to easy isolation of the desired product, it is preferably performed in a 2-phase system of an aromatic hydrocarbon such as for example toluene and water.

As the pyridine compound represented by the formula (2), for example pyridine and 4-dimethylaminopyridine are preferred.

The quantity of the pyridine compound represented by the formula (2) is normally 0.001 equivalents to 100 equivalents, preferably 0.05 equivalents to 1 equivalent of the compound represented by formula (1).

Further, when the E form is isomerized, it can be subjected to react a pyridine compound represented by the formula (2) in an aforesaid solvent, or else a pyridine compound represented by the formula (2) can itself be used as the solvent.

As the base used in the reaction, a pyridine compound represented by the formula (2) can be used alone - however it may be preferable to use another base simultaneously.

In that case, as the base used simultaneously with the pyridine compound represented by the formula (2), alkali metal hydroxides such as sodium hydroxide and potassium hydroxide; alkali metal carbonates such as sodium carbonate and potassium carbonate; organic bases such as triethylamine, pyridine and diazabicycloundecene (DBU); alkali metal alkoxides such as sodium methoxide, sodium ethoxide and tert-butoxypotassium; organolithium compounds such as butyllithium; lithium amides such as lithium diisopropylamide and lithium bistrimethylsilylamide; and sodium hydride and the like are mentioned, and in particular, for example alkali metal hydroxides such as sodium hydroxide and

potassium hydroxide and alkali metal carbonates such as sodium carbonate and potassium carbonate are preferred.

It may be preferable to add a phase transfer catalyst to the reaction liquid. As the phase transfer catalyst used, quaternary ammonium salts such as tetrabutylammonium chloride, tetrabutylammonium bromide and benzyldimethylammonium chloride, quaternary phosphonium salts such as tetraethylphosphonium bromide, tetrabutylphosphonium bromide, tetrabutylphosphonium chloride and the like are mentioned.

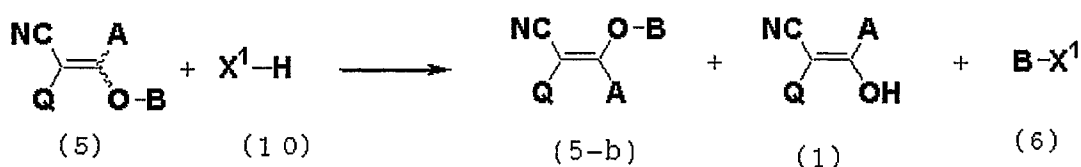
The quantity of phase transfer catalyst added is preferably 0.0001 equivalents to 1 equivalent, more preferably 0.001 equivalents to 0.5 equivalents of the compound represented by formula (1).

The addition period of the compound represented by the aforesaid formula (3) and the compound represented by the aforesaid formula (4) varies depending on the reactivity of the substrate and the reaction temperature, and is preferably 30 mins to 20 hrs.

The quantity of the compound represented by the aforesaid formula (3) or (4) is preferably 1.0 equivalents to 10.0 equivalents, more preferably 1.0 equivalents to 2.0 equivalents of the compound represented by the aforesaid formula (1).

In a geometric isomer mixture of a compound represented by the formula (5), the E form can be preferentially decomposed according to the following reaction scheme, and the Z form isolated.

Scheme 3



[In scheme 3, Q,A,B has the same meaning as aforesaid, and X¹ represents a C₁-C₁₀ alkoxy group or benzyl group]

In other words, by reacting a geometric isomer mixture of the compound represented by the formula (5) with an alcohol represented by the formula (10), the

E form is preferentially decomposed, to give a compound represented by the formula (1) and an ester represented by the formula (6).

As the aforesaid C₁-C₁₀ alcohol represented by X¹-H in the present invention, methanol, ethanol, 1-propanol, 2-propanol, 1-butanol, 2-butanol, 2,2-dimethylpropanol, ethylene glycol and the like are mentioned.

The reaction temperature is preferably 0°C to 150°C, more preferably 50°C to 100°C.

The reaction is preferably performed in an unreactive gas atmosphere.

As the unreactive gas, nitrogen, argon and xenon are mentioned.

As regards the quantity of alcohol used, at least 1 equivalent is necessary, but it is preferably at least 3 equivalents of the compound represented by formula (5).

The reaction can be performed in the alcohol solvent, or in a solvent mixture of alcohol and another solvent. As solvents other than the alcohol, for example ethers such as diethyl ether, tetrahydrofuran, dimethoxyethane, dioxan and methyl cyclopentyl ether; aromatic hydrocarbons such as benzene, xylene and toluene; aliphatic hydrocarbons such as pentane, hexane, cyclo-hexane and petroleum ether; halogenated hydrocarbons such as dichloromethane, chloroform, 1,2-dichloroethane and carbon tetrachloride; esters such as ethyl acetate and butyl acetate; ketones such as acetone and methyl ethyl ketone; nitriles such as acetonitrile and propionitrile; amides such as N,N-dimethylformamide, N,N-dimethylacetamide, N-methylpyrrolidone and N,N'-dimethylimidazolinone; or dimethyl sulfoxide; or mixtures of these solvents and the like are mentioned.

If no substituent groups displaying acidity or basicity are present in A, B and Q, the compounds represented by the formula (1) are acidic substances, and the compounds represented by the formula (5) and the compounds represented by the formula (6) are neutral substances, hence the compounds represented by the formula (1) can be isolated simply by normal operations using liquids, without the use of complex operations such as chromatography.

As operations after the reaction, for example a liquid fractionation using water and an organic solvent is preferably used, and by the use of an alkaline aqueous

solution such as aqueous sodium hydroxide solution or potassium hydroxide solution as the aqueous layer, the compound represented by the formula (1) partitions into the aqueous phase, and the undecomposed isomer of the compound represented by the formula (5-b) and the compound represented by the formula (6) partition into the organic phase, and these compounds can be isolated. Furthermore, by removing the organic solvent from the organic layer containing the compound represented by the formula (5-b) and the compound represented by the formula (6), and performing normal crystallization operations and the like, the compound represented by the formula (5-b) can be isolated from the compound represented by the formula (6).

The compound represented by the formula (1) is a starting material for the compound represented by the formula (5), and since it can be recovered and reutilized, there is little wastage, which is industrially very advantageous.

As the aqueous alkaline solution used in the extraction operation after the reaction, aqueous sodium hydroxide solution, aqueous potassium hydroxide solution, aqueous sodium carbonate solution, aqueous sodium hydrogen carbonate solution, aqueous potassium carbonate solution or aqueous potassium hydrogen carbonate solution and the like are mentioned.

The concentration of the aqueous alkaline solution used in the extraction operation after the reaction is 0.1% to 30%, preferably 0.5 to 10%.

As the organic solvent used in the extraction operation after the reaction, hydrocarbon solvents such as benzene, toluene and xylene; aliphatic hydrocarbons such as hexane, heptane and octane; halogenated hydrocarbons such as chloroform, 1,2-dichloroethane and carbon tetrachloride; ethers such as diethyl ether, diisopropyl ether and dimethoxyethane; or esters such as ethyl acetate and butyl acetate; or mixtures of these solvents, and the like are mentioned.

Examples

Below, the present invention is specifically described by the presentation of practical examples, however, the present invention is not restricted thereby.

[Practical Example 1] Preferential Production Method

0.0122 g of dimethylaminopyridine, 0.16 g of tetra-butylammonium bromide, 1.26 g

of sodium hydrogen carbonate and 1.93 g of 2-cyano-2-(2-phenylthiazol-4-yl)-1-(2-methyl-4-trifluoromethylthiazol-5-yl) ethenyl alcohol were added to 10 g of toluene, and heated to 60°C. A solution of 0.75 g of pivaloyl chloride mixed with 10 g of toluene was added dropwise to this solution over 3 hrs. During this, the reaction liquid was sampled several times and the state of the reaction checked by HPLC. When the quantities of the geometric isomer of {2-cyano-2-(2-phenylthiazol-4-yl)-1-(2-methyl-4-trifluoromethylthiazol-5-yl)}ethenyl 2,2-dimethylpropionate ester product and starting material which were present were calculated from the sensitivity ratio, it was confirmed that the Z form was always the main product in the reaction liquid. The results are shown in Table 1.

Table 1

Piv. Cl. added (equivs.)	S. M. present (%)	E form present (%)	Z form present (%)	Z/E ratio
0	100			
0.25	63.3	11.0	25.7	2.33
0.5	41.9	15.2	42.9	2.81
0.75	24.3	20.6	55.1	2.68
1	4.8	24.7	70.5	2.85
1.25	1.9	25.1	73.0	2.91

Key: Piv. Cl. = pivaloyl chloride, S.M. = starting material

[in Table 1, the ratios of starting material, E form and Z form present indicate the mole ratios of the three compounds]

[Practical Example 2] Preferential Production Method

0.24 g of sodium hydroxide, 0.0122 g of dimethylaminopyridine, 0.16 g of tetrabutylammonium bromide and 1.97 g of 2-cyano-2-(2-phenyl-thiazol-4-yl)-1-(2-methyl-4-trifluoromethylthiazol-5-yl)ethenyl alcohol were added to a solvent mixture of 10 g of toluene and 20 g of water, and heated to 60°C. A solution of 0.9 g of pivaloyl chloride mixed with 10 g of toluene was added dropwise to this solution over 3 hrs, while maintaining it at 60°C. During this, the reaction liquid was sampled several times, and the state of the reaction checked by HPLC. When the quantities of the geometric isomer of {2-cyano-2-(2-phenylthiazol-4-yl)-1-(2-methyl-4-tri-fluoromethylthiazol-5-yl)}ethenyl 2,2-dimethylpropionate ester product and starting material which were present were calculated from the sensitivity ratio, it was confirmed that the Z form was always the main product in the reaction liquid. Further, the quantity-based yields at the end of the reaction were E form 25.6%, Z form 69.1% and starting material 2.4%. The results are shown in Table 2.

Table 2

Piv. Cl. added (equivs.)	S. M. present (%)	E form present (%)	Z form present (%)	Z/E ratio
0	100			
0.25	64.8	9.4	25.8	2.74
0.5	57.0	10.7	32.3	3.02
0.75	37.1	15.5	47.4	3.05
1	13.1	22.6	64.3	2.84
1.25	3.1	26.2	70.7	2.69
1.5	2.0	26.5	71.5	2.70

Key: Piv. Cl. = pivaloyl chloride, S.M. = starting material

[in Table 2, the ratios of starting material, E form and Z form present indicate the mole ratios of the three compounds]

[Practical Example 3] Isomerization of E form to Z form

5864 g of (1E)-{2-cyano-2-(2-phenylthiazol-4-yl)-1-(2-methyl-4-trifluoromethylthiazol-5-yl)} 2,2-dimethylpropionate were suspended in 14660 g of toluene. 30.6 g of 4-dimethylaminopyridine were added, the reaction liquid was heated to 60°C, and after visual checking that the starting material had completely dissolved, it was stirred for 2.5 hrs. On analysis of the reaction liquid by HPLC, it was confirmed that in relative terms 53% of the Z form, which is the geometric isomer of the starting material, had formed, and 31% of the E form, which was the starting material, remained.

[Comparison Example 1]

1.0 g of 2-cyano-2-(2-phenylthiazol-4-yl)-1-(2-methyl-4-trifluoromethylthiazol-5-yl) ethenyl alcohol and 0.28 g of triethylamine were dissolved in 10 ml of toluene, and 0.33 g of pivaloyl chloride were added dropwise to this over 1 hr. After stirring overnight at room temperature, it was extracted by addition of 20 ml of water. After separation of the organic layer, the solvent was distilled off, and the residue was washed with 10 ml of isopropyl alcohol. The crystals obtained were filtered off and dried under vacuum, and 1.05 g of (1E)-{2-cyano-2-(2-phenylthiazol-4-yl)-1-(2-methyl-4-trifluoromethylthiazol-5-yl)}ethenyl 2,2-dimethylpropionate ester were obtained as a pale yellow solid (yield 86.6%).

[Comparison Example 2]

22.1 kg of 2-cyano-2-(2-phenylthiazol-4-yl)-1-(2-methyl-4-trifluoromethylthiazol-5-

yl) ethenyl alcohol were suspended in 155.25 kg of toluene, and 6.51 kg of triethylamine were added at room temperature. This solution was cooled to 10°C, and 7.75 kg of pivaloyl chloride were added over 25 mins. The reaction liquid was restored to room temperature, and stirred for 4 hrs, then, when the reaction liquid was analyzed by HPLC, it was confirmed that of the geometric isomers of the {2-cyano-2-(2-phenylthiazol-4-yl)-1-(2-methyl-4-trifluoromethyl-thiazol-5-yl)}ethenyl 2,2-di-methylpropionate ester, which was the product, in relative terms 93.6% of the E form and 3.9% of the Z form had been produced.

[Practical Example 4] Decomposition of One Geometric Isomer

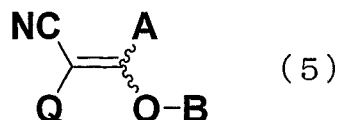
1622 g of 2,2-dimethyl-{2-cyano-2-(2-phenylthiazol-4-yl)-1-(2-methyl-4-trifluoromethylthiazol-5-yl)}ethenyl propionate ester geometric isomer mixture (E:Z = 1:3) were dissolved in 3800 g of methanol with heating at 65-70°C, and stirred for 16 hrs while being maintained at this temperature. After HPLC confirmation of the disappearance of one isomer, the solvent was distilled off and the residue was extracted by addition of 7000 g of toluene and 2440 g of 2% aqueous sodium hydroxide solution. After separation of the aqueous layer, the toluene layer was washed with 820 g of 1% aqueous sodium hydroxide solution, and then washed 3 times with 1300 g of water. After removal of the toluene by distillation, 6500 g of heptane were added, and after heating to dissolve, this was cooled to room temperature. The crystals which deposited were filtered off, and on drying 944 g of 2,2-dimethyl-(1Z)-{2-cyano-2-(2-phenylthiazol-4-yl)-1-(2-methyl-4-trifluoromethyl-thiazol-5-yl)}propionic acid ethenyl ester were obtained. Further, after addition of 35% aqueous HCl solution to the previously separated 2% aqueous sodium hydroxide solution layer until it reached pH 6, it was extracted by addition of 1500 g of chloroform. After washing the chloroform layer twice with 1000 g of water and distilling off the chloroform, 341 g of 2-cyano-2-(2-phenylthiazol-4-yl)-1-(2-methyl-4-trifluoromethylthiazol-5-yl)ethenyl alcohol were obtained.

Possible Industrial Applications

The production method of the present invention is useful as a method for obtaining the Z form of an acrylonitrile compound, which is a compound useful for pesticides and the like, as the main product. Further, it is useful as a method for isolating the Z form of an acrylonitrile compound and as a simple method for recovering the decomposition products.

Claims

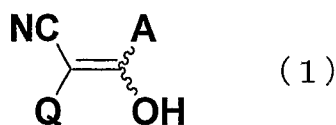
1. A method for the preferential production of the Z form of a compound represented by the formula (5):



[in formula (5), A, B and Q have the same meanings as stated below],

wherein

an acrylonitrile compound represented by the formula (1):



[in the formula, A and Q each independently are optionally G-substituted phenyl group, optionally G-substituted naphthyl group or optionally G-substituted heterocyclic group (provided that this heterocyclic group is thienyl, furyl, pyrrolyl, oxazolyl, thiazolyl, imidazolyl, isoxazolyl, isothiazolyl, pyrazolyl, 1,3,4-oxadiazolyl, 1,3,4-thiadiazolyl, 1,2,4-oxadiazolyl, 1,2,4-thiadiazolyl, 1,2,4-triazolyl, 1,2,3-thiadiazolyl, 1,2,3-triazolyl, 1,2,3,4-tetrazolyl, pyridyl, pyrimidinyl, pyrazinyl, pyridazinyl, 1,3,5-triazinyl, 1,2,4-triazinyl, 1,2,4,5-tetrazinyl, pyrazolinyl, imidazolinyl, oxazolinyl, isoxazolinyl, thiazolinyl, imidazolidinonyl, imidazolinonyl, 3(2H)-pyridazinonyl, benzothiazolyl, benzimidazolyl, indazolyl, benz-oxazolyl, quinolyl, isoquinolyl, quinoxaliny, phthalazinyl, cinnoliny or quinazolinyl),

provided that if Q is an optionally G-substituted phenyl group, optionally G-substituted pyridyl group or optionally G-substituted thienyl group, A is an optionally substituted naphthyl group or optionally G-substituted heterocyclic group (provided that this heterocyclic group is thienyl, furyl, pyrrolyl, oxazolyl, thiazolyl, imidazolyl, isoxazolyl, isothiazolyl, pyrazolyl, 1,3,4-oxadiazolyl, 1,3,4-thiadiazolyl, 1,2,4-oxadiazolyl, 1,2,4-thiadiazolyl, 1,2,4-triazolyl, 1,2,3-thiadiazolyl, 1,2,3-triazolyl, 1,2,3,4-tetrazolyl, pyridyl, pyrimidinyl, pyrazinyl, pyridazinyl, 1,3,5-triazinyl, 1,2,4-triazinyl, 1,2,4,5-tetrazinyl, pyrazolinyl, imidazolinyl, oxazolinyl, isoxazolinyl, thiazolinyl, imidazolidinonyl, imidazolinonyl, 3(2H)-pyridazinonyl, benzothiazolyl, benzimidazolyl, indazolyl, benzoxazolyl, quinolyl, isoquinolyl, quinoxaliny, phthalazinyl, cinnoliny or quinazolinyl),

G is any substituent group selected from halogen atom, C₁-C₁₀ alkyl, C₂-C₄

cyanoalkyl, optionally halogen atom- or C₁-C₄ alkyl-substituted phenyl-substituted C₁-C₄ alkyl, C₂-C₅ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₆ halocycloalkyl, optionally C₁-C₃ alkyl-substituted C₃-C₆ cycloalkyl, C₁-C₁₀ alkoxy, C₂-C₆ alkenyloxy, C₂-C₆ alkynyloxy, C₁-C₄ haloalkoxy, C₂-C₆ haloalkenyloxy, C₂-C₆ haloalkynyloxy, C₁-C₄ alkylsulfenyl, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₂-C₆ alkenylsulfenyl, C₂-C₆ alkenylsulfinyl, C₂-C₆ alkenylsulfonyl, C₂-C₆ alkynylsulfenyl, C₂-C₆ alkynylsulfinyl, C₂-C₆ alkynylsulfonyl, C₁-C₄ haloalkylsulfenyl, C₁-C₄ haloalkylsulfinyl, C₁-C₄ haloalkylsulfonyl, C₂-C₆ haloalkenylsulfenyl, C₂-C₆ haloalkenylsulfinyl, C₂-C₆ haloalkenylsulfonyl, C₂-C₆ haloalkynylylsulfenyl, C₂-C₆ haloalkynylylsulfinyl, C₂-C₆ haloalkynylylsulfonyl, CHO, NO₂, CN, OH, naphthyl, optionally halogen atom- or C₁-C₄ alkyl-substituted phenyl-substituted methoxy, C₂-C₇ alkoxycarbonyl, C₂-C₄ alkoxyalkyl, C₂-C₄ alkylcarbonyl, C₂-C₄ haloalkylcarbonyl, C₂-C₅ alkylcarbonyloxy, C₂-C₅ haloalkylcarbonyloxy, C₃-C₇ dialkyl-aminocarbonyloxy, optionally Y-substituted phenyl, optionally Y-substituted phenoxy, optionally Y-substituted benzoyl, optionally Y-substituted pyridyl, optionally Y-substituted pyridyloxy, optionally Y-substituted thienyl, methylenedioxy linked to an adjacent substitution site, halomethylenedioxy linked to an adjacent substitution site and -N=CT²T³ (provided that T² and T³ each independently are H, phenyl, benzyl or C₁-C₆ alkyl or else both T² and T³ together with the linking carbon atom may form a 5-membered ring, 6-membered ring, 7-membered ring or 8-membered ring), (provided that if there are 2 or more such substituent groups, they may be the same or different), the number of such substituent groups is 1, 2, 3 or 4 or else it is a 5-membered ring, 6-membered ring, 7-membered ring or 8-membered ring formed via an alkylene group linked to an adjacent substitution site, and

Y is any substituent group selected from halogen atom, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₁-C₄ alkoxy, C₁-C₄ halo-alkoxy, C₁-C₄ alkylsulfenyl, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₂-C₅ alkenylsulfenyl, C₂-C₅ alkenylsulfinyl, C₂-C₅ alkenylsulfonyl, C₁-C₄ haloalkylsulfonyl, NO₂, CN, CHO, OH, -NU¹U², phenyl, phenoxy or C₂-C₅ alkoxycarbonyl (provided that, if there are 2 or more such substituent groups, they may be the same or different) and the number of such substituent groups is 1, 2, 3, 4 or 5, and

U¹ and U² each independently represent H, C₁-C₆ alkyl, C₂-C₅ alkylcarbonyl, phenyl or benzyl, or else both U¹ and U² together with the linking carbon atom may form a 5-membered ring, 6-membered ring, 7-membered ring or 8-membered ring] is reacted with a compound represented by the formula (3):

B-X (3)

[in the formula (3), B is C₁-C₄ alkylsulfonyl, optionally halogen atom- or C₁-C₄ alkyl-substituted phenylsulfonyl, -SO₂CF₃, C₁-C₄ monoalkylaminosulfonyl, C₂-C₈ dialkylaminosulfonyl, phenylaminosulfonyl, C₂-C₅ monoalkylaminothiocarbonyl, C₃-C₉ dialkylaminothiocarbonyl, C₂-C₅ cyanoalkyl, C₃-C₉ alkoxycarbonylalkyl or -C(=O)T¹, T¹ is C₁-C₂₀ alkyl, C₂-C₆ alkenyl, C₁-C₆ haloalkyl, C₁-C₄ alkoxy-C₁-C₄ alkyl, C₃-C₆ halocycloalkyl, optionally halogen atom- or C₁-C₄ alkyl-substituted phenyl-substituted C₁-C₄ alkyl, optionally C₁-C₃ alkyl-substituted phenyl-substituted cycloalkyl, optionally halogen atom- or C₁-C₄ alkyl-substituted phenyl- and C₁-C₄ alkyl-substituted cyclopropyl group, optionally halogen atom- or C₁-C₄ alkoxy-substituted phenyl- and halogen atom-substituted C₃-C₄ cycloalkyl group, optionally halogen atom-substituted C₂-C₄ alkenyl- and C₁-C₄ alkyl-substituted cyclopropyl group, optionally halogen atom- or C₁-C₄ alkyl substituted phenyl-substituted C₂-C₄ alkenyl group, C₁-C₁₂ alkoxy, C₁-C₄ haloalkoxy, C₂-C₅ alkenyloxy, optionally C₁-C₃ alkyl-substituted C₃-C₆ cycloalkoxy, benzyloxy, C₂-C₅ alkoxycarbonyl, NU¹U², phenylamino, optionally Y-substituted phenyl, optionally Y-substituted phenylthio, optionally Y-substituted naphthyl or optionally Y-substituted 5-membered or 6-membered heterocyclic group (provided that these heterocyclic groups are selected from thienyl, furyl, pyrrolyl, oxazolyl, isoxazolyl, thiazolyl, isothiazolyl, pyrazolyl, imidazolyl, 1,3,4-oxadiazolyl, 1,2,4-oxadiazolyl, 1,3,4-thiadiazolyl, 1,2,4-thiadiazolyl, 1,2,4-triazolyl, 1,2,3-thia-diazolyl, 1,2,3-triazolyl, 1,2,3,4-tetrazolyl, pyridyl, pyrimidinyl, pyrazinyl, pyridazinyl, 1,3,5-triazinyl, 1,2,4-triazinyl, pyrazolinyl, imidazolinyl, oxazolinyl, isoxazolinyl, thiazolinyl and 3(2H)-pyridazinonyl),

X is a halogen atom,

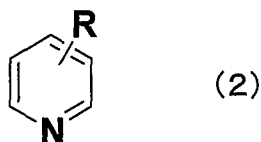
Y is any substituent group selected from halogen atom, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, C₁-C₄ alkylsulfenyl, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₂-C₅ alkenylsulfenyl, C₂-C₅ alkenylsulfinyl, C₂-C₅ alkenylsulfonyl, C₁-C₄ haloalkylsulfonyl, NO₂, CN, CHO, OH, -NU¹U², phenyl, phenoxy or C₂-C₅ alkoxycarbonyl (provided that, if there are 2 or more such substituent groups, they may be the same or different) and the number of such substituent groups is 1, 2, 3, 4 or 5]

or a compound represented by the formula (4)

B-O-B (4)

[in the formula (4), B has the same meaning as aforesaid]

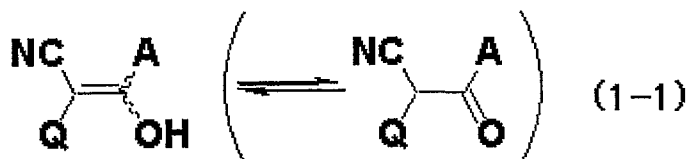
in the presence of a pyridine compound represented by the formula (2):



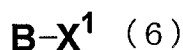
[in the formula (2), R represents H or $-\text{NU}^3\text{U}^4$ (provided that U^3 and U^4 each independently are H or $\text{C}_1\text{-C}_8$ alkyl or else both U^3 and U^4 together with the linking nitrogen atom may form a 5-membered ring, 6-membered ring, 7-membered ring or 8-membered ring)].

2. A method for the preferential production of the Z form of a compound represented by the said formula (5) by reacting a compound represented by the said formula (2) with the E form thereof.
3. The production method as claimed in claim 1, wherein, in the formula (1), A is an optionally substituted pyrazolinyl group or an optionally substituted thiazolinyl group, Q is an optionally substituted thiazolinyl group, and, in the formula (3) and the formula (4), B is a $\text{C}_1\text{-C}_4$ alkylcarbonyl group.
4. The production method as claimed in claim 2, wherein, in the formula (5), A is an optionally substituted pyrazolinyl group or an optionally substituted thiazolinyl group, Q is an optionally substituted thiazolinyl group, and, B is a $\text{C}_1\text{-C}_4$ alkylcarbonyl group.
5. The production method as claimed in claim 1, wherein, in the formula (1), A is a 2-methyl-4-trifluoromethyl-thiazol-5-yl group, and Q is a 2-phenylthiazol-4-yl group, and, in the formula (3) and the formula (4), B is a tert-butylcarbonyl group.
6. The production method as claimed in claim 2, wherein, in the formula (5), A is a 2-methyl-4-trifluoromethyl-thiazol-5-yl group, Q is a 2-phenylthiazol-4-yl group, and B is a tert-butylcarbonyl group.
7. The production method as claimed in any of claim 1 to 6, which is performed in the presence of an alkali metal hydroxide or alkali metal carbonate and a phase transfer catalyst.

8. A method for the isolation of the Z form of an acrylonitrile compound, wherein a geometric isomer mixture of an acrylonitrile compound represented by the said formula (5) is dissolved or suspended in a C₁-C₁₀ alcohol or a solvent containing a C₁-C₁₀ alcohol, the E form in the resulting solution or suspension is preferentially decomposed, and the Z form that remains and both the compound represented by the formula (1-1):



and the compound represented by the formula (6):



(in formula (1-1) and formula (6), A, B and Q have the same meanings as aforesaid and X¹ represents a C₁-C₁₀ alkyl group), which are the main decomposition products, are separated.

9. The isolation method as claimed in claim 8, wherein, in the formula (1-1), A is an optionally substituted pyrazoliny group or an optionally substituted thiazoliny group, Q is an optionally substituted thiazoliny group, and in the formula (3) and the formula (4), B is a C₁-C₄ alkylcarbonyl group.

10. The isolation method as claimed in claim 8, wherein, in the formula (1-1) and formula (5), A is a 2-methyl-4-trifluoromethyl-thiazol-5-yl group, Q is a 2-phenyl-thiazol-4-yl group, and in the formula (5) and the formula (6), B is a tert-butylcarbonyl group.

INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2007/054623

A. CLASSIFICATION OF SUBJECT MATTER
INV. C07D277/32 A01N43/78

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C07D A01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, BEILSTEIN Data, CHEM ABS Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE WPI Week 200447 Derwent Publications Ltd., London, GB; AN 2004-492791 XP002436692 -& JP 2004 182601 A (NIPPON SODA CO) 2 July 2004 (2004-07-02) cited in the application Schemes on pages 5-6 abstract	1-7
X	----- EP 1 439 171 A1 (NIPPON SODA CO [JP]) 21 July 2004 (2004-07-21) cited in the application See, for instance, examples 5-6 and 9-10, page 9. & WO 03/031421 A (NIPPON SODA CO [JP]; MATSUI NOBUO [JP]; FURUKAWA HIRONORI [JP]; OGIHARA) 17 April 2003 (2003-04-17) ----- -/--	1-7

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

☒ See patent family annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
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INTERNATIONAL SEARCH REPORT

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