INSTRUCTIONS
(a) If Convention application insert "Convention"

594342

(a) Convention

57877/86

AUSTRALIA

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(b) Delete one

APPLICATION FOR A (b) STANDARD/~~PETTY~~ PATENT

LODGED AT SUB-OFFICE
23 MAY 1986
Melbourne

(c) Insert FULL name(s) of applicant(s)

~~I~~/We (c) Mitsui Toatsu Chemicals Inc

(d) Insert FULL address(es) of applicant(s)

of (d) 2-5,3-chome, Kasumigaseki,
Chiyoda-ku, Tokyo, JAPAN.

(e) Delete one

(f) Insert TITLE of invention

(g) Insert "complete" or "provisional" or "petty patent"

hereby apply for the grant of a (e) Standard/XXXXPatent for an invention entitled

(f) N-(3-CHLORO-4-ISOPROPYLPHENYL) CARBOXAMIDE DERIVATIVE AND SELECTIVE HERBICIDE

which is described in the accompanying (g) Complete specification.

(*Note: The following applies only to Convention applications*)

Details of basic application(x)

(h) Insert number, country and filing date for the/or each basic application

(h)

Application No.	Country	Filing Date
112,087/85	JAPAN	27 May 1985
116,591/85	JAPAN	31 May 1985

PATENT OFFICE
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Collector of Public Moneys

APPLICATION ACCEPTED AND AMENDMENTS ALLOWED 5-1-90

Address for Service:

PHILLIPS ORMONDE AND FITZPATRICK
Patent and Trade Mark Attorneys
367 Collins Street
Melbourne, Australia 3000

(i) Insert date of signing

Dated (i) 22ND MAY, 1986

(j) Signature of applicant(s) (For body corporate see headnote*)

(k) Corporate seal if any

(k)

(j) PHILLIPS, ORMONDE AND FITZPATRICK
Attorneys for:-
MITSUI TOATSU CHEMICALS INC

David B Fitzpatrick

Note: No legalization or other witness required

PHILLIPS ORMONDE AND FITZPATRICK
Patent and Trade Mark Attorneys
367 Collins Street
Melbourne, Australia

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DECLARATION FOR A PATENT APPLICATION

▼ INSTRUCTIONS

(a) Insert "Convention" if applicable
(b) Insert FULL name(s) of applicant(s)
(c) Insert "of addition" if applicable
(d) Insert TITLE of invention
(e) Insert FULL name(s) AND address(es) of declarant(s) (See headnote*)
(f) Insert FULL name(s) AND address(es) of actual inventor(s)
(g) Recite how applicant(s) derive(s) title from actual inventor(s) (See headnote**)
(h) Insert country, filing date, and basic applicant(s) for the/or EACH basic application
(k) Insert PLACE of signing
(l) Insert DATE of signing
(m) Signature(s) of declarant(s)

Note: No legalization or other witness required

In support of the (a) Convention application made by
(b)
MITSUI TOATSU CHEMICALS INC.

(hereinafter called "applicant~~(s)~~") for a patent (c) for an invention entitled (d)

"N-(3-CHLORO-4-ISOPROPYLPHENYL) CARBOXAMIDE DERIVATIVE AND SELECTIVE HERBICIDE"

I/~~We~~ (e) Yasuaki Tozuka, Executive Managing Director, of Mitsui Toatsu Chemicals, Inc., of 2-5, 3-chome, Kasumigaseki, Chiyoda-ku, Tokyo, Japan

do solemnly and sincerely declare as follows:

1. ~~I am/We are the applicant(s)~~.

(or, *in the case of an application by a body corporate)*

1. I am ~~/We are~~ authorized to make this declaration on behalf of the applicant(s).

2. ~~I am/We are the actual inventor(s) of the invention.~~

(or, *where the applicant(s) is/are not the actual inventor(s))*

2. (f) Tetsuo Takematsu, of 612, Mine-machi, Utsunomiya-shi, Tochigi-ken, Japan; Mitihiko Nakaya, of 4-10-8, Hisagi, Zushi-shi, Kanagawa-ken, Japan; and Koichi Moriyasu, of 2882-4-35, Iijima-cho, Totsuka-ku, Yokohama-shi, Kanagawa-ken, Japan

~~is~~/are the actual inventor(s) of the invention and the facts upon which the applicant~~(s)~~ is/~~are~~ entitled to make the application are as follows:
(g)

Applicant is the assignee of the actual inventors.

(Note: *Paragraphs 3 and 4 apply* **only** *to Convention applications)*

3. The basic application(s) for patent or similar protection on which the application is based ~~is~~/are identified by **country, filing date, and basic applicant~~(s)~~** as follows:
(h)

Japan	27 May, 1985	MITSUI TOATSU CHEMICALS, INC.
Japan	31 May, 1986	MITSUI TOATSU CHEMICALS, INC.

4. The basic application(s) referred to in paragraph 3 hereof ~~was~~/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

Declared at (k) Tokyo, Japan

Dated (l) 14 May, 1986.

(m)

Yasuaki Tozuka
Yasuaki Tozuka

To: The Commissioner of Patents

P18/7/78

PHILLIPS ORMONDE & FITZPATRICK
Patent and Trade Mark Attorneys
367 Collins Street
Melbourne, Australia

AS:DW

(12) PATENT ABRIDGMENT (11) Document No. AU-B-57877/86
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 594342

(54) Title
N-(3-CHLORO-4-ISOPROPYL)CARBOXAMIDES

International Patent Classification(s)
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(21) Application No. : 57877/86 (22) Application Date : 23.05.86

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(43) Publication Date : 04.12.86

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(71) Applicant(s)
MITSUI TOATSU CHEMICALS INC.

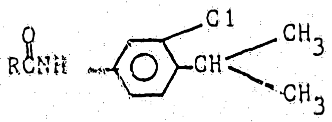
(72) Inventor(s)
TETSUO TAKEMATSU; MITIHIKO NAKAYA; KOICHI MORIYASU

(74) Attorney or Agent
PHILLIPS,ORMONDE & FITZPATRICK

(56) Prior Art Documents
DE 2249547
GB 869169
US 3407056

(57) Claim

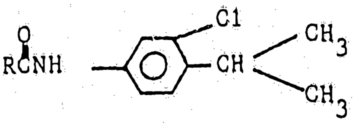
1. N-(3-chloro-4-isopropylphenyl) carboxamide represented by the formula (I):



(I)

wherein R represent a 1-methylbutyl.

2. A selective herbicide comprising a herbicidally effective amount of N-(3-chloro-4-isopropylphenyl) carboxamide represented by the formula (I):



(I)

wherein R represents a 1-methylbutyl group as an active ingredient, a carrier and/or at least one adjuvant.

AUSTRALIA

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COMPLETE SPECIFICATION

(ORIGINAL)

LODGED AT SUB-OFFICE
23 MAY 1986
Melbourne

Class

Int. Class

Application Number: 57877/86

Lodged:

Complete Specification Lodged:

Accepted:

Published:

Priority

Related Art:

This document contains the amendments made under Section 49 and is correct for printing.

APPLICANT'S REF.: K-90(Toatsu)/HF

Name(s) of Applicant(s): MITSUI TOATSU CHEMICALS INC

Address(es) of Applicant(s): 2-5, 3-chome, Kasumigaseki,
Chiyoda-ku, Tokyo, Japan.

Actual Inventor(s): Tetsuo TAKEMATSU, Mitihiko NAKAYA & Koichi MORIYASU

Address for Service is:

PHILLIPS, ORMONDE AND FITZPATRICK
Patent and Trade Mark Attorneys
367 Collins Street
Melbourne, Australia, 3000

Complete Specification for the invention entitled:

N-(3-CHLORO-4-ISOPROPYLPHENYL)CARBOXAMIDE DERIVATIVE AND SELECTIVE HERBICIDE

The following statement is a full description of this invention, including the best method of performing it known to nt(s):

This invention relates to an N-(3-chloro-4-isopropyl)carboxamide derivative, and a selective herbicide comprising it as an active ingredient which controls noxious weeds in the cultivation of wheat, an important gramineous crop in agriculture, effectively and selectively by foliar application.

For a control of weeds in wheat cultivation, phenoxy-type herbicides have been used most widely. They include, for example, 2,4-dichlorophenoxyacetic acid [2,4-D; P. W. Zimmerman and A. E. Hitchcock, Contrib. Boyce Thompson Inst., 12, 321 (1942)], 2-methyl-4-chlorophenoxyacetic acid [MCPA; M. E. Synerholm and P. W. Zimmerman, Contrib. Boyce Thompson Inst., 14, 91 (1945)], 4-(2-methyl-4-chlorophenoxy)butyric acid [MCPB; German Patent 1,000,632 (1957) and British Patent 793,513 (1958)], and 4-(2,4-dichlorophenoxybutyric acid [2,4-DB; M. E. Synerholm and. P. W. Zimmerman, Contrib. Boyce Thompson Inst., 14, 369 (1945)]. However, these herbicides are foliar treating agents which are effective only for controlling broad-leaved weeds, and because of their significant phytotoxicity to wheat, their use is limited only to a stage where the crop has grown to some extent.

Urea-type herbicides such as 3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea [linuron; U. S. Patent 2,960,534 issued November 15, 1960], 3-(3-chloro-4-methoxyphenyl)-1,1-dimethylurea [metoxuron; French Patents 1,497,867 and 1,497,868 granted October 13, 1967], 3-(3-chloro-4-methylophenyl)-1,1-dimethylurea [chlortoluron; U. S. Patents 2,655,444 and 2,655,445 issued October 13, 1953], 3-(4-isopropylphenyl)-1,1-dimethylurea [isoproturon; German OLS 2,107,774 published September 16, 1971, and German OLS 2,137,992 published February 10, 1972], and 3-(2-benzothiazolyl)-1,3-dimethylurea [methabenzthiazuron; U. S. Patent 2,756,135 issued July 24, 1956 and British Patent 1,085,430 patented October 4, 1967] are very important in wheat cultivation. Since, however, most of them cause phytotoxicity to the crop, they are used mainly as a preemergence soil treating agent. When they are used as a foliar treating agent, their selectivity differs greatly depending upon the variety of wheat, the cultivation conditions, etc. Moreover, their herbicidal spectrum does not cover all hazardous weeds in wheat cultivation, and they are usually applied as mixtures.

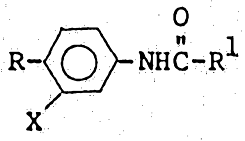
Attempts have been made to apply 2-(2-chloro-4-ethylamino-s-triazin-6-ylamino)-2-methylpropionitrile [cyanazine; British Patent 1,132,306 patented October 30, 1968], 3,4-dimethyl-2,6-dinitro-N-(1-ethylpropyl)aniline [pendimethalin; German OLS 2,232,263 published January 11, 1973], alpha,alpha,alpha-trifluoro-2,6-dinitro-N-(2-chloroethyl)-N-propyl-p-toluidine [fluchloralin; German OLS 2,161,879 published June 20, 1973], and 2,4-dichlorophenyl-3-methoxycarbonyl-4-nitrophenylether [bifenox; U. S. Patent 3,784,635 issued January 8, 1974] as herbicides for controlling weeds in wheat cultivation. They are also used as mixtures, and when used singly, they exhibit only an insufficient efficacy against many hazardous weeds.

4-Chloro-2-butynyl-N-(3-chlorophenyl) carbamate [barban; U. S. Patent 2,906,614 issued September 29, 1959], N-benzoyl-N-(3,4-dichlorophenyl)-2-aminopropionic acid ethyl ester [benzoylprop-ethyl; Dutch Patent Application 6,717,715 filed July 1, 1968], 1,2-dimethyl-3,5-diphenyl-1H-pyrazolium methyl sulfate [difenzoquat; German OLS 2,441,504 published March 20, 1975] and (±)-2-[4-(2,4-dichlorophenoxy)phenoxy]propionic acid methyl ester [diclofop-methyl; German OLS 2,223,894 published December 13, 1973] are applied as agent for exclusively combatting wild oats, a very strongly hazardous weed, but their practical effect is not sufficient.

Other herbicides for wheat cultivation include, for example, 3-isopropyl-1H-2,1,3-benzothiazin-(4)-3H-one-2,2-dioxide [bentazon; South African Patent 6,705,164 patented January 23, 1968 and German OLS 1,913,650 published October 1, 1970] and 2-chloro-N-(4-methoxy-6-methyl-1,3,5-triazin-2-yl-aminocarbonyl)benzenesulfonamide [chlorsulfuron; U. S. Patent 4,127,660 issued November 28, 1978] which has recently aroused interest as a highly active compound. The former is a compound having high safety to wheat, but its application is limited to certain broad-leaved weeds. The latter has an excellent soil treating effect at very low dosages with an outstanding residual activity, and also is highly safe to wheat. However, even at low dosages, it is likely to cause phytotoxicity to crops grown in wheat fields after harvesting wheat. Accordingly, its use is greatly restricted. Nowadays, agricultural chemicals are required not only to have excellent activity but also to have high safety against humans and animals and their environment.

Much work has been undertaken on N-phenylcarboxylic acid amide derivatives over many years, and various excellent herbicides of this type have been known and used. They are disclosed, for example, in C. W. Hoffman et al., J. Agric. Food Chem., 8, 298 (1960) [N-(3,4-dichlorophenyl)propionamide; propanil], British Patent 869,169 patented May 31, 1961 [karsil, solan], German Patent 1,166,547 patented May 26, 1964 [monalide], U. S. Patent 3,816,092 issued June 11, 1974, British Patent 885,043 patented May 4, 1959 [DCMA; dicryl], U. S. 3,277,107 issued October 4, 1966 [cypromid], U. S. Patent 4,166,735 issued September 4, 1979, and U. S. Patent 3,277,171 issued October 4, 1966. Many of these compounds kill weeds very effectively in foliar treatment and show a high level of selectivity for certain kinds of important crops. These compounds are also expected to decompose comparatively rapidly, and it is anticipated to some extent that their effect on crops to be grown after harvesting will be small and they will have little residual effects in the environment. Many of these prior art references, however, fail to disclose the selectivity of these compounds for wheat. The selectivities of compounds, which are disclosed in some of these references, are insufficient, or such compounds have an insufficient herbicidal efficacy. In fact, the compounds disclosed in these prior art references are difficult to use in actual wheat cultivation.

Japanese Patent Publication No. 14240/1966 published on August 9, 1966 and German OLS 2,249,547 published on April 18, 1974 disclose the selectivity of N-phenylcarboxylic acid amide derivatives for wheat, but these compounds are not entirely satisfactory in their herbicidal efficacy against weeds and their phytotoxicity to crops. In particular, German OLS 2,249,547 disclose compounds of the following general formula



wherein R represents an alkyl group having 2 to 6 carbon atoms, R^1 represents an alkyl group having 2 to 8 carbon atoms, an alkenyl group having 3 to 6 carbon atoms or a cycloalkyl group having 3 to 8 carbon atoms, and X represents a halogen atom.

A very few specific compounds, however, are actually cited in the specification as examples of the above compounds, and when R is an isoporopyl group, only an ethyl group is shown as an example of R^1. Furthermore, these compounds are not practically feasible for the reason given above.

Japanese Laid-Open Patent Publication No. 193806/1984 published on November 2, 1984 and Japanese Laid-Open Patent Publication No. 23357/1985 published on February 5, 1985 disclose N-(4-isopropylphenyl)carboxyamide derivatives. These compounds, however, have the defect that their effects are unstable and they do not show herbicidal activity on some important weeds.

It has been strongly desired therefore to develop a chemical having essential selectivity for weeds in the cultivation of important gramineous crops, particularly wheat, a chemical which is little affected by physical factors such as soil conditions (i.e., foliar treating agents), a chemical which shows an efficacy in low dosages and has a broad herbicidal spectrum ranging from gramineous weeds to broad-leaved weeds, and a chemical which rapidly decomposes and does not exert deleterious effects such as environmental pollution.

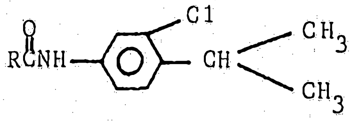
It is an object of this invention to provide a herbicide whose efficacy or phytotoxicity does not depend upon physical factors such as soil conditions in the cultivation of wheat which is an important gramineous crop.

A more specific object of this invention is to provide a highly selective herbicide which has essential selectivity for an important gramineous crop, particularly wheat, and produces an accurate control efficacy by simple foliar treatment in low dosages.

The present inventors studied many compounds in order to develop a highly selective herbicide for important gramineous crops, particularly wheat, and have now found that in foliar treatment, N-(3-chloro-4-isopropylphenyl)carboxamide derivatives have an excellent selective herbicidal action and has a very broad herbicidal spectrum while causing no phytotoxicity to important gramineous crops, particularly wheat, even when applied in very high concentrations, and that these compounds solve the various problems described above.

Generally, compounds of the same series or structurally similar compounds are thought to have similar properties. But actually, it is not easy to infer such properties, and for example, by simply increasing the alkyl chain of one substituent in a herbicidal compound, the herbicidal activity of the compound against weeds or its phytotoxicity to crops varies greatly.

According to the present invention there is provided N-(3-chloro-4-isopropylphenyl) carboxamide represented by the formula (I):



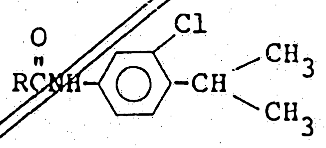
(I)

wherein R represents a 1-methylbutyl.

~~compounds solve the various problems described above.~~

~~Generally, compounds of the same series or structurally similar compounds are thought to have similar properties. But actually, it is not easy to infer such properties, and for example, by simply increasing the alkyl chain of one substituent in a herbicidal compound, the herbicidal activity of the compound against weeds or its phytotoxicity to crops varies greatly.~~

~~The N-(3-chloro-4-isopropylphenyl)carboxamide derivatives in accordance with this invention are novel compounds represented by general formula (I) below~~



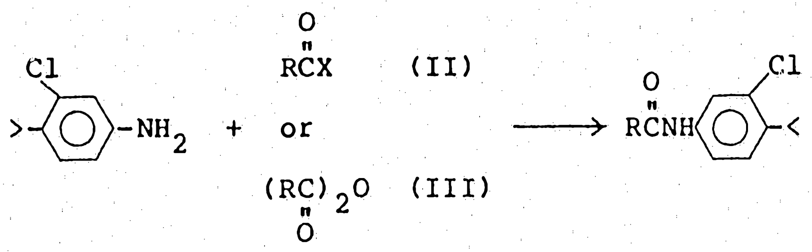
(I)

~~wherein R is a 1-methylbutyl, 1-methylcyclopropyl or cyclopropyl group.~~

A herbicide comprising an N-(3-chloro-4-isopropylphenyl)carboxamide derivative in accordance with this invention having general formula (I) as an active ingredient, when applied by foliar treatment, very effectively controls almost allhazardous upland farm weeds, for example strongly hazardous gramineous weeds such as wild oats (Avena fatua), meadow foxtail (Alopecurus pratensis), blackgrass (Alopecurus myosuroides), annual bluegrass (Poa annua), water foxtail (Alopecurus aequalis), barnyard grass (Echinochloa oryzicola), crabgrass (Digitaria ciliaris) and green foxtail (Setaria viridis); and strongly hazardous weeds such as green amaranth (Amaranthus retroflexus), common purslane (Portulaca oleracea), cocklebur (Xanthium strumarium), cleavers (Galium spurium), lamb's quarters (Chenopodium album), chickweed (Stellaria media), tall morning glory (Ipomea purpurea), Cerastium holosteoides, velvet leaf (Abutilon theophrasti), oriental senna (Cassia obtusifolia), pick purse (Capsella bursapastoris), charlock (Sinapis arvensis), dayflower (Commelina communis), johnson grass (Sorghum helepense), speedwell (Veronica persica), Veronica caninotesticulate, hairly galinsoga (Galinsoga ciliata), common groundsel (Senecio vulgaris), matricaria (Matricaria chamomilla), and Urtica. A compound of formula (I) in which R is 1-methylbutyl is preferred in respect of the stability of its effect. On the other hand, no phytotoxicity of this herbicide to important gramineous crops, particularly wheat, is observed.

Thus, the N-(3-chloro-4-isopropylphenyl)carboxamide derivative of this invention ~~have~~ has essential foliar treatment selectivity in the cultivation of important gramineous crops, particularly wheat, and can be very safely used. Various herbicides now in use in the cultivation of wheat are soil treating agents. The defects of these herbicides, that is, variations in efficacy and phytotoxicity owing to physical factors such as soil conditions, are not at all observed in the herbicide of this invention. Furthermore, the herbicide of this invention has little effects on crops cultivated in the same field after harvesting of wheat.

The N-(3-chloro-4-isopropylphenyl)carboxamide derivative in accordance with this invention is a novel compound, and can be easily produced by reacting 3-chloro-4-isopropylaniline with a carboxylic acid halide derivative of general formula (II) or a carboxylic acid anhydride derivative of general formula (III) in accordance with the following scheme.



(In the above scheme, R represents a 1-methylbutyl, ~~1-methylcyclopropyl or cyclopropyl~~ group, and X represents a halogen atom.)

The reaction is carried out in the absence of solvent or in an inert solvent. Examples of the inert solvent include aromatic hydrocarbons such as benzene, toluene, xylene, chlorobenzene and dichlorobenzene, ketones such as acetone and methyl ethyl ketone, nitriles such as acetonitrile and propionitrile, ethers such as ethyl ether, tetrahydrofuran and dioxane, and aprotic polar solvents such as dimethylformamide, dimethyl sulfoxide and hexamethylphosphoramide. In using the acid halide or acid anhydride, an organic base such as triethylamine, pyridine, dimethylaniline or 1,8-diazabicyclo(5,4,0)-7-undecene or an inorganic base such as potassium carbonate, sodium carbonate, sodium hydroxide, potassium hydroxide or sodium hydrogen carbonate may be used, as required, as an acid binder. The reaction temperature is -10 to 150°C, preferably 5 to 90°C, more preferably 15 to 70°C. The reaction may also be carried out at the refluxing temperature of the solvent used. The reaction time differs according to the reaction temperature or the solvent used. Generally, it is 1 second to 10 hours, preferably 1 minute to 5 hours, more preferably 20 minutes to 3 hours.

The rate of application of the N-(3-chloro-4-isopropylphenyl)-carboxamide derivative of this invention can be selected according to the extent to which the growth of weeds is required to be inhibited. The standard rate of application is 0.1 to 10 kg per hectare, preferably 0.2 to 3 kg per hectare.

The herbicide of this invention comprises the compound of general formula (I) as a main ingredient. The compound of formula (I) may be directly used against plants to be treated. Generally, however, it is used in usual formulations containing a carrier and as required other adjuvants, for example as a dust, granules, a wettable powder, an emulsifiable concentrate or a flowable agent.

Examples of the carrier are inorganic materials such as clays, talc, bentonite, calcium carbonate, diatomaceous earth, zeolite and silicic anhydride, organic materials of plant origin such as wheat flour, soybean meal, starch and crystalline cellulose, polymeric compounds such as petroleum resins, polyvinyl chloride and polyalkylene glycols, urea, and waxes. Liquid carriers such as oils, organic solvents and water may also be used.

Examples of the adjuvants are a wetting agent, a dispersing agent, a sticker, and a spreader which may, as required, be used either singly or in combination.

Various surface-active agents, polymeric compounds such as gelatin, albumin, sodium alginate, methyl cellulose, polyvinyl alcohol and xanthan gum, and other adjuvants may be cited as auxiliary agents which are used for the purpose of wetting, dispersion, spreading, stabilization of components or stabilization of properties. Industrial fungicides, bactericides and moldproofing agents may be added to flowable agents for killing fungi, bacteria or molds.

The surface-active agents may be nonionic, anionic, cationic and amphoteric. Examples of preferred surface-active agents include products of polymerization of ethylene oxide with alkylphenols, higher alcohols, alkylnaphthols, higher fatty acids, fatty acid esters or dialkylphosphoric acid amines, a copolymer of ethylene oxide and propylene oxide, alkylsulfuric acid ester salts (such as sodium laurylsulfate), alkylsulfonic acid salts (sodium 2-ethylhexenesulfonate), and arylsulfonic acid salts (such as sodium ligninsulfonate, and sodium dodecylbenzenesulfonate).

The content of the compound of general formula (I) in the herbicide of this invention differs depending upon the formulation, and usually is 1 to 20% by weight for a dust, 20 to 90% by weight for a wettable powder, 1 to 30% by weight for granules, 1 to 50% by weight for an emulsifiable concentrate, 10 to 90% by weight for a flowable agent, and 20 to 70% by weight for a dry flowable agent. The content of the adjuvants is 0 to 80% by weight, and the amount of the carrier is obtained by subtracting the contents of the active compound and the adjuvants from 100% by weight.

The herbicide of this invention may be applied in admixture with at least one other herbicide, other agricultural chemicals such as an insecticide or a plant growth regulator, a soil conditioner, and a fertilizer substance, or may be formulated into a mixed agent with such other chemicals. Sometimes, this manner of application is expected to give a synergistic effect.

The following example illustrates the present invention more specifically.

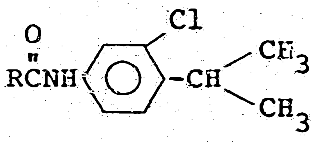
SYNTHESIS EXAMPLE 1

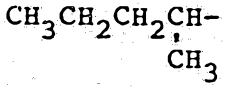
Production of N-(3-chloro-4-isopropylphenyl)-2-methylvaleramide:-

To 36 ml of toluene were added 1.0 g (5.9/1000 mole) of 3-chloro-4-isopropylaniline and 0.7 g of pyridine, and 0.9 g (5.9/1000 mole) of 2-methylvaleryl chloride was added. The mixture was stirred at room temperature for 20 minutes. The crystals that precipitated were separated by filtration. Water (70 ml) was added to the filtrate, and the mixture was extracted with toluene. The toluene solution was washed with a saturated aqueous solution of sodium hydrogen carbonate, and dried over anhydrous sodium sulfate. The resulting dried solution was concentrated by an evaporator. Recrystallization of the resulting crude crystals from methanol gave 1.2 g of N-(3-chloro-4-isopropylphenyl)-2-methylvaleramide in a yield of 76.0 % based on 3-chloro-4-isopropylaniline.

The compound of formula (I) in accordance with this invention and its physical properties are shown in Table 1. The active ingredient compounds used in the following Formulation Examples and Test Examples are designated by the compound numbers given in Table 1.

Table 1



Compound No.	R in formula (I)	Physical properties
1.	1-methylbutyl  $CH_3CH_2CH_2\underset{CH_3}{CH}-$	$IR\nu_{max}^{KBr}$ cm^{-1}: 3300, 1660. $NMR\delta_{TMS}^{CCl_4}$: 0.86(3H, t, J=7Hz), 1.12(3H, s), 1.20(6H, d, J=7Hz), 1.24-1.76(4H, m), 2,48 (1H, m), 3.32(1H, m), 7.08(1H, d, J=8Hz), 7.40(1H, dd, J=8Hz, J=2Hz), 7.60(1H, d, J=2Hz) 9.22(1H, bs). m.p.: 66.0-68.0°C. Elemental analysis(%): Calc(%) C;67.27, H;8.28, N;5.23, Cl;13.24 Found(%) C;67.07, H;8.57, N;5.17, Cl;13.05

~~to be continued~~

Examples are given below to illustrate the formulation of the herbicide of this invention and its herbicidal activity.

FORMULATION EXAMPLE 1

Wettable powder:-

Fifty-five parts by weight of compound No. 1, 5 parts by weight of white carbon, 4 parts by weight of polyoxyethylene alkylphenyl ether ammonium sulfate, 2 parts by weight of sodium ligninsulfonate and 34 parts by weight of diatomaceous earth were well pulverized and mixed to form a wettable powder.

FORMULATION EXAMPLE 2

Flowable agent:-

Water (76.7 parts by weight) was mixed with 20 parts by weight of compound No. 1, 2 parts by weight of sodium ligninsulfonate, 0.3 part by weight of xanthan gum and 1 part by weight of polyoxyethyelne alkylaryl ether, and the mixture was finely pulverized by a sand grinder to form a flowable agent.

FORMULATION EXAMPLE 3

Dust:-

Three parts by weight of compound No. 1, 3 parts by weight of sodium ligninsulfonate, 2 parts by weight of polyoxyethylene alkylaryl ether and 92 parts by weight of clay were mixed and pulverized to form a dust.

FORMULATION EXAMPLE 4

Dry flowable agent:-

Sixty parts of compound No. 1, 5 parts by weight of sodium alkylbenzenesulfonate and 35 parts by weight of polypropylene glycol polyethylene glycol ether were finely pulverized by using a jet-O-miser to form a dry flowable agent.

FORMULATION EXAMPLE 5

Granules:-

Twelve parts by weight of finely pulverized compound No. 1, 60 parts by weight of bentonite, 25 parts by weight of talc, 2 parts by weight of sodium naphthalene-sulfonate/ formaldehyde condensate and 1 part by weight of dioctyl sulfosuccinate were well mixed, and a suitable amount of water was added to wet the mixture. The mixture was extruded by an injecting former to form granules. The granules were air-dried at 60 to 90°C, crushed, and adjusted to a diameter of 0.3 to 1 mm.

FORMULATION EXAMPLE 6

Emulsifiable concentrate:-

Fifty parts by weight of compound No. 1, 15 parts by weight of Gafac RS-610 (trademark of General Aniline & Film Corporation; polyoxyethylene phosphate) and 35 parts by weight of o-xylene were mixed and dissolved to form an emulsifiable concentrate.

FORMULATION EXAMPLE 7

Emulsifiable concentrate:-

Twenty-five parts of compound No. 1, 15 parts by weight of Plysurf A-210G (trademark of Dai-ichi Kogyo Seiyaku Co., Ltd.; polyoxyethylene phosphate) and 60 parts by weight of o-xylene were mixed and dissolved to form an emulsifiable concentrate.

TEST EXAMPLE 1

Plastic pots (1/10,000 a) were filled with the soil taken from an upland farm, and seeds of one kind of test plant were sown in each pot and grown in a greenhouse. When each plant grew to a stage of 2 or 3 leaves, each of the test compounds was dissolved in acetone containing polyoxyethylene sorbitan monooleate and sorbitan monolaurate. The solution was sprayed by a pressure micro-sprayer at a rate of 2 kiloliters per hectare. On the 21st day after the spraying of the chemical, the effects of the chemical on the crops and weeds were observed and examined. The results are shown in Table 2. The degree of injury to the test plants was evaluated on the following scale.

Rating	Degree of injury (%)	State of the injury
5	100	Withered (complete control of weeds)
4	80	Enormous injury (80% weed control)
3	60	Medium injury (60% weed control)
2	40	Small injury (40% weed control)
1	20	Slight injury (20% weed control)
0	0	No injury (no weed control)

The control compounds shown in Table 2 were as follows:

A: N-(3,4-dichlorophenyl)propionamide (propanil)

B: N-(3,4-dichlorophenyl)-2-methylpentanamide (karsil) [British Patent 869,169]

C: N-(3-chloro-4-methylphenyl)-2-methylpentanamide (solan) [British Patent 869,169)

D: N-(3,4-dichlorophenyl)methacrylamide (dicryl) [British Patent 885,043]

Table 2

Compound	Concentration X 1,000 ppm	Weed (a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	Crop Rice	Wheat	Corn	Peanut	Soybean
A	1	4	5	3	1	3	5	4	5	5	5	2	2	0	2	1	2	2
	2	5	5	4	2	4	5	5	5	5	5	3	3	1	3	1	2	3
	5	5	5	5	2	4	5	5	5	5	5	5	4	1	3	3	3	4
B	1	3	5	4	0	2	4	4	5	4	5	2	3	2	1	1	1	1
	2	5	5	4	2	2	5	5	5	5	5	3	4	2	3	2	2	2
	5	5	5	5	2	3	5	5	5	5	5	4	5	3	3	3	3	3
C	1	3	4	3	0	2	5	4	5	4	5	2	2	2	2	1	1	1
	2	5	5	5	1	2	5	5	5	4	5	3	2	3	2	2	2	2
	5	5	5	5	2	3	5	5	5	5	5	4	3	3	3	3	3	2
D	1	3	4	3	0	2	5	4	4	4	4	2	2	2	2	1	1	2
	2	4	5	3	1	3	5	5	5	4	5	3	2	3	3	3	2	3
	5	5	5	5	1	3	5	5	5	5	5	4	3	3	3	3	3	3
Compound No. 1 of this invention	1	4	5	4	3	5	5	5	5	5	5	5	5	2	0	1	0	2
	2	5	5	5	3	5	5	5	5	5	5	5	5	2	0	2	1	2
	5	5	5	5	4	5	5	5	5	5	5	5	5	3	1	2	2	3

TEST EXAMPLE 2

A plastic planter (1/1,000 a) was filled with the soil from an upland farm, and seeds of wild oats, water foxtail, annual bluegrass, chickweeed, lamb's quarters and black bindweed as weeds were sown in the planter. Simultaneously, seeds of wheat (variety: Norin No. 61) and barley (variety: Tochigi Sekitori No. 1) as crops were sown in the planter. These plants were cultivated in a phytotron (12 - 18^{o}C). When wheat grew to a stage of 2 or 3 leaves, a predetermined amount of each of the test compounds formulated as in Formulation Example 15 was diluted with water in an amount corresponding to 500 liters per hectare, and applied by a micro-sprayer. In the third week after the treatment with the chemical, the effects of the chemical on the weeds and crops were observed and evaluated. The results are shown in Table 3. The degree of injury to the test plants was rated as in Test Example 1.

The control compounds indicated in Table 3 were as follows:

E: N-(4-isopropylphenyl)-2-methyl-2-pentenamide (Japanese Laid-Open Patent Publication No. 23357/1985)

F: N-(3-chloro-4-isopropylphenyl)propionamide (West German Patent 2,249,547)

G: N-(3-chloro-4-methylphenyl)-2-methyl-2-pentenamide (British Patent 885,043)

Table 3

Compound	Concentration X 1,000 ppm	Weed							Crop	
		(d)	(m)	(e)	(h)	(g)	(i)	(n)	Wheat	Barley
E	1	0	2	2	2	5	1	2	0	0
	2	1	3	3	3	5	2	4	0	0
	4	2	3	4	4	5	3	4	0	0
F	1	1	1	1	2	3	2	1	1	1
	2	1	1	2	2	5	2	2	2	2
	4	2	2	3	4	5	3	3	2	3
G	1	1	2	2	2	5	1	2	1	1
	2	1	3	3	3	5	3	3	2	2
	4	1	3	4	4	5	4	3	3	2
Compound No. 1 of this invention	1	3	4	4	5	5	5	4	0	0
	2	4	4	5	5	5	5	5	0	0
	4	5	5	5	5	5	5	5	0	0

TEST EXAMPLE 3

A planter having a capacity of 1/1000 a was filled with soil, and seeds of wheat, wild oats, meadow foxtail, black grass, water foxtail, annual bluegrass, pick purse, cleavers, lamb's quarters, dead nettle, Cerastium holosteoides, Veronica caninotesticulate, and chickweed were sown, and grown in a greenhouse. When the test plants grew to the 2- to 3-leaf stage, a predetermined amount of a flowable agent prepared as in Formulation Example 6 was diluted with water in an amount corresponding to 10 liters per are, and the dilution was sprayed by a microsprayer. Thirty days after the treatment, the state of growth of the crop and the weeds was examined, and the results shown in Table 4 were obtained.

In Table 4, the degree of phytotoxicity to the crop and the herbicidal efficacy on the weeds are expressed on the following standards of evaluation by comparing the state of growth of the crop or weed with the air-dried amount of the crop or weed in the non-treated area.

Standards of evaluation (survival rate based on the air-dried weight in the non-treated area)

0: 91 - 100 %
1: 61 - 90 %
2: 36 - 60 %
3: 11 - 35 %
4: 6 - 10 %
5: 0 - 5 %

As the control methabenzthiazuron, diclofop-methyl and propanil, a commercial tribunil wettable powder, a commercial Hoelon emulsiable concentrate and a commercial stam emulsifiable concentrate were used.

Table 4

Compound		Rate of application of the active ingredient (g/a)	Crop	Weed											
			Wheat	(d)	(o)	(p)	(m)	(e)	(q)	(r)	(g)	(h)	(s)	(t)	(u)
Compound No. 1 of this invention		2.5	0	5	5	4	5	5	5	5	5	4	5	4	5
		5	0	5	5	5	5	5	5	5	5	5	5	5	5
		10	0	5	5	5	5	5	5	5	5	5	5	5	5
(Control)	H	10	0	0	0	0	0	0	4	3	4	5	4	3	4.5
		20	0	0	0	1	0	2	5	4.5	4	5	5	5	5
		30	0.5	0	2	2	1.5	3	5	5	5	5	5	5	5
	I	5	0	4	4	2	4	4	0	0	0	0	0	0	0
		10	0	5	5	3	4	5	0	1	0	0	0	1	1
		20	1	5	5	5	5	5	0	1.5	1	1	0	1	2
	J	2.5	0	3	3	2	2	2	3	3	4	2	2	2	2
		5	0	3	3	3	3	3	4	3.5	5	3	3	2	3
		10	0	5	4	4	4	4	5	4.5	5	5	3	3	3
	K	5	2	3	2	1	2	1	3	3	3.5	3	3	3	3
		10	3	3	3	3	3	4	4	4.5	4	3.5	3.5	3.5	4
		20	4	4	4	4	3.5	4.5	4.5	5	5	5	4.5	5	4.5
	A	2.5	2.5	2	2	2	2	2	3	3	3	2	2	3	1
		5	3	3	4	3	3.5	3.5	3.5	4	4	4	4	3	3
		10	3	4	4	3	4	4	5	5	4.5	5	4	4	4

H: 3-(2-benzothiazolyl)-1,3-dimethylurea (methabenzthiazuron)

I: methyl(±)-2-[4-(2,4-dichlorophenoxy)phenoxy]propionate (diclofop-methyl)

J: N-(4-isopropylphenyl)-2-methyl-2-pentenamide (Japanese Laid-Open Patent Publication No. 23357/1985)

K: N-(3,4-dichlorophenyl)-2-bromo-2-methylvaleramide (Japanese Patent Publication No. 14240/1966)

~~TEST EXAMPLE 4~~

~~Compound No. 3 of the invention was subjected to a herbicidal activity test in accordance with the method of Test Example 1. The results given in Table 5 was obtained. As a control compound, N-(3,4-dichlorophenyl)cyclopropanecarboxamide (L) (cypromid; U. S. Patent No. 3,272,107) was used instead of N-(3-chloro-4-methylphenyl)-2-methylpentanamide (c).~~

The plants shown by alphabets in Tables 2 to 4 were as follows:-

	English	Scientific nomenclature
(a)	crabgrass	Digitaria cilialis
(b)	green foxtail	setaria viridis
(c)	barnyard grass	Echinochloa oryzicola
(d)	wild oats	Avena fatua L.
(e)	annual bluegrass	Poa annua L.
(f)	green amaranth	Amaranthus retroflexus
(g)	lamb's quarters	Chenopodium album
(h)	chickweed	Stellaria media
(i)	charlock	Sinapis arvensis
(j)	black bindweed	Polygonum convolvulus
(k)	cocklebur	Xanthium strumarium
(l)	morning glory	Ipomea purpurea
(m)	water foxtail	Alopecurus aequalis
(n)	matricaria	Matricaria chamomilla
(o)	meadow foxtail	Alopecurus pratensis
(p)	black grass	Alopecurus myosuroides
(q)	pick purse	Capsella bursapastoris
(r)	cleavers	Galium spurium
(s)	henbit	Lamium amplexicaule
(t)	-	Cerastium holosteoides
(u)	-	Veronica caninotesticulata

The fogegoing test results demonstrate that the herbicides containing the compounds of this invention have a marked herbicidal efficacy at low dosages against all weeds tested by a foliar treatment not affected by the soil while showing outstanding selectivity for useful gramineous crops, particularly wheat, and that they excell the control chemicals (such as methabenzthiazuron, propanil, karsil, etc.) or other known compounds.

ADDITIONAL TEST EXAMPLES

In order to demonstrate technical advantages of the compound of the present invention over many other compounds whether known or novel, comparative tests on herbicidal effects were made.

Propanil (known compound), compounds disclosed in DE 2,249,547 and other compounds, which were prepared by reacting an aniline derivative described in DE 2,249,547 (page 4) with an acid derivative described in DE 2,249,547 (page 6-7), were used as comparative compounds.

The comparative compounds were synthesized according to the following Synthesis Example, and properties thereof are shown in Table 5.

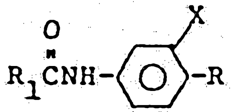
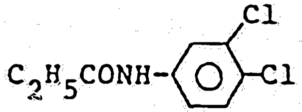
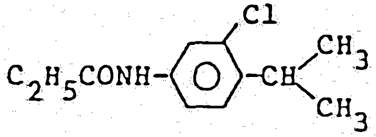
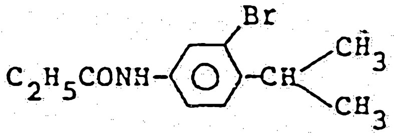
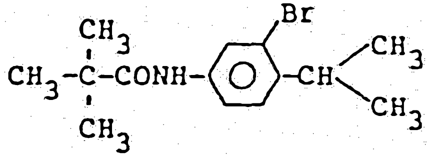
Synthesis Example

To 15 ml of benzene were added 0.5 g (2.3/1000 mol) of 3-chloro-4-tert-butylaniline hydrochloride and 0.5 g of triethylamine. Furtehr 0.34 g (2.3 mmols) of cyclohexanecarboxylic acid chloride was added, and the mixture was stirred at room temperature for 10 minutes. The precipitated insoluble matter was separated by filtration. Subsequently, 100 ml of benzene was added to the filtrate, and the resulting filtrate was washed with a saturated aqueous solution of sodium hydrogen carbonate and dried over anhydrous sodium sulfate. Crude crystals obtained by concentrating the dried filtrate through an evaporator were purified by silica gel column chromatography to afford 0.61 g of N-(4-tert-butyl-3-chlorophenyl)cyclohexanecarboxamide (Comparative Compound No. 24) in yield of 90.4%.

The other comparative compounds were also synthesized in the same manner as above.

17 11 89 5787

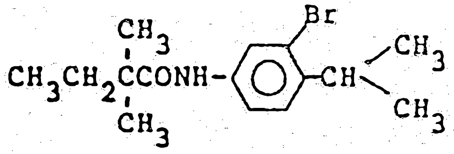
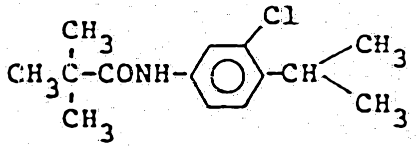
Table 5

Comparative Compound No.		Properties
1		Known compound (propanil)
2		Ref-1, Beispiel 2
3		m.p. 98.0-99.0°C IR ν_{max}^{KBr} (cm^{-1}): 3300, 1660 Elemental analysis (%) $C_{12}H_{16}BrNO$ C H Br N Calc. 53.35 5.98 29.57 5.18 Found 53.33 6.17 29.33 5.17
4		m.p. 118.0-120.0°C IR ν_{max}^{KBr} (cm^{-1}): 3360, 1660 Elemental analysis (%) $C_{14}H_{20}BrNO$ C H Br N Calc. 56.38 6.77 26.79 4.70 Found 56.38 6.85 26.13 4.67

- to be continued -

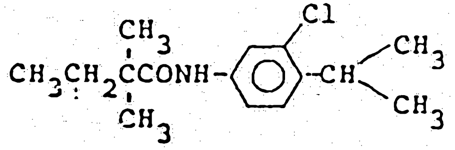
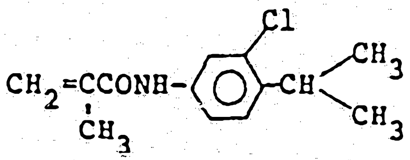
17 11 89 57877

Table 5 (continued)

5		m.p. 140.0-142.0°C IR ν_{max}^{KBr} (cm^{-1}): 3350, 1655 NMR $\delta_{TMS}^{CCl_4}$: 0.90 (3H, t, J=7Hz), 1.15-1.26 (12H, band), 1.64 (2H, q, J=7Hz), 3.30 (1H, m), 7.15 (1H, d, J=9Hz), 7.54 (1H, dd, J=9Hz, J=2Hz), 7.58 (1H, d, J=2Hz) Elemental analysis (%) $C_{15}H_{22}BrNO$ C H Br N Calc. 57.69 7.10 25.58 4.48 Found 57.45 7.41 25.30 4.45
6		m.p. 157-159.0°C IR ν_{max}^{KBr} (cm^{-1}): 3370, 1660 NMR $\delta_{TMS}^{CCl_4}$: 1.12 (6H, d, J=6Hz), 1.28 (9H, s), 3.32 (1H, m), 7.12 (1H, d, J=8Hz), 7.30 (1H, dd, J=8Hz, J=2Hz), 7.45 (1H, d, J=2Hz) Elemental analysis (%) $C_{14}H_{20}ClNO$ C H Cl N Calc. 66.26 7.94 13.97 5.51 Found 66.26 7.91 14.03 5.63

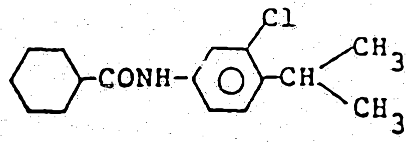
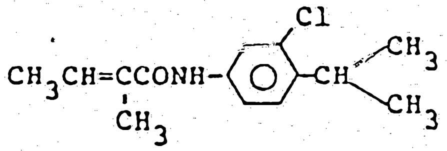
- to be continued -

Table 5 (continued)

7		m.p. 126.0-128.0°C IR ν_{max}^{KBr} (cm^{-1}): 3340, 1660 NMR $\delta_{TMS}^{CCl_4}$: 0.88 (3H, t, J=8Hz), 2.16-2.30 (12H, m), 1.56 (2H, q, J=8Hz), 7.09 (1H, d, J=8Hz), 7.32 (1H, dd, J=8Hz, J=2Hz), 7.41 (1H, d, J=2Hz), 7.44 (1H, s) Elemental analysis (%) $C_{15}H_{22}ClNO$ C H Cl N Calc. 67.27 8.28 13.23 5.23 Found 66.96 8.36 13.31 5.22
8		m.p. 109.0-111.0°C IR ν_{max}^{KBr} (cm^{-1}): 3260, 1660 NMR $\delta_{TMS}^{CCl_4}$: 1.22 (6H, d, J=6Hz), 2.01 (3H, s), 3.00 (2H, s), 3.30 (1H, m), 7.28 (1H, d, J=8Hz), 7.60 (1H, dd, J=8Hz, J=2Hz), 7.89 (1H, d, J=2Hz), 9.16 (1H, broad s) Elemental analysis (%) $C_{13}H_{16}ClNO$ C H Cl N Calc. 65.68 6.78 14.91 5.89 Found 65.61 7.06 14.68 5.84

- to be continued -

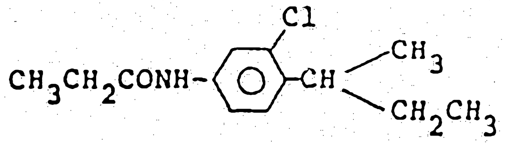
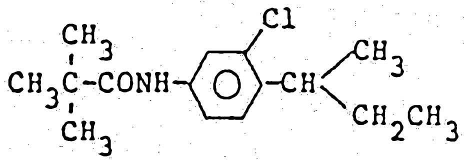
Table 5 (continued)

9		m.p. 104.0-108.0°C IR ν_{max}^{KBr} (cm^{-1}): 3280, 1660 NMR $\delta_{TMS}^{acetone-d6}$: 1.20 (6H, d, J=8Hz), 1.32-2.10 (11H, band), 3.26 (1H, m) 7.30 (1H, d, J=5Hz), 7.53 (1H, dd, J=5Hz, J=2Hz), 7.90 (1H, d, J=2Hz), 9.26 (1H, s) Elemental analysis (%) $C_{16}H_{22}ClNO$ C H Cl N Calc. 68.68 7.92 12.67 5.00 Found 68.77 8.03 12.33 4.80
10		IR ν_{max}^{film} (cm^{-1}): 3300, 1655 NMR $\delta_{TMS}^{CCl_4}$: 1.17 (6H, d, J=7Hz), 1.64 (3H, d, J=8Hz), 1.80 (3H, broad s), 3.28 (1H, septet, J=7Hz), 6.35 (1H, m), 7.03 (1H, d, J=10Hz), 7.37 (1H, dd, J=10Hz, J=3Hz), 7.57 (1H, d, J=3Hz), 8.72 (1H, broad s) Elemental analysis (%) $C_{14}H_{18}ClNO$ C H Cl N Calc. 66.79 7.20 14.08 5.56 Found 66.70 7.09 13.96 5.61

- to be continued -

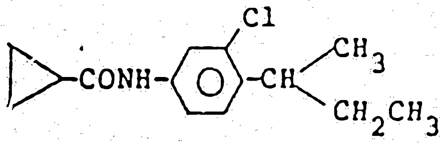
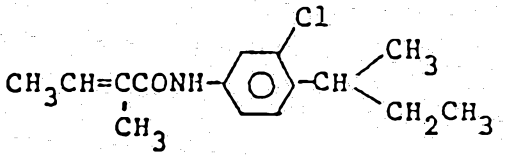
28

Table 5 (continued)

11		IR ν^{film}_{max} (cm^{-1}): 3320, 1665 NMR $\delta^{CCl_4}_{TMS}$: 0.83 (3H, t, J=8Hz), 1.10-1.28 (6H, m), 1.56 (2H, q d, J=8Hz, J=6Hz), 2.34 (2H, q, J=7Hz), 2.90-3.24 (1H, m), 7.02 (1H, d, J=8Hz), 7.34 (1H, dd, J=8Hz, J=2Hz), 7.53 (1H, d, J=2Hz) Elemental analysis (%) $C_{13}H_{18}ClNO$ C H Cl N Calc. 65.12 7.56 14.78 6.67 Found 64.97 7.52 14.83 6.57
12		m.p. 119.0-120.0°C IR ν^{KBr}_{max} (cm^{-1}): 3380, 1660 NMR $\delta^{CCl_4}_{TMS}$: 0.85 (3H, t, J=7Hz), 1.10-1.36 (12H, band), 1.40-1.70 (2H, m), 2.96-3.28 (1H, m), 7.04 (1H, d, J=8Hz), 7.39 (1H, dd, J=8Hz, J=2Hz), 7.63 (1H, d, J=2Hz) Elemental analysis (%) $C_{15}H_{22}ClNO$ C H Cl N Calc. 67.27 8.28 13.23 5.23 Found 67.06 8.43 13.34 5.38

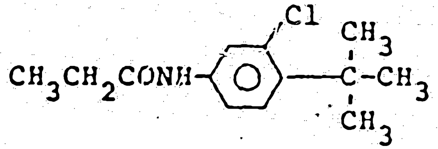
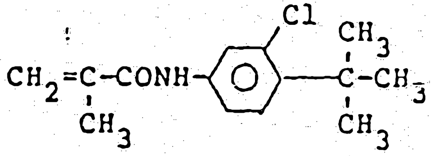
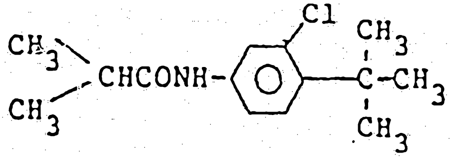
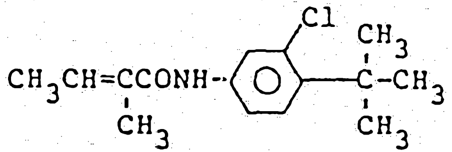
- to be continued -

Table 5 (continued)

13		m.p. 165.0-167.0°C IR γ_{max}^{KBr} (cm^{-1}): 3300, 1655 NMR $\delta_{TMS}^{DMSO-d6}$: 0.70-0.93 (7H, band), 1.16 (3H, d, J=7Hz), 1.40-1.75 (3H, m), 2.96-3.24 (1H, m), 7.25 (1H, d, J=9Hz), 7.43 (1H, dd, J=9Hz, J=2Hz), 7.77 (1H, d, J=2Hz), 10.25 (1H, broad s) Elemental analysis (%) $C_{14}H_{18}ClNO$ C H Cl N Calc. 66.79 7.20 14.08 5.56 Found 67.01 7.11 13.98 5.35
14		IR γ_{max}^{film} (cm^{-1}): 3310, 1660 NMR $\delta_{TMS}^{CCl_4}$: 0.80 (3H, t, J=7Hz), 1.10 (3H, d, J=7Hz), 1.30-1.84 (8H, m), 3.03 (1H, sextet, J=7Hz), 6.36 (1H, m), 7.03 (1H, d, J=9Hz), 7.47 (1H, dd, J=9Hz, J=3Hz), 7.58 (1H, d, J=3Hz), 8.48 (1H, broad s) Elemental analysis (%) $C_{15}H_{20}ClNO$ C H Cl N Calc. 67.78 7.58 13.33 5.27 Found 67.55 7.72 13.42 5.48

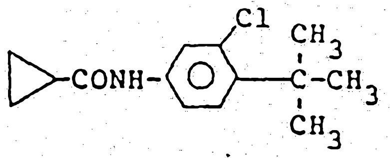
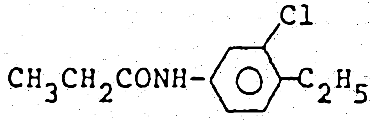
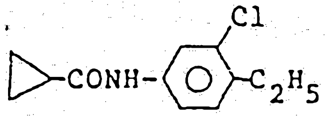
- to be continued -

Table 5 (continued)

15		Ref-1, Beispiel 3
16		Ref-1, Beispiel 4
17		Ref-1, Beispiel 5
18		m.p. 144.0-145.0°C IR ν_{max}^{KBr} (cm^{-1}): 3300, 1660 NMR $\delta_{TMS}^{CCl_4}$: 1.42 (9H, s), 1.76 (3H, broad s), 1.83 (3H, broad s), 6.50 (1H, m), 7.36 (1H, d, J=8Hz), 7.57 (1H, dd, J=8Hz, J=2Hz), 7.82 (1H, d, J=2Hz), 9.71 (1H, s) Elemental analysis (%) $C_{15}H_{20}ClNO$ C H Cl N Calc. 67.78 7.58 13.33 5.27 Found 67.52 7.55 13.10 5.33

- to be continued -

Table 5 (continued)

19		m.p. 140.0-142.0°C IR ν_{max}^{KBr} (cm^{-1}): 3220, 1660 NMR $\delta_{TMS}^{CCl_4}$: 0.72-0.92 (4H, band), 1.37 (9H, s), 1.60-1.88 (1H, m), 7.34-7.50 (2H, m), 7.68-7.92 (1H, m) Elemental analysis (%) $C_{14}H_{18}ClNO$ C H Cl N Calc. 66.79 7.20 14.08 5.56 Found 66.53 7.36 13.98 5.51
20		Ref-1, Beispiel 1
21		m.p. 114.0-116.0°C IR ν_{max}^{KBr} (cm^{-1}): 3300, 1670 NMR $\delta_{TMS}^{DMSO-d6}$: 0.62-1.00 (4H, band), 1.18 (3H, t, J=6Hz), 1.58-1.92 (1H, m), 2.65 (2H, q, J=6Hz), 7.18 (1H, d, J=8Hz), 7.36 (1H, dd, J=8Hz, J=2Hz), 7.71 (1H, d, J=2Hz) Elemental analysis (%) $C_{12}H_{14}ClNO$ C H Cl N Calc. 64.43 6.30 15.84 6.27 Found 64.18 6.43 15.79 6.18

- to be continued -

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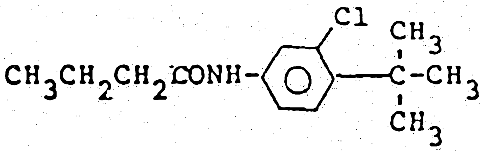
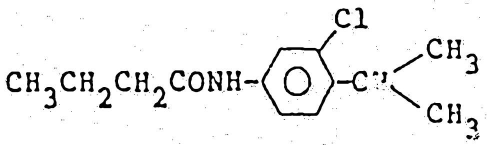
Table 5 (continued)

22		m.p. 74.0-76.0°C IR ν_{max}^{nujol} (cm^{-1}): 3300, 1660 NMR $\delta_{TMS}^{CCl_4}$: 0.96 (3H, t, J=7Hz), 1.45 (9H, s), 1.72 (2H, sextet, J=7Hz), 2.33 (2H, t, J=7Hz), 7.24 (1H, d, J=8Hz), 7.38 (1H, dd, J=7Hz, J=3Hz), 7.54 (1H, d, J=3Hz), 8.87 (1H, broad s) Elemental analysis (%) $C_{14}H_{20}ClNO$ C H Cl N Calc. 66.26 7.94 13.97 5.51 Found 66.43 8.02 13.61 5.44
23		m.p. 65.0-67.0°C IR ν_{max}^{nujol} (cm^{-1}): 3280, 1650 NMR $\delta_{TMS}^{DMSO-d6}$: 0.95 (3H, t, J=7Hz), 1.22 (6H, d, J=7Hz), 1.63 (2H, sextet, J=7Hz), 2.28 (2H, t, J=7Hz), 3.24 (1H, septet, J=7Hz) 7.25 (1H, d, J=8Hz), 7.43 (1H, dd, J=8Hz, J=2Hz), 7.80 (1H, d, J=2Hz) Elemental analysis (%) $C_{13}H_{18}ClNO$ C H Cl N Calc. 65.12 7.56 14.78 5.84 Found 65.31 7.57 14.61 5.77

- to be continued -

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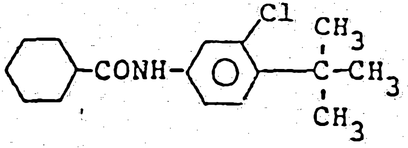
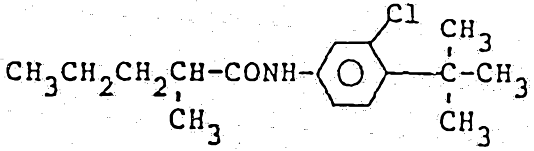
Table 5 (continued)

24		m.p. 117.0-119.0°C IR ν_{max}^{nujol} (cm^{-1}): 3240, 1655 NMR $\delta_{TMS}^{CDCl_3}$: 1.00-2.40 (20H, band), 7.23 (1H, d, J=8Hz), 7.42 (1H, dd, J=8Hz, J=2Hz), 7.57 (1H, d, J=2Hz) Elemental analysis (%) $C_{17}H_{24}ClNO$ C H Cl N Calc. 69.49 8.23 12.06 4.76 Found 69.27 8.10 12.09 4.75
25		m.p. 102.0-104.0°C IR ν_{max}^{nujol} (cm^{-1}): 3310, 1660 NMR $\delta_{TMS}^{CCl_4}$: 0.88 (3H, t, J=7Hz), 1.10-1.75 (16H, band), 2.30-2.60 (1H, m), 7.25 (1H, d, J=9Hz), 7.45 (1H, dd, J=9Hz, J=2Hz), 7.60 (1H, d, J=2Hz), Elemental analysis (%) $C_{16}H_{24}ClNO$ C H Cl N Calc. 68.18 8.58 12.57 4.97 Found 68.30 8.63 12.41 4.81

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- to be continued -

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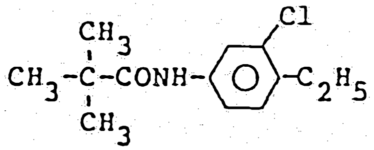
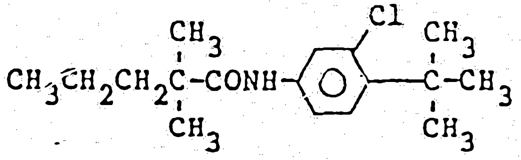
Table 5 (continued)

26		m.p. 113.0-114.0°C IR ν_{max}^{KBr} (cm^{-1}): 3300, 1650 NMR $\delta_{TMS}^{DMSO\text{-}d6}$: 1.16 (3H, t, J=8Hz), 1.21 (9H, s), 2.60 (2H, q, J=8Hz), 7.22 (1H, d, J=8Hz), 7.50 (1H, dd, J=8Hz, J=2Hz), 7.77 (1H, d, J=2Hz), 9.18 (1H, s) Elemental analysis (%) $C_{13}H_{18}ClNO$ C H Cl N Calc. 65.12 7.56 14.78 5.84 Found 65.10 7.54 14.91 5.72
27		m.p. 132.0-134.0°C IR ν_{max}^{nujol} (cm^{-1}): 3360, 1650 NMR $\delta_{TMS}^{CDCl_3}$: 0.85 (3H, t, J=7Hz), 1.06-1.70 (19H, band) 7.24-7.38 (2H, band), 7.56 (1H, d, J=2Hz) Elemental analysis (%) $C_{17}H_{26}ClNO$ C H Cl N Calc. 69.01 8.85 11.98 4.73 Found 68.82 8.91 11.77 4.94

- to be continued -

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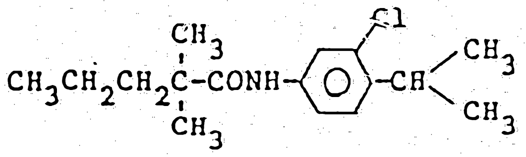
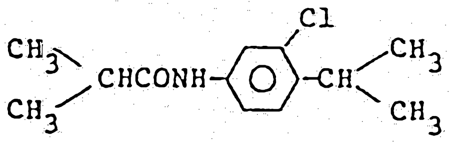
Table 5 (continued)

28		m.p. 103.0-104.0°C IR ν_{max}^{nujol} (cm^{-1}): 3280, 1650 NMR $\delta_{TMS}^{CDCl_3}$: 0.90 (3H, t, J=7Hz), 1.10-1.72 (16H, band), 3.30 (1H, m), 7.18 (1H, d, J=10Hz), 7.37 (1H, dd, J=10Hz, J=3Hz), 7.62 (1H, d, J=3Hz) Elemental analysis (%) $C_{16}H_{24}ClNO$ C H Cl N Calc. 68.18 8.58 12.57 4.97 Found 68.02 8.44 12.71 4.81
29		m.p. 83.0-85.0°C IR ν_{max}^{nujol} (cm^{-1}): 3280, 1655 NMR $\delta_{TMS}^{CDCl_3}$: 1.23 (6H, d, J=7Hz), 1.25 (6H, d, J=7Hz), 2.52 (1H, m), 3.35 (1H, m), 7.18 (1H, d, J=9Hz), 7.38 (1H, dd, J=9Hz, J=3Hz), 7.61 (1H, d, J=3Hz), Elemental analysis (%) $C_{13}H_{18}ClNO$ C H Cl N Calc. 65.12 7.56 14.78 5.84 Found 65.00 7.41 14.90 5.72

COMPARATIVE TESTS

Plastic pots (1/10,000 are) were filled with the soil taken from an upland farm, and seeds of one kind of test plants were sown in each pot and grown in a greenhouse. When each plant grew to a stage of 2 or 3 leaves, each of the test compounds was dissolved in acetone containing polyoxyethylene sorbitan monooleate and sorbitan monolaurate. The solution was sprayed by a pressure microsprayer at a rate of 500 liters per hectare. On the 21st day after the spraying of the chemical, the effects of the chemical on the crop and weeds were observed and examined. The results are shown in Table 6. The degree of injury to the test plants was evaluated on the following scale.

Rating	Degree of injury (%)	State of the injury
5	100	Withered (complete control of weeds)
4	80	Enormous injury (80% weed control)
3	60	Medium injury (60% weed control)
2	40	Small injury (40% weed control)
1	20	Slight injury (20% weed control)
0	0	No injury (no weed control)

The following eight types of weeds were used:

Veronica hederaefolia	(Vh)
Ambrosia artemisifolia	(Aa)
Cerastium vulgatum	(Cv)
Sesbania exaltata	(Se)
Cassia obstusifolia	(Co)
Euphobia macualata	(Em)
Chenopodium album	(Ca)
Stellaria media	(Sm)

Table 6

Test compound	Concentration X 500 ppm	AI Kg/ha	Weed								Crop
			Vh	Aa	Cv	Se	Co	Em	Ca	Sm	Wheat
Compound of This Invention	1	0.25	5	5	5	5	5	5	5	5	0
	2	0.5	5	5	5	5	5	5	5	5	0
	5	1.25	5	5	5	5	5	5	5	5	0
Comparative Compound 1	1	0.25	2	1	2	1	1	2	1	1	1
	2	0.5	3	2	3	2	2	3	3	3	2
	5	1.25	5	4	5	5	4	5	4	4	3
" 2	1	0.25	0	1	1	1	0	1	1	1	0
	2	0.5	1	2	2	2	1	2	3	2	1
	5	1.25	2	3	3	4	3	4	5	3	2
" 3	1	0.25	0	1	0	0	0	1	0	0	0
	2	0.5	0	2	1	1	1	2	1	1	1
	5	1.25	1	3	2	3	2	3	3	3	1
" 4	1	0.25	2	1	1	1	0	1	1	1	0
	2	0.5	3	2	2	2	1	2	3	2	2
	5	1.25	5	4	3	4	3	4	5	4	3
" 5	1	0.25	0	0	0	0	0	0	0	1	0
	2	0.5	1	1	0	0	1	0	2	2	0
	5	1.25	3	3	1	2	2	1	3	4	0
" 6	1	0.25	1	0	1	0	0	1	1	0	0
	2	0.5	2	2	2	2	2	2	3	2	1
	5	1.25	4	4	4	5	3	4	5	4	2

- to be continued -

Table 6 (continued)

Test compound	Concentration X 500 ppm	AI Kg/ha	Weed								Crop
			Vh	Aa	Cv	Se	Co	Em	Ca	Sm	Wheat
Comparative Compound 7	1	0.25	0	0	0	0	0	0	0	0	0
	2	0.5	0	1	1	1	0	1	1	1	0
	5	1.25	2	3	3	3	2	3	3	3	1
" 8	1	0.25	1	0	1	0	1	0	0	1	0
	2	0.5	2	2	2	1	2	2	1	3	1
	5	1.25	4	4	5	3	4	4	4	4	2
" 9	1	0.25	0	0	0	0	0	0	0	0	0
	2	0.5	0	0	0	0	0	0	0	0	0
	5	1.25	0	1	0	1	2	0	1	1	0
" 10	1	0.25	1	1	1	1	1	1	1	2	1
	2	0.5	2	3	2	2	2	2	3	3	2
	5	1.25	3	5	3	5	4	3	4	4	3
" 11	1	0.25	0	1	1	0	1	0	1	0	0
	2	0.5	1	2	2	1	2	1	2	1	1
	5	1.25	2	4	4	2	4	2	3	3	2
" 12	1	0.25	1	0	1	0	1	1	2	1	0
	2	0.5	2	1	2	1	2	2	2	3	1
	5	1.25	5	2	5	3	4	3	4	4	2
" 13	1	0.25	1	2	1	1	1	0	0	1	1
	2	0.5	2	3	2	1	2	2	1	3	2
	5	1.25	4	5	4	4	5	4	3	5	3

- to be continued -

Table 6 (continued)

Test compound	Concentration X 500 ppm	AI Kg/ha	Weed								Crop
			Vh	Aa	Cv	Se	Co	Em	Ca	Sm	Wheat
Comparative Compound 14	1 2 5	0.25 0.5 1.25	1 2 5	0 1 2	1 1 3	1 2 4	0 1 2	1 2 5	0 2 4	1 2 4	1 2 3
" 15	1 2 5	0.25 0.5 1.25	0 1 2	1 2 3	1 2 3	1 2 3	1 2 3	0 1 2	1 2 4	1 3 5	0 1 2
" 16	1 2 5	0.25 0.5 1.25	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	0 1 2	1 2 4	1 2 4	1 1 2
" 17	1 2 5	0.25 0.5 1.25	1 2 3	1 2 3	1 2 2	0 1 2	1 2 3	0 1 2	1 2 3	0 1 3	0 1 2
" 18	1 2 5	0.25 0.5 1.25	1 2 3	0 1 2	1 2 3	0 1 2	1 1 2	1 2 3	0 2 4	1 2 4	0 0 2
" 19	1 2 5	0.25 0.5 1.25	1 2 3	1 3 4	1 2 3	1 3 5	1 2 3	1 2 3	0 1 3	1 3 4	0 2 3
" 20	1 2 5	0.25 0.5 1.25	0 2 4	0 2 4	0 1 2	1 2 4	0 1 3	1 1 3	1 2 4	1 2 4	0 1 1

- to be continued -

Table 6 (continued)

Test compound	Concentration X 500 [illegible]	AI Kg/ha	Weed								Crop
			Vh	Aa	Cv	Se	Co	Em	Ca	Sm	Wheat
Comparative Compound 21	1	0.25	1	1	0	0	1	1	1	0	0
	2	0.5	2	2	2	2	1	2	2	2	1
	5	1.25	4	4	5	4	4	3	4	4	2
" 22	1	0.25	0	0	0	0	1	1	0	0	0
	2	0.5	1	0	0	1	1	1	1	0	0
	5	1.25	2	1	2	2	2	2	2	2	0
" 23	1	0.25	0	0	0	1	1	1	0	0	0
	2	0.5	1	1	1	2	2	2	1	1	0
	5	1.25	3	2	3	3	3	2	3	2	0
" 24	1	0.25	0	0	0	0	0	0	0	0	0
	2	0.5	0	0	0	0	0	0	0	0	0
	5	1.25	0	1	0	1	2	0	1	1	0
" 25	1	0.25	1	1	1	0	1	1	0	0	0
	2	0.5	2	2	2	2	2	2	2	1	1
	5	1.25	3	5	5	4	3	4	4	3	1
" 26	1	0.25	1	0	1	1	1	1	1	0	0
	2	0.5	2	1	2	1	2	2	2	2	1
	5	1.25	4	3	5	4	5	4	4	4	2
" 27	1	0.25	1	1	1	0	0	1	1	1	0
	2	0.5	2	2	2	2	1	2	2	2	1
	5	1.25	3	3	2	3	2	3	3	4	2

- to be continued -

Table 6 (continued)

Test compound	Concentration X 500 ppm	AI Kg/ha	Weed								Crop
			Vh	Aa	Cv	Se	Co	Em	Ca	Sm	Wheat
Comparative Compound 28	1	0.25	1	2	1	1	2	1	1	1	0
	2	0.5	3	3	2	2	3	2	2	2	1
	5	1.25	4	5	3	4	5	3	4	5	3
" 29	1	0.25	1	2	2	0	1	1	1	1	0
	2	0.5	2	2	3	1	2	2	2	2	1
	5	1.25	5	4	5	3	4	4	5	4	2

As is clear from the results in Table 2, N-(3-chloro-4-isopropylphenyl)propionamide (Comparative Compound No. 2; Beispeil 2) which is a compound described in DE 22,49547 and whose aniline moiety is the same as that in the compound of this invention cannot completely wither weeds even in the treatment in a concentration of 2,500 ppm (1.25 kg/ha). Likewise, Comparative Compound No. 7 which is an isomer of the compound of this invention and Comparative Compounds Nos. 6, 23, 28 & 29 which are homologs of 1-methylbutyl either do not wither completely or wither insufficiently, weeds in the treatment in a concentration of 2,500 ppm (1.25 kg/ha).

N-(4-tert-butyl-3-chlorophenyl)-2-methylpentamide (Comparative Compound No. 25) whose acid moiety is the same as that of the compound of this invention also shows an insufficient herbicidal effect in the treatment in a concentration of 2,500 ppm (1.25 kg/ha).

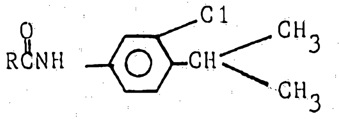
The other four compounds [Comparative Compounds No. 15 (Beispiel 3), No. 16 (Beispiel 4), No. 17 (Beispiel 5) and No. 20 (Beispiel 1)] or the compounds comprising other combinations of aniline derivatives and carboxylic acid derivatives described in DE 2,249,547 also show an insufficient herbicidal effect in the treatment in a concentration of 2,500 ppm (1.25 kg/ha).

On the other hand, the compound of this invention completely withers weeds even in the treatment in a concentration of 500 ppm (0.25 kg/ha) which is not more than one-fifth that of the compounds in DE 2,249,547, without observing toxicity to wheat. Such remarkable herbicidal effect shown by the compound of this invention is considered to be so surprising as to be unexpected from DE 2,249,547.

VF

The Claims defining the invention are as follows:

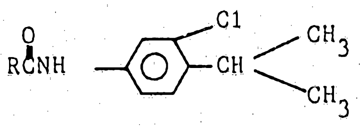
1. N-(3-chloro-4-isopropylphenyl) carboxamide represented by the formula (I):



(I)

wherein R represent a 1-methylbutyl.

2. A selective herbicide comprising a herbicidally effective amount of N-(3-chloro-4-isopropylphenyl) carboxamide represented by the formula (I):



(I)

wherein R represents a 1-methylbutyl group as an active ingredient, a carrier and/or at least one adjuvant.

3. A method of synthesis substantially as herein described with reference to synthesis example 1.

4. A herbicide formulation substantially as herein described with reference to any one of formulation examples 1 to 7.

5. A method of applying a herbicide substantially as herein described with reference to any one of test examples 1 to 3.

DATED: 14 November 1989
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