1,035,093

PATENT SPECIFICATION

NO DRAWINGS

1,035,093

Date of Application and filing Complete Specification: Dec. 7, 1962.
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Application made in United States of America (No. 158,567) on Dec. 11, 1961.
(Divided out of No. 1,035,091.)
(Patent of Addition to No. 968,661 dated Aug. 15, 1960.)
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Int. Cl.:—C 07 d 51/30 // A 01 n

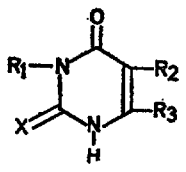
COMPLETE SPECIFICATION

Improvements relating to Herbicides

We, E. I. Du Pont De Nemours And Company, a Corporation organised and existing under the laws of the State of Delaware, United States of America, of Wilmington 98, Delaware, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

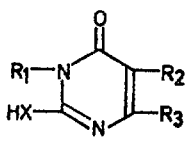
This invention relates to 3 - substituted uracils and is an improvement in or modification of the invention described in our Patent No. 968,661.

Our Specification No. 968,661 discloses that certain 3-substituted uracils have herbicidal activity. Those 3-substituted uracils are compounds of the general formula:



I

or the corresponding isomeric formula:



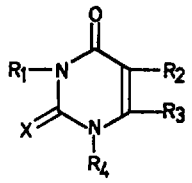
II

wherein R_1 is a covalent organic radical of molecular weight 15 to 250 which is an alkyl group of up to 10 carbon atoms, a substituted alkyl group in which the alkyl group contains up to 3 carbon atoms, a phenyl group, a substituted phenyl group, an aralkyl group of 7 or 8 carbon atoms, a substituted aralkyl group of 7 to 12 carbon atoms, an alkenyl group of 3 to 6 carbon atoms, a propynyl group, a butynyl group, a cycloalkyl group of 5 to 8 carbon atoms, a cycloalkenyl group of 5 to 8 carbon atoms or a cyano group; R_2 is a hydrogen or halogen atom or an alkyl group of up to 4 carbon atoms, an alkoxy group of up to 3 carbon atoms, a nitro group, an alkoxymethyl group of 2 to 4 carbon atoms, a hydroxy-methyl group, a hydroxyethyl group, an allyl group, a thiocyanato group, a cyano group, a halogenomethyl group or a methyl thiomethyl group; R_3 is a hydrogen or chlorine atom or an alkyl group of up to 5 carbon atoms, a methoxy group or an ethoxy group; or R_2 and R_3 together form a divalent alkylene bridge of formula $(CH_2)_n$, wherein n is 3, 4 or 5; and X is oxygen or sulphur, preferably oxygen; with the proviso that if R_2 is a hydrogen atom, then either R_3 is an alkyl group of 1 to 5 carbon atoms and R_1 is an alkyl group of 3 to 6 carbon atoms, an allyl group, a propynyl group or a cycloalkyl or cycloalkenyl group of 5 to 8 carbon atoms, or R_3 is a hydrogen atom and R_1 is a cycloalkyl or cycloalkenyl group of 5 to 8 carbon atoms; and metal salts of such uracils.

Within the broad class of 3-substituted uracils defined in Specification No. 968,661 are four particular classes which are the

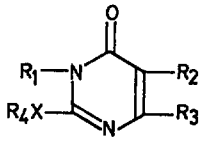
[*Price 4s. 6d.*]

subject of our Patents Nos. 968,662; 968,663; 968,664 and 968,665, which are patents of addition to Patent No. 968,661. Certain other 3-substituted uracils having herbicidal properties are disclosed in our Patent No. 968,666, which is also a patent of addition to our Patent No. 968,661. These uracils, all of which have a substituent in the 1- or 2-position are compounds of the general formula:



I

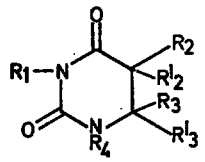
or the corresponding isomeric formula:



II

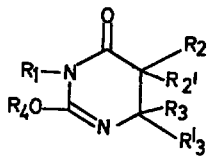
wherein R_1 is a covalent organic radical of molecular weight 15 to 250 which is an alkyl group of up to 10 carbon atoms, a substituted alkyl group in which the alkyl group contains up to 3 carbon atoms, a phenyl group, a substituted phenyl group, an aralkyl group of 7 or 8 carbon atoms, a substituted aralkyl group of 7 to 12 carbon atoms, an alkenyl group of 3 to 6 carbon atoms, a propynyl group, a butynyl group, a cycloalkyl group of 5 to 8 carbon atoms, a cycloalkenyl group of 5 to 8 carbon atoms or a cyano group; R_2 is a hydrogen or halogen atom or an alkyl group of up to 4 carbon atoms, an alkoxy group of up to 3 carbon atoms, a nitro group, an alkoxymethyl group of 2 to 4 carbon atoms, a hydroxymethyl group, a hydroxyethyl group, an allyl group, a thiocyanato group, a cyano group, a halogenomethyl group, or a methyl thiomethyl group; R_3 is a hydrogen or chlorine atom or an alkyl group of up to 5 carbon atoms, a methoxy group, or an ethoxy group; or R_2 and R_3 together form a divalent alkylene bridge of formula $(CH_2)_n$, wherein n is 3, 4 or 5; R_4 is a covalent radical of molecular weight up to 250 which is an alkyl group of up to 3 carbon atoms, a hydroxymethyl group, a hydroxyethyl group, a carboxyethyl group, a substituted carbamyl group, a substituted thiocarbamyl group, a diethylphosphoryl group, a chloromethylthio group, a phenylthio group, a halogenophenylthio group, a nitrophenylthio group, a dinitrophenylthio group, a tolylthio group or an acyl group; and X is oxygen or sulphur; with the proviso that if R_2 is a hydrogen atom and R_4 is a methyl group, then R_1 is a cycloalkyl or cycloalkenyl group of 5 to 8 carbon atoms.

The present invention relates to certain 3-substituted hydrouracils which have herbicidal activity, namely compounds of the general formula



I

or the corresponding isomeric formula



II

wherein R_1 represents a radical having a molecular weight up to 350 which is an alkyl radical containing 1 to 10 carbon atoms, a substituted alkyl radical containing 1 to 8 carbon atoms, an aryl radical containing 5 to 10 carbon atoms, a substituted phenyl radical, a substituted naphthyl radical, an aralkyl radical containing 5 to 13 carbon atoms, a substituted aralkyl radical containing 7 to 13 carbon atoms, an alkenyl radical containing 3 to 8 carbon atoms, a cycloalkyl radical containing 3 to 12 carbon atoms, a cycloalkenyl radical containing 4 to 12 carbon atoms, a substituted cycloalkyl radical containing 3 to 13 carbon atoms, a substituted cycloalkenyl radical containing 4 to 13 carbon atoms, a cycloalkyl alkyl radical containing 4 to 13 carbon atoms, a cycloalkenyl alkyl radical containing 5 to 13 carbon atoms, a (substituted cycloalkyl)alkyl radical containing 5 to 14 carbon atoms or a (substituted cycloalkenyl)alkyl radical containing 5 to 14 carbon atoms;

R_2 represents a radical having a molecular weight up to 250 which is a a hydrogen, chlorine, fluorine, bromine or iodine atom, a methyl radical, an ethyl radical, a propyl radical, a butyl radical, a methoxy radical, an ethoxy radical, a propoxy radical, a butoxy radical, a nitro radical, an alkoxymethyl radi-

cal containing 2 to 6 carbon atoms, a hydroxyalkyl radical containing 1 to 6 carbon atoms, an alkylthio radical containing 1 to 4 carbon atoms, a methylthiomethyl radical, a dimethyl carbamyl radical, a dimethyl sulphonamido radical, a methyl sulphonyl radical, an acetamido radical or a *p*-chlorocarbanilyl radical;

R_2' represents a hydrogen, chlorine or bromine atom;

R_3 represents a radical having a molecular weight up to 200 which is a hydrogen, chlorine or bromine atom, an alkyl radical containing 1 to 5 carbon atoms, a chloroalkyl radical containing 1 to 4 carbon atoms, a bromoalkyl radical containing 1 to 4 carbon atoms, a *p*-bromophenyl radical or an alkoxy radical containing 1 to 5 carbon atoms; or

R_2 and R_3 together represent a divalent alkylene radical of formula $(CH_2)_n$ where n is 3, 4 or 5;

R_3' represents a hydrogen or chlorine atom, an hydroxy radical, an alkoxy radical containing 1 to 6 carbon atoms, an acyloxy radical containing 1 to 6 carbon atoms, a substituted acyloxy radical containing 1 to 6 carbon atoms, a benzyl radical, a cyclohexyloxy radical, a hexanoyl radical, a 2-chloroethoxy radical, a 2,2,3,3-tetrafluoropropoxy radical, a 2-methoxyethoxy radical, a methoxymethyl radical or a methyl radical;

R_4 represents a hydrogen, chlorine or bromine atom, an alkyl radical containing 1 to 5 carbon atoms, a substituted alkyl radical containing 1 to 5 carbon atoms, a trichloromethylthio radical or an alkenyl radical containing 2 to 5 carbon atoms; with the proviso that the molecular weight of the hydrouracil is less than 500.

In one class of compounds within the general formula given above R_1 represents a radical having a molecular weight of at most 350 which is an alkyl radical containing 1 to 6 carbon atoms, a substituted alkyl radical containing 1 to 6 carbon atoms, a phenyl radical, a substituted phenyl radical, a naphthyl radical, a substituted naphthyl radical, a cycloalkyl radical containing 5 to 10 carbon atoms, a substituted cycloalkyl radical containing 5 to 10 carbon atoms, a cycloalkenyl radical containing 5 to 10 carbon atoms; R_2 represents a hydrogen or halogen atom, a nitro radical, a methyl or ethyl radical, an alkoxy radical containing 1 to 5 carbon atoms, a hydroxymethyl radical, a methoxymethyl radical, or an ethoxyethyl radical; R_2' represents a hydrogen, chlorine or bromine atom; R_3 represents a hydrogen or chlorine atom, an hydroxy radical, an alkoxy radical containing 1 to 6 carbon atoms, a haloalkoxy radical containing 1 to 6 carbon atoms, an acyloxy radical containing 1 to 6 carbon atoms or a substituted acyloxy radical containing 1 to 6 carbon atoms; R_3' represents a hydrogen or chlorine atom or a methyl or ethyl radical; or R_2 and R_3 together form a divalent alkylene radical of formula $(CH_2)_n$ where n is 3, 4 or 5; and R_4 represents a chlorine or bromine atom or a methyl, ethyl or trichloromethylthio radical.

In a second class of hydrouracils, which are believed to be novel, R_1 represents an alkyl radical containing 3 to 6 carbon atoms; a cycloalkyl radical containing 5 to 10 carbon atoms or a cycloalkenyl radical containing 5 to 10 carbon atoms; R_2 represents a hydrogen, chlorine, bromine or fluorine atom, a nitro radical, a methyl radical, an ethyl radical, a methoxy radical, a $-CH_2OH$ radical or a $-CH_2OC_2H_5$ radical; R_2' represents a chlorine, bromine or hydrogen atom; R_3 represents a chlorine atom or a methyl or ethyl radical; or R_2 and R_3 together form a divalent alkylene radical of formula $(CH_2)_n$ wherein n is 3, 4 or 5; R_3' represents a hydrogen atom, an acyloxy radical containing 1 to 6 carbon atoms, a substituted acyloxy radical containing 1 to 6 carbon atoms or an alkoxy radical containing 1 to 6 carbon atoms with the proviso that when one but not both of R_2 and R_2' is hydrogen, R_3' is hydrogen and when each of R_2, R_2' and R_3' is hydrogen, R_1 is a cycloalkenyl radical of 5 to 8 carbon atoms or a cycloalkyl radical of 5 to 8 carbon atoms; and R_4 represents a hydrogen atom.

If R_1 represents a substituted alkyl radical the or each substituent is preferably a methoxy radical or a bromine atom; if R_1 represents a substituted phenyl radical the or each substituent is preferably a chlorine, fluorine or bromine atom, an alkoxy radical, an alkyl radical containing 1 to 5 carbon atoms, e.g. a methyl radical, a chloroalkyl radical, a fluoromethyl radical, a chloroalkoxy radical, a perchloryl radical or a phenyl radical; if R_1 represented a substituted benzyl radical the or each substituent is preferably a chlorine atom, an alkyl radical containing 1 to 4 carbon atoms, a nitro radical or an alkoxy radical containing 1 to 4 carbon atoms; if R_1 represents a substituted cycloalkyl, cycloalkenyl, cycloalkyl alkyl or cycloalkenyl alkyl radical the or each substituent is preferably a chlorine or bromine atom, an alkyl radical containing 1 to 4 carbon atoms e.g. a methyl radical, a methoxy radical or an ethoxy radical; if R_3 represents a haloalkoxy radical the or each halogen atom is preferably a chlorine or fluorine atom; and if R_3 represents a substituted acyloxy radical, the or each substituent is preferably a chlorine atom.

Among the specific radicals which may be represented by R_1 are phenyl, naphthyl, *o*-biphenyl, pyridyl, chlorophenyl, bromophenyl, alkoxyphenyl, dichlorophenyl, dibromophenyl, fluorophenyl, trichlorophenyl, alkylphenyl of 7 to 11 carbon atoms, dialkylphenyl of 8 to 12 carbon atoms, chloroalkylphenyl of 7 to 10 carbon atoms, nitrochlorophenyl, nitrophenyl, dichloronitrophenyl, chloroalkoxyphenyl of 7 to 11 carbon atoms,

trifluoromethylphenyl, alkylnaphthyl of 11 to 15 carbon atoms, chloronaphthyl, tetrahydronaphthyl and indenyl; furfuryl, benzyl, phenylalkyl of 8 to 11 carbon atoms (total), chlorobenzyl, dichlorobenzyl, alkylbenzyl of 8 to 11 carbon atoms (total), dialkylbenzyl of 9 to 13 carbon atoms (total), nitrobenzyl, alkoxybenzy of 8 to 11 carbon atoms (total) and naphthylmethyl; cyclododecyl, cyclohexyl, cyclohexenyl, cyclohexylalkyl, cyclohexenyl alkyl, cyclopentyl, cyclopentenyl, cyclopentyl alkyl, cyclopentenyl alkyl, cycloheptyl, cycloheptenyl, cyclooctyl, norbornyl, norbornenyl, norbornyl alkyl, norbornenyl alkyl, bicyclo (2,2,2) octyl, bicyclo (2,2,2) octenyl, bicyclo (2,2,2) octyl alkyl, bicyclo (2,2,2,) octenyl alkyl, cyclopropyl, cyclobutyl, cyclobutylalkyl, cyclobutenyl, cyclobutenylalkyl, indanyl, hexahydroindenyl, tetrahydroindanyl, hexahydroindenyl alkyl, hexahydroindanyl, tetrahydroindanyl alkyl, fenchyl, bornyl, hexahydroindanyl alkyl, hexahydro - 4,7 - methanoindenyl, hexahydro-4,7 - methanoindenyl alkyl, hexahydro - 4,7 - methanoindanyl, tetrahydro - 4,7 - methanoindanyl, hexahydro - 4,7 - methanoindanyl alkyl, tetrahydro - 4,7 - methanoindanyl alkyl, decahydronaphthyl, decahydronaphthyl alkyl, tetrahydronaphthyl, tetrahydronaphthyl alkyl, decahydro - 1,4 - methanonaphthyl, decahydro - 1,4 - methanonaphthyl alkyl, octahydro - 1,4 - methanonaphthyl, octahydro - 1,4-methanonaphthyl alkyl, decahydro-1,4,5,8-dimethanonaphthyl, decahydro - 1,4,5,8 - dimethanonaphthyl alkyl, octahydro - 1,4,5,8 - dimethanonaphthyl and octahydro - 1,4,5,8 - dimethanonaphthyl alkyl.

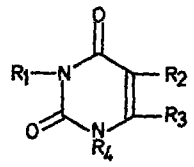
The term "acyl" is used herein in a broad sense to denote a radical derived from an organic acid by the removal of the hydroxyl group. Preferred acyl groups have the formula:—



wherein R_{11} represents a hydrogen atom, an alkyl radical of 1 to 4 carbon atoms, a chloroalkyl radical of 1 to 4 carbon atoms, a polychloroalkyl radical of 1 to 4 carbon atoms, a phenyl radical, a chlorophenyl radical of 1 to 3 chlorine atoms, a benzyl radical, a chlorobenzyl radical of 1 to 3 chlorine atoms, a phenoxymethyl or a chlorophenoxymethyl radical containing 1 to 3 chlorine atoms.

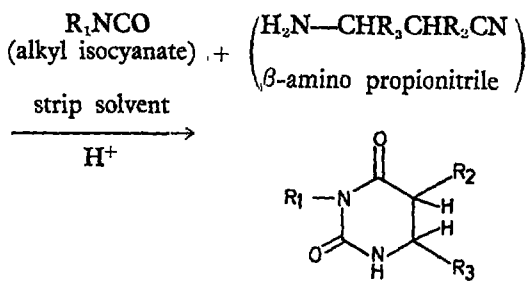
The hydrouracils may be prepared by three basic methods.

The first method involves the addition of moieties across the double bond between the 5- and 6-positions of a uracil starting material of the general structure



wherein R_1, R_2, R_3 and R_4 are as defined above. Examples of moieties which add across the double bond are organic hypochlorites, such as alkyl and acyl hypochlorites, hydrogen (by catalytic hydrogenation) and halogens. When the 5-position in the uracil starting material is substituted with hydrogen, the compound resulting from a hypochlorite addition will have two chlorine atoms in the 5-position. When the substituent (R_2) in the 5-position of the uracil starting material is anything else, only one chlorine will be added in the 5-position of the resulting product.

A second method is illustrated by the following equations:



This method is limited to the preparation of hydrouracils in which R_2' and R_3' are both hydrogen and R_2 and $_3$ are hydrogen atoms or lower alkyl radicals. The reaction is carried out by mixing the reactants in an inert solvent such as benzene, toluene, xylene or cyclohexane. The reaction is spontaneous and exothermic. The solvent is stripped off under reduced pressure and the residue is suspended in a dilute (6N) aqueous acid such as hydrochloric or sulphuric acid, in a ratio of about one part of residue to each 20 parts of acid. The mixture is boiled for approximately one hour and then evaporated to dryness under

reduced pressure to give the desired hydrouracil, which can, if required, be recrystallised from water or such solvents as alcohol, acetonitrile, or nitromethane.

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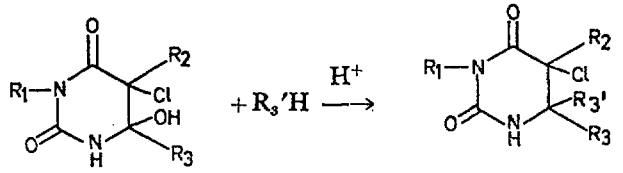
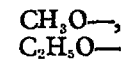
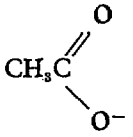


wherein R_3' represents a radical such as a chlorine atom or a radical of formula



or



This reaction is carried out by dissolving the hydrouracil starting material in the reagent-solvent in a ratio of about 1 to 10. About 1 to 5%, by weight of the starting hydrouracil, of an acid catalyst should also be present. Suitable catalysts are anhydrous hydrochloric acid, sulphuric acid, and *p*-toluene sulphonic acid. The reactants are allowed to stand at room temperature for from 5 to 25 hours. The product is isolated by stripping off the solvent under reduced pressure to give a solid crystalline material which can be recrystallised from acetonitrile, nitromethane, cyclohexane or benzene.

Further details regarding the preparation of hydrouracils will be found in Journal Am. Chem. Soc., *59*, 2436 (1937); Journal Am. Chem. Soc., *60*, 1622 (1938); Journal Biol. Chem., *199*, 333 (1952); Monatsh., *64*, 333 (1934); Ber., *38*, 1689 (1905); Journal Am. Chem. Soc., *58*, 299 (1936); and Journal Org. Chem., *24*, 571 (1959).

It will be noted that the definition above refers to the isomeric enol form of the uracil, as well as the usual keto form. It is thought that there is a tautomeric equilibrium between the two forms. However, for the sake of convenience the keto form is generally referred to herein. It may also be noted that since "uracil" is the commonly accepted name for 2,4 - dihydroxypyrimidine, or, in its keto form, 1,2,3,4 - tetra - hydropyrimidine - 2,4 - dione, the compounds can also be named as pyrimidines.

The compounds to which the present invention relates (referred to herein as "the said compounds") can be formulated as herbicidal compositions comprising at least one of the said compounds associated with a compatible diluent or surface-active agent, or both. The term "herbicidal composition" is used herein to include both compositions which are ready for use as herbicides and concentrates which require dilution before use as herbicides. The compositions may contain for example 0.5 to 95% by weight of the 3-substituted uracil. (Parts, proportions and percentages are by weight throughout this specification except where otherwise noted.)

A third method is the introduction of functional groups into hydrouracils which have been prepared according to the two aforementioned procedures, e.g. as follows:—

The diluent may be a liquid other than an oil, especially water, or an oil, or a solid carrier. The term "oil" is used herein to denote a liquid which is immiscible with water and soluble in ether, and which has a boiling point not lower than 125°C. Two or more different types of diluent may be present, as for example in compositions obtained by dispersing a wettable powder in a liquid diluent. Liquid compositions may be in the form of solutions or dispersions.

Powder and dust preparations can be made by mixing the said compounds with finely-divided solids, preferably talcs, natural clays, pyrophyllite, diatomaceous earth, flours such as walnut shell, wheat, redwood, soya bean and cotton seed flours, or inorganic substances such as magnesium carbonate, calcium carbonate, calcium phosphate, sulphur and lime. These preparations are made by thoroughly blending the active ingredient and the solid. The particles in such preparations are preferably less than 50 microns in average diameter.

Water-soluble preparations can be prepared by mixing a said compound with an alkaline solubilising agent. Solid bases having a pH of at least 9.5 in a 1% aqueous solution, such as sodium or potassium phosphates, silicates, carbonates, borates, oxides or hydroxides are suitable. The preparations can contain from 0.5 to 80% of the said compound and from 5 to 99.5% of the solubilising agent. Water-soluble diluents such as urea and dextrose may also be used.

Granules and pellets can be made by mixing a said compound in finely-divided form with a suitable clay, moistening this mixture with from 15 to 20% by weight of water, and for example extruding the mass through a suitable die under pressure. The extrusions

are cut into pellets of pre-determined lengths and then dried. These pellets can be granulated if desired.

Granules or pellets can also be prepared by spraying a suspension or solution of a said compound onto the surface of a preformed granule of clay, vermiculite or other suitable granular material. If the said compound is in solution, it will penetrate into the pores of the granule and so will adhere without the aid of a binding agent. When the said compound is insoluble in the liquid and is carried as a suspension, it is preferable that a binding agent such as goulac, dextrin, swollen starch, glue or polyvinyl alcohol be added. In either case, the granule is then dried and ready for use.

The said compounds can also be formulated with non-aqueous liquids. Aliphatic and aromatic hydrocarbons, especially those derived from petroleum and having boiling points of from 125°C. to 400°C. are preferred. Hydrocarbons having lower boiling points should not be used because of their undesirable volatilisation characteristics and inflammability. In the case of those compounds having inadequate solubility in the carrier, it is convenient to prepare liquid compositions by milling the components in a mill such as a pebble mill until the particles have average diameters of from 1 to 50 microns, preferably 5 to 20 microns.

The herbicidal compositions, whatever physical form they take, can also contain a surface-active agent. The surfactant renders the preparations readily dispersible in liquids and improves their action on waxy leaves and the like. For general application, surface-active agents are used in the compositions at concentrations of from 1 to 10% by weight. Levels of from 0.5 to 6 parts of surfactant for each part of uracil, however, sometimes give unusual and unexpected results. Preparations having these higher levels of surfactants sometimes show greater herbicidal effectiveness than can be expected from a consideration of activity of the components used separately.

The term "surface-active agent" is used herein to include wetting agents, dispersing agents, suspending agents and emulsifying agents. Surface-active agents suitable for use are set forth in "Detergents and Emulsifiers ... up-to-date", 1962, John W. McCutcheon, Inc., Morristown, New Jersey. Other surface-active agents which can be used in these preparations are listed in U.S. Patent Specifications 2,412,510; 2,426,417 and 2,655,447, British Specification No. 492,742 and Bulletin E-607 of the Bureau of Entomology and Plant Quarantine of the U.S. Department of Agriculture.

The compositions can also optionally contain adhesives such as gelatin, blood albumin and such resins as rosin alkyd resins. These increase retention and tenacity of deposits following application.

The preparations can also contain corrosion inhibitors, antifoam agents, dyes and pigments, anticaking agents, and hard water stabilisers.

The herbicidal compositions can be formulated to contain two or more of the said compounds. They can also be formulated to contain other herbicides in addition to the said compounds to give compositions which have advantages over compositions containing only the individual herbicides. The other herbicide may be a 3-substituted uracil or salt or nitrogenous base or phenol addition compound thereof as disclosed in our co-pending applications Nos. 46342/62 (1,035,091), 6191/66 (1,035,092), 6193/66 (1,035,094), 6194/66 (1,035,095), 6195/66 (1,035,096), 6196/66 (1,035,097) and 8987/66 (1,035,098).

Among the known herbicides which can be combined with the said compounds are:

Substituted Ureas

3 - (3,4 - dichlorophenyl) - 1,1 - dimethylurea
3 - (4 - chlorophenyl) - 1,1 - dimethylurea
3 - phenyl - 1,1 - dimethylurea
3 - (3,4 - dichlorophenyl) - 3 - methoxy - 1,1 - dimethylurea
3 - (4 - chlorophenyl) - 3 - methoxy - 1,1 - dimethylurea
3 - (3,4 - dichlorophenyl) - 1 - *n* - butyl - 1 - methylurea
3 - (3,4 - dichlorophenyl) - 1 - methoxy - 1 - methylurea
3 - (4 - chlorophenyl) - 1 - methoxy - 1 - methylurea
3 - (3,4 - dichlorophenyl) - 1,1,3 - trimethylurea
3 - (3,4 - dichlorophenyl) - 1,1 - diethylurea
3 - (*p* - chlorophenoxyphenyl) - 1,1 - dimethylurea

These ureas can be mixed with the said compounds in proportions of from 1:4 to 4:1, respectively, the preferred ratio being 1:2 to 2:1.

Substituted Triazines

2 - chloro - 4,6 - bis(ethylamino) - *s* - triazine
2 - chloro - 4 - ethylamino - 6 - isopropylamino - *s* - triazine
2 - chloro - 4,6 - bis(methoxypropylamino) - *s* - triazine
2 - methoxy - 4,6 - bis(isopropylamino) - *s* - triazine
2 - diethylamino - 4 - isopropylacetamido - 6 - methoxy - *s* - triazine
2 - isopropylamino - 4 - methoxyethylamino - 6 - methylmercapto - *s* - triazine
2 - methylmercapto - 4,6 - bis(isopropylamino) - *s* - triazine
2 - methylmercapto - 4,6 - bis(ethylamino) - *s* - triazine

2 - methylmercapto - 4 - ethylamino - 6 - isopropylamino - *s* - triazine
2 - methoxy - 4,6 - bis(ethylamino) - *s* - triazine
2 - methoxy - 4 - ethylamino - 6 - isopropylamino - *s* - triazine
2 - chloro - 4,6 - bis(isopropylamino) - *s* - triazine

These triazines can be mixed with the said compounds in proportions of from 1:4 to 4:1 respectively, the preferred ratio being 1:2 to 2:1.

Phenols

Dinitro-o-*sec.*-butylphenol and its salts
Pentachlorophenol and its salts

These phenols can be mixed with the said compounds in the proportions of 1:10 to 20:1, respectively, the preferred ratio being 1:5 to 5:1.

Carboxylic Acids and Derivatives

The following carboxylic acids and derivatives can be mixed with the said compounds in the listed proportions:

A. 2,3,6 - trichlorobenzoic acid and its salts
2,3,5,6 - tetrachlorobenzoic acid and its salts
2 - methoxy - 3,5,6 - trichlorobenzoic acid and its salts
2 - methoxy - 3,6 - dichlorobenzoic acid and its salts
3 - amino - 2,5 - dichlorobenzoic acid and its salts
3 - nitro - 2,5 - dichlorobenzoic acid and its salts
2 - methyl - 3,6 - dichlorobenzoic acid and its salts
2,4 - dichlorophenoxyacetic acid and its salts and esters
2,4,5 - trichlorophenoxyacetic acid and its salts and esters
(2 - methyl - 4 - chlorophenoxy)acetic acid and its salts and esters
2 - (2,4,5 - trichlorophenoxy)propionic acid and its salts and esters
2 - (2,4,5 - trichlorophenoxy)ethyl 2,2-dichloropropionate
4 - (2,4 - dichlorophenoxy)butyric acid and its salts and esters
4 - (2 - methyl - 4 - chlorophenoxy)butyric acid and its salts and esters
2,3,6 - trichlorobenzoyloxypropanol

Mixed in a 1:16 to 8:1 ratio, preferably a 1:4 to 4:1 ratio.

B. 2,6 - dichlorobenzonitrile

Mixed in a 1:4 to 4:1 ratio, preferably a 1:3 to 3:1 ratio.

C. Trichloroacetic acid and its salts

Mixed in a 1:2 to 25:1 ratio, preferably a 1:1 to 8:1 ratio.

D. 2,2 - dichloropropionic acid and its salts

Mixed in a 1:4 to 8:1 ratio, preferably a 1:2 to 4:1 ratio.

E. N,N - di(*n* - propyl)thiolcarbamic acid, ethyl ester
N,N - di(*n* - propyl)thiolcarbamic acid, n-propyl ester
N - ethyl - N - (*n* - butyl)thiolcarbamic acid, ethyl ester
N - ethyl - N - (*n* - butyl)thiolcarbamic acid, n-propyl ester

Mixed in a 1:2 to 24:1 ratio, preferably a 1:1 to 12:1 ratio.

F. N - phenylcarbamic acid, isopropyl ester
N - (*m* - chlorophenyl)carbamic acid, isopropyl ester
N - (*m* - chlorophenyl)carbamic acid, 4-chloro - 2 - butynyl ester

Mixed in a 1:2 to 24:1 ratio, preferably a 1:1 to 12:1 ratio.

G. 2,3,6 - trichlorophenylacetic acid and its salts

Mixed in a 1:12 to 8:1 ratio, preferably a 1:4 to 4:1 ratio.

H. 2 - chloro - N,N - diallylacetamide
Maleic hydrazide

Mixed in a 1:2 to 10:1 ratio, preferably a 1:1 to 5:1 ratio.

Inorganic and Mixed Inorganic-Organic Salts

The following salts can be mixed with the said compounds in the listed proportions:

A. Calcium propylarsonate
Disodium monomethylarsonate
Octyl-dodecylammoniummethylarsonate
Dimethylarsinic acid

Mixed in a 1:4 to 4:1 ratio, preferably a 1:2 to 2:1 ratio.

B. Sodium arsenite

Mixed in a 1:5 to 40:1 ratio, preferably a 1:4 to 25:1 ratio.

C. Lead arsenate
Calcium arsenate

Mixed in a 100:1 to 600:1 ratio, preferably a 150:1 to 400:1 ratio.

D. Sodium tetraborate hydrated, granulated
Sodium metaborate
Sodium pentaborate
Polyborchlorate
Unrefined borate ore such as borascu

Mixed in a 3:1 to 1500:1 ratio, preferably a 6:1 to 1000:1 ratio.

E. Ammonium thiocyanate

Mixed in a 1:10 to 20:1 ratio, preferably a 1:5 to 5:1 ratio.

F. Sodium chlorate

Mixed in a 1:1 to 40:1 ratio, preferably a 2:1 to 20:1 ratio.

G. Ammonium sulphamate

Mixed in a 1:1 to 100:1 ratio, preferably a 1:1 to 50:1 ratio.

Other Organic Herbicides

These organic herbicides can be mixed with the said compounds in the listed proportions:

A. 5,6 - dihydro - (4A,6A) - dipyrido - (1,2/ - A,/2',1' - C) pyrazinium dibromide

Mixed in a 1:20 to 16:1 ratio, preferably a 1:5 to 5:1 ratio.

B. 3 - amino - 1,2,4 - triazole

Mixed in a 1:20 to 20:1 ratio, preferably a 1:5 to 5:1 ratio.

C. 3,6 - endoxohexahydrophthalic acid

Mixed in a 1:3 to 20:1 ratio, preferably a 1:2 to 10:1 ratio.

D. Hexachloroacetone

Mixed in a 1:2 to 16:1 ratio, preferably a 1:1 to 8:1 ratio.

E. Diphenylacetonitrile

N,N - dimethyl - α,α - diphenylacetamide

N,N - di - *n* - propyl - 2,6 - dinitro - 4 - trifluoromethylaniline

N,N - di - *n* - propyl - 2,6 - dinitro - 4 - methylaniline

Mixed in a 1:10 to 30:1 ratio, preferably a 1:5 to 20:1 ratio.

F. O - (2,4 - dichlorophenyl) - O - methyl - isopropylphosphoramidothioate

2,3,5,6 - tetrachloroterephthalic acid, dimethyl ester

Mixed in a 1:4 to 20:1 ratio, preferably a 1:3 to 15:1 ratio.

G. 2,4 - dichloro - 4' - nitrodiphenyl ether

Mixed in a 1:10 to 30:1 ratio, preferably a 1:5 to 20:1 ratio.

In a further aspect the invention provides a method of controlling the growth of weeds at a locus which comprises applying to the locus a herbicidally effective quantity of at least one of the said compounds. The amount of active compound used will depend on the weeds to be controlled, the formulation used, the mode of application, the climate, season of the year, rainfall and other variables, and because of this it is not possible to state generally a particular rate of application which will be suitable for all situations.

Some of the said compounds are especially useful in controlling the growth of weeds on uncultivated areas. Thus in suitable circumstances some of the said compounds can be used as soil sterilants and/or in soil-foliage applications.

It has been found that strikingly similar herbicidal activity can be obtained with seemingly unrelated substituents round the uracil ring. It has also been found that changes in useful selective phytotoxicity (applicable in certain weed-crop combinations) may result when a relatively minor structural modification of R_1 (for example a normal alkyl chain altered to a branched chain) has been made. The 5-substituents (described for R_2 above) for example, have been found to have a minimum range of herbicidal effectiveness and/or species selectivity dependent on the nature of the substituent (if any) in the 3- or 6-position. There has been found little continuity of herbicidal effect which could be ascribed to a particular substituent independently of the other two substituents in the 3,5,6-positions.

Some of the said compounds are particularly useful against both broadleaf and grass weeds. Others are particularly effective against hard-to-kill nutsedge and perennial grasses such as quack grass, Johnson grass, and Bermuda grass. Others are particularly effective on highly adsorptive substrates such as railroad ballast, heavy clay soil, and soils high in organic matter. For example, a pre-emergence treatment has been used to control such germinating broadleaf weeds as pigweed, lamb's quarter, mustard, chickweed and ragweed, and such grass weeds as crab grass and foxtails. Some of the said compounds are particularly effective in soil-foliage applications for the control of such broadleaves as pigweed, lamb's quarter, mustard, chickweed and ragweed and such grass weeds as crab grass, foxtails, quack grass and seedling Johnson grass.

Some of the said compounds are particularly useful as soil sterilants and for general weed control, e.g. on industrial areas, railroad rights-of-way, and areas adjacent to croplands in agricultural areas.

Certain of the said compounds also exhibit selective herbicidal action in crops. By properly selecting a said compound and a rate and time of application, annual grass and broadleaf seedlings in such crops as asparagus, corn, flax, sugar cane, safflower, peanuts, citrus, alfalfa, strawberries, gladiolus, stone fruits, sorghum, sugar beets, red beets, mangels, spinach, potatoes, pineapple, cotton and cucurbits can be controlled.

By proper selection of rate and time of application, certain of the said compounds can also be used to control weeds growing in dormant crops.

This selective activity and activity on weeds growing in dormant crops is described in more detail in the Examples.

Many of the compounds have unusually high oil solubility, and so are useful for application in oils such as herbicidal oils, diesel oil, kerosene, xylene, and other commercially available spray oils. High oil solubility makes shipment of many uracil/oil "concentrates" practical. Such concentrates can be diluted with low-cost diesel oil and herbicidal oils at the site of application.

Broadly speaking, the compounds are used at levels of about $\frac{1}{4}$ pound per acre to about 80 pounds per acre for general weed control. For selective weed control in crops, rates of $\frac{1}{4}$ or $\frac{1}{2}$ to 3 or 8 pounds per acre will generally be used, and in pre-emergence treatments from $\frac{1}{4}$ to 5, preferably $\frac{1}{2}$ to 2 or 4 pounds per acre, may for example be used. More of the active material can be used to control difficult-to-kill species growing under adverse conditions. Economic factors, such as inaccessibility of the area to be treated, e.g. fire breaks in forests, may also favour higher rates, with less frequent treatments.

The invention is illustrated by the following Examples.

EXAMPLE 1

Preparation of 3 - *sec* - butyl - 5,5 - dichloro - 6 - methoxy - 6 - methyl hydrouracil

A mixture of 192 parts of 3 - *sec* - butyl - 6 - methyl - uracil and 1000 parts of methanol is stirred beneath a nitrogen blanket as 142 parts of gaseous chlorine are gradually added. The exothermic reaction is maintained at 25°C. with a cooling bath. The addition of the chlorine is completed in about 1 hour, and the reaction mixture is stirred at 25°C. for an additional 2 hours.

The resulting slurry is concentrated at reduced pressure to about one-third of its original volume, chilled in an ice bath, and filtered. The resulting white solid, 3 - *sec* - butyl - 5,5 - dichloro - 6 - methoxy - 6 - methyl hydrouracil, m.p. 144°C. to 147°C. is sufficiently pure for formulation as an herbicide.

The compounds in the following table are prepared in a similar fashion by substituting the listed reactants for those specified above.

Substituted Uracil	Parts by Weight	Alcohol	Halogen	Parts by Weight	Substituted Hydrouracil Product
3-propyl-6-methyluracil	168	methyl alcohol	chlorine	142	5,5-dichloro-6-methoxy-6-methyl-3-propyl hydrouracil
3-isopropyl-6-methyluracil	168	methyl alcohol	chlorine	142	5,5-dichloro-6-methoxy-6-methyl-3-isopropyl hydrouracil
3-isopropyl-6-methyluracil	168	isopropyl alcohol	chlorine	142	5,5-dichloro-6-isopropoxy-6-methyl-3-isopropyl hydrouracil
5,6-dimethyl-3-isopropyl-uracil	182	methyl alcohol	chlorine	71	5-chloro-5,6-dimethyl-6-methoxy-3-isopropyl hydrouracil
5,6-dimethyl-3-isopropyluracil	182	methyl alcohol	bromine	160	5-bromo-5,6-dimethyl-6-methoxy-3-isopropyl hydrouracil
3-isopropyl-6-methyluracil	168	butyl alcohol	chlorine	142	6-butoxy-5,5-dichloro-6-methyl-3-isopropyl hydrouracil
3-isopropyl-6-methyluracil	168	cyclohexanol	chlorine	142	5,5-dichloro-6-cyclohexoxy-6-methyl-3-isopropyl hydrouracil
3-isopropyl-6-ethyluracil	182	methyl alcohol	chlorine	142	5,5-dichloro-6-ethyl-6-methoxy-3-isopropyl hydrouracil
3-isopropyl-5-ethyl-6-methyluracil	196	methyl alcohol	chlorine	71	5-chloro-5-ethyl-6-methoxy-6-methyl-3-isopropyl hydrouracil
3-isopropyl-6-methyl-5-nitrouracil	213	methyl alcohol	chlorine	71	5-chloro-6-methoxy-6-methyl-5-nitro-3-isopropyl hydrouracil

Substituted Uracil	Parts by Weight	Alcohol	Halogen	Parts by Weight	Substituted Hydrouracil Product
3-butyl-6-methyluracil	182	methyl alcohol	chlorine	142	3-butyl-5,5-dichloro-6-methoxy-6-methyl hydrouracil
3-butyl-5,6-dimethyluracil	196	methyl alcohol	bromine	160	5-bromo-3-butyl-5,6-dimethyl-6-methoxy hydrouracil
3-t.butyl-6-methyluracil	182	methyl alcohol	chlorine	142	3-t.butyl-5,5-dichloro-6-methoxy-6-methyl hydrouracil
3-t.butyl-6-methyluracil	182	ethyl alcohol	chlorine	142	3-t.butyl-5,5-dichloro-6-ethoxy-6-methyl hydrouracil
3-*sec*-butyl-6-methyluracil	182	ethyl alcohol	chlorine	142	3-*sec*-butyl-5,5-dichloro-6-ethoxy-6-methyl hydrouracil
3-*sec*-butyl-6-methyluracil	182	n-butyl alcohol	chlorine	142	3-*sec*-butyl-6-butoxy-5,5-dichloro-6-methyl hydrouracil
3-*sec*-butyl-6-methyluracil	182	n-hexyl alcohol	chlorine	142	3-*sec*-butyl-5,5-dichloro-6-n-hexoxy-6-methyl hydrouracil
3-*sec*-butyl-5,6-dimethyl-uracil	196	methyl alcohol	bromine	160	5-bromo-3-*sec*-butyl-5,6-dimethyl-6-methoxy hydrouracil
3-*sec*-butyl-6-methyl-5-nitrouracil	227	ethyl alcohol	chlorine	71	3-*sec*-butyl-5-chloro-6-ethoxy-6-methyl-5-nitro hydrouracil

Substituted Uracil	Parts by Weight	Alcohol	Halogen	Parts by Weight	Substituted Hydrouracil Product
3-isobutyl-6-methyluracil	182	methyl alcohol	chlorine	142	3-isobutyl-5,5-dichloro-6-methoxy-6-methyl hydrouracil
3-pentyl-6-methyluracil	196	methyl alcohol	chlorine	142	5,5-dichloro-6-methoxy-6-methyl 3-pentyl hydrouracil
3-pentyl-6-methyluracil	196	n-butyl alcohol	chlorine	142	6-n-butoxy-5,5-dichloro-6-methyl-3-pentyl hydrouracil
3-(2-methyl butyl)-6-methyluracil	196	ethyl alcohol	chlorine	142	5,5-dichloro-6-ethoxy-6-methyl-3-(2-methyl butyl)hydrouracil
3-hexyl-6-methyluracil	210	methyl alcohol	chlorine	142	5,5-dichloro-6-methoxy-6-methyl-3-hexyl hydrouracil
3-(2-methyl pentyl)-6-methyluracil	210	ethyl alcohol	chlorine	142	5,5-dichloro-6-ethoxy-6-methyl-3-(2-methyl pentyl)hydrouracil
3-(3-methyl pentyl) 6-methyluracil	210	methyl alcohol	chlorine	142	5,5-dichloro-6-methoxy-6-methyl-3-(3-methyl pentyl)hydrouracil
3-cyclopentyl-6-methyluracil	194	methyl alcohol	chlorine	142	3-cyclopentyl-5,5-dichloro-6-methoxy-6-methyl hydrouracil
3-cyclopentyl-6-methyl-uracil	194	isopropyl alcohol	chlorine	142	3-cyclopentyl-5,5-dichloro-6-methyl-6-isopropoxy hydrouracil
3-cyclopentyl-5,6-dimethyluracil	208	methyl alcohol	chlorine	71	5-chloro-3-cyclopentyl-5,6-dimethyl-6-methoxy hydrouracil

Substituted Uracil	Parts by Weight	Alcohol	Halogen	Parts by Weight	Substituted Hydrouracil Product
3-cyclohexyl-6-methyluracil	208	methyl alcohol	chlorine	142	3-cyclohexyl-5,5-dichloro-6-methoxy-6-methyl hydrouracil
3-cyclohexyl-5,6-dimethyl-uracil	222	methyl alcohol	bromine	160	5-bromo-3-cyclohexyl-5,6-dimethyl-6-methoxy hydrouracil
3-cyclohexyl-6-methyluracil	208	ethyl alcohol	chlorine	142	3-cyclohexyl-5,5-dichloro-6-ethoxy-6-methyl hydrouracil
3-cyclohexyl-6-methyluracil	208	n-butyl alcohol	chlorine	142	6-n-butoxy-3-cyclohexyl-5,5-dichloro-6-methyl hydrouracil
3-cyclohexyl-6-methyluracil	208	n-pentyl alcohol	chlorine	142	3-cyclohexyl-5,5-dichloro-6-methyl-6-n-pentoxy hydrouracil
3-cyclohexyl-6-methyluracil	208	cyclohexanol	chlorine	142	6-cyclohexoxy-3-cyclohexyl-5,5-dichloro-6-methyl hydrouracil
3-cyclohexyl-6-ethyluracil	222	methyl alcohol	chlorine	142	3-cyclohexyl-5,5-dichloro-6-ethyl-6-methoxy hydrouracil
3-cyclohexyl-6-methyl-5-nitrouracil	253	ethyl alcohol	chlorine	71	5-chloro-3-cyclohexyl-6-ethoxy-6-methyl-5-nitro hydrouracil
3-cycloheptyl-6-methyl-uracil	222	ethyl alcohol	chlorine	142	3-cycloheptyl-5,5-dichloro-6-ethoxy-6-methyl hydrouracil
3-cyclooctyl-6-methyluracil	236	methyl alcohol	chlorine	142	3-cyclooctyl-5,5-dichloro-6-methoxy-6-methyl hydrouracil

Substituted Uracil	Parts by Weight	Alcohol	Halogen	Parts by Weight	Substituted Hydrouracil Product
6-methyl-3-phenyluracil	202	methyl alcohol	chlorine	142	5,5-dichloro-6-methoxy-6-methyl-3-phenyl hydrouracil
6-methyl-3-phenyluracil	202	propyl alcohol	chlorine	142	5,5-dichloro-6-methyl-3-phenyl-6-n-propoxy hydrouracil
6-methyl-3-phenyluracil	202	ethyl alcohol	chlorine	142	6-ethoxy-5,5-dichloro-6-methyl-3-phenyl hydrouracil
6-methyl-3-phenyluracil	202	cyclohexanol	chlorine	142	6-cyclohexyloxy-5,5-dichloro-6-methyl-3-phenyl hydrouracil
5,6-dimethyl-3-phenyluracil	216	ethyl alcohol	chlorine	71	5-chloro-5,6-dimethyl-6-ethoxy-3-phenyl hydrouracil
6-methyl-3-p-tolyluracil	216	methyl alcohol	chlorine	142	5,5-dichloro-6-methoxy-6-methyl-3-p-tolyl hydrouracil
3-p-chlorophenyl-6-methyl-uracil	236.5	ethyl alcohol	chlorine	142	3-p-chlorophenyl-5,5-dichloro-6-ethoxy-6-methyl hydrouracil
3-p-nitrophenyl-6-methyl-uracil	247	methyl alcohol	chlorine	142	5,5-dichloro-6-methoxy-6-methyl-3-p-nitrophenyl hydrouracil
5,6-dimethyl-3-phenyluracil	216	methyl alcohol	bromine	160	5-bromo-5,6-dimethyl-6-methoxy-3-phenyl hydrouracil
3-*sec*-butyl-6-ethyluracil	196	ethyl alcohol	chlorine	142	3-*sec*-butyl-5,5-dichloro-6-ethoxy-6-ethyl hydrouracil

Substituted Uracil	Parts by Weight	Alcohol	Halogen	Parts by Weight	Substituted Hydrouracil Product
3-isopropyl-5-methoxy-methyl-6-methyluracil	212	methyl alcohol	chlorine	71	5-chloro-3-isopropyl-6-methoxy-5-methoxymethyl-6-methyl hydrouracil
5-fluoro-3-isopropyl-6-methyluracil	186	methyl alcohol	chlorine	71	5-chloro-5-fluoro-3-isopropyl-6-6-methoxy-6-methyl hydrouracil
5-ethoxymethyl-3-isopropyl-6-methyluracil	226	methyl alcohol	chlorine	71	5-chloro-5-ethoxymethyl-3-isopropyl-6-methoxy-6-methyl hydrouracil
3-*sec*-butyl-5-ethoxy-methyl-6-ethyluracil	254	methyl alcohol	chlorine	71	3-*sec*-butyl-5-chloro-5-ethoxy-methyl-6-ethyl-6-methoxy hydrouracil
3-cyclohexyl-5-methoxy-methyl-6-methyluracil	252	methyl alcohol	chlorine	71	5-chloro-3-cyclohexyl-6-methoxy-5-methoxymethyl-6-methyl hydrouracil
3-cyclohexyl-5-fluoro-6-methyluracil	226	methyl alcohol	chlorine	71	5-chloro-3-cyclohexyl-5-fluoro-6-methoxy-6-methyl hydrouracil
3-cyclohexyl-5-hydroxy-methyl-6-methyluracil	238	methyl alcohol	chlorine	71	5-chloro-3-cyclohexyl-5-hydroxy-methyl-6-methoxy-6-methyl hydrouracil
3-isopropyl-5-hydroxy-methyl-6-methyluracil	200	methyl alcohol	chlorine	71	5-chloro-5-hydroxymethyl-3-isopropyl-6-methoxy-6-methyl hydrouracil
5-hydroxymethyl-6-methyl-3-phenyluracil	232	methyl alcohol	chlorine	71	5-chloro-5-hydroxymethyl-6-methoxy-6-methyl-3-phenyl hydrouracil
5-methoxymethyl-6-methyl-3-phenyluracil	246	methyl alcohol	chlorine	71	5-chloro-6-methoxy-5-methoxymethyl-6-methyl-3-phenyl hydrouracil
5-fluoro-6-methyl-3-phenyluracil	220	methyl alcohol	chlorine	71	5-chloro-5-fluoro-6-methoxy-6-methyl-3-phenyl hydrouracil
6-ethyl-3-isopropyl-5-methoxymethyluracil	226	methyl alcohol	chlorine	71	5-chloro-6-ethyl-3-isopropyl-6-methoxy-5-methoxymethyl hydrouracil

EXAMPLE 2

Preparation of 3 - *sec* - butyl - 5,6 - trimethylene hydrouracil

A mixture of 208 parts of 3 - *sec* - butyl - 5,6 - trimethylene uracil, 18.5 parts of 5% ruthenium on carbon and 7300 parts of dioxane is charged into an autoclave and shaken in hydrogen at a pressure of 1000 p.s.i. and a temperature of 200°C. for 3 hours. The reaction mixture is filtered free of suspended catalyst while hot, and the resulting solution is concentrated to about one-tenth of its volume at reduced pressure.

The solution is cooled, and the solid which precipitates is filtered off and recrystallized from acetonitrile. The resulting white, solid 3 - *sec* - butyl - 5,6 - trimethylene hydrouracil melts at 131—134°C.

The compounds in the following table are similarly prepared by substituting the listed uracil starting material for 3 - *sec* - butyl - 5,6 - trimethyleneuracil.

Uracil Starting Material	Parts by Weight	Hydrouracil Product
5,6-dimethyl-3-butyluracil	196	5,6-dimethyl-3-butyl hydrouracil
5,6-dimethyl-3-*sec*-butyluracil	196	5,6-dimethyl-3-*sec*-butyl hydrouracil
5,6-dimethyl-3-(2-methyl-butyl)uracil	210	5,6-dimethyl-3-(2-methyl-butyl)hydrouracil
5,6-dimethyl-3-pentyluracil	210	5,6-dimethyl-3-pentyl hydrouracil
3-cyclohexyl-5,6-dimethyluracil	224	3-cyclohexyl-5,6-dimethyl hydrouracil
5,6-dimethyl-3-isopropyluracil	182	5,6-dimethyl-3-isopropyl hydrouracil
3-(2-methylbutyl)-5,6-tri-methyleneuracil	222	3-(2-methylbutyl)-5,6-trimethylene hydrouracil
3-cyclohexyl-5,6-trimethylene-uracil	236	3-cyclohexyl-5,6-trimethylene hydrouracil
3-isopropyl-5,6-tetramethylene-uracil	208	3-isopropyl-5,6-tetramethylene hydrouracil
3-cyclohexyl-5,6-tetramethylene-uracil	250	3-cyclohexyl-5,6-tetra-methylene hydrouracil
3-*sec*-butyl-5,6-tetra-methyleneuracil	222	3-*sec*-butyl-5,6-tetra-methylene hydrouracil
3-isopropyl-5,6-penta-methyleneuracil	222	3-isopropyl-5,6-penta-methylene hydrouracil
6-ethyl-3-isopropyl-5-methyluracil	196	6-ethyl-3-isopropyl-5-methyl hydrouracil
3-cyclohexyl-6-ethyl-5-methyluracil	238	3-cyclohexyl-6-ethyl-5-methyl hydrouracil
5-hydroxymethyl-3-isopropyl-6-methyluracil	186	5-hydroxymethyl-3-isopropyl-6-methyl hydrouracil
3-*sec*-butyl-5-hydroxy-methyl-6-methyluracil	200	3-*sec*-butyl-5-hydroxymethyl-6-methyl hydrouracil
3-cyclohexyl-5-methoxy-methyl-6-methyluracil	238	3-cyclohexyl-5-methoxy-methyl-6-methyl hydrouracil
3-isopropyl-5-methoxy-methyl-6-methyluracil	198	3-isopropyl-5-methoxy-methyl-6-methyl hydrouracil

EXAMPLE 3

Preparation of 6 - acetoxy - 5,5 - dichloro - 3 - isopropyl - 6 - methyl hydrouracil

A mixture of 168 parts of 3 - isopropyl - 6 - methyl - uracil and 1000 parts of acetic anhydride is maintained under a nitrogen blanket with stirring, as 142 parts of gaseous chlorine are gradually added. The reaction mixture is maintained at 10°C. with a cooling bath. The addition of chlorine is complete in about 1 hour and the reaction is stirred at wet ice-bath temperature for an additional one-half hour.

During the course of the reaction, the original solid dissolves completely and a new solid reprecipitates. This is filtered off, washed with cyclohexane and dried. The product is sufficiently pure for incorporation into herbicidal formulations.

The following compounds are prepared in a like fashion by substituting the listed reactants for those used in this example.

Uracil Starting Material	Parts by Weight	Halogen	Parts by Weight	Anhydride	Hydrouracil Product
5,6-dimethyl-3-isopropyl-uracil	182	chlorine	71	acetic anhydride	6-acetoxy-5-chloro-5,6-dimethyl-3-isopropyl hydrouracil
3-isobutyl-6-methyluracil	182	chlorine	142	acetic anhydride	6-acetoxy-3-isobutyl-5,5-dichloro-6-methyl hydrouracil
5-chloro-3-isopropyl-6-~~methyloracil~~ methyluracil	202.5	bromine	160	acetic anhydride	6-acetoxy-5-bromo-5-chloro-3-isopropyl-6- methyl hydrouracil
3-*sec*-butyl-6-methyluracil	182	chlorine	142	acetic anhydride	6-acetoxy-3-*sec*-butyl-5,5-dichloro-6-methyl hydrouracil
3-*sec*-amyl-6-methyl-5-nitrouracil	241	chlorine	71	acetic anhydride	6-acetoxy-3-*sec*-amyl-5-chloro-6-methyl-5-nitro hydrouracil
3-cyclopentyl-6-methyluracil	194	chlorine	142	acetic anhydride	6-acetoxy-3-cyclopentyl-5,5-dichloro-6-methyl hydrouracil
3-cyclohexyl-6-methyluracil	208	chlorine	142	acetic anhydride	6-acetoxy-3-cyclohexyl-5,5-dichloro-6-methyl hydrouracil
3-isopropyl-6-methyluracil	168	chlorine	142	propionic anhydride	5,5-dichloro-3-isopropyl-6-methyl-6-propionoxy hydrouracil
3-isopropyl-6-methyluracil	168	chlorine	142	chloroacetic anhydride	6-chloroacetoxy-5,5-dichloro-6-methyl-3-isopropyl hydrouracil

Uracil Starting Material	Parts by Weight	Halogen	Parts by Weight	Anhydride	Hydrouracil
3-cyclooctyl-6-methyluracil	236	chlorine	142	acetic anhydride	6-acetoxy-3-cyclooctyl-5,5-dichloro-6-methyl hydrouracil
3-cyclohexyl-5-methoxy-methyl-6-methyluracil	252	chlorine	71	acetic anhydride	6-acetoxy-5-chloro-3-cyclohexyl-5-methoxymethyl-6-methyl hydrouracil
6-chloro-3-propyluracil	188.5	chlorine	142	acetic anhydride	6-acetoxy-3-isopropyl-5,5,6-trichloro hydrouracil
3-butyl-6-methoxyuracil	198	chlorine	142	acetic anhydride	6-acetoxy-3-butyl-5,5-dichloro-6-methoxy hydrouracil
3-t.butyl-6-methyluracil	182	chlorine	142	butyric anhydride	6-butyroxy-3-t.butyl-5,5-dichloro-6-methyl hydrouracil
6-methyl-3-phenyluracil	202	chlorine	142	acetic anhydride	6-acetoxy-5,5-dichloro-6-methyl-3-phenyl hydrouracil
5-fluoro-6-methyl-3-plenyluracil	220	bromine	160	acetic anhydride	6-acetoxy-5-bromo-5-fluoro-6-methyl-3-phenyl hydrouracil
3-cyclohexyl-5,6-di methyluracil	222	chlorine	71	acetic anhydride	6-acetoxy-5-chloro-3-cyclohexyl-5,6-dimethyl hydrouracil

PATENT OFFICE

Product

EXAMPLE 4

Preparation of 3 - isopropyl - 6 - methyl - 5,5,6 - trichloro hydrouracil

Into a vessel equipped with a stirrer, dry-ice condenser and thermometer are placed 500 parts of acetic acid, 200 parts of water and 168 parts of 3 - isopropyl - 6 - methyl - uracil. The mixture is stirred and maintained at 30—35°C. as 147 parts of chlorine are gradually added. The reaction is rapid and after the mixture has been stirred for a short time, an additional 800 parts of water are added.

The resulting solid white precipitate is filtered off. The filter cake is resuspended in 600 parts of water, filtered and the solid allowed to air dry. The 5,5 - dichloro - 6 - hydroxy - 3 - isopropyl - 6 - methyl hydrouracil thus prepared melts at 136.5—138.5°C.

Five-hundred parts of thionyl chloride are placed in a vessel equipped with a stirrer and a condenser fitted with a scrubber to wash away corrosive gases. To this are gradually added, with stirring, 255 parts of the 5,5-dichloro - 6 - hydroxy - 3 - isopropyl - 6 - methyl hydrouracil. Stirring is continued until hydrogen chloride and sulfur dioxide evolution ceases.

A total of 800 parts of cyclohexane are added to the mixture and the resulting white solid precipitate is filtered off. The precipitate is resuspended in 400 parts of cyclohexane and refiltered. The solid is dried in a vacuum oven at room temperature. The product is sufficiently pure for incorporation into herbicidal formulations.

The compounds listed in the following table are prepared in a similar fashion by substituting the listed reactants for those used in this example.

Uracil Starting Material	Parts by Weight	Halogen	Parts by Weight	Halogenating Agent	Parts by Weight	Hydrouracil Product
3-butyl-6-methyluracil	182	chlorine	147	thionyl chloride	500	3-butyl-6-methyl-5,5,6-trichloro hydrouracil
6-methyl-3-*sec*-butyluracil	182	chlorine	147	thionyl chloride	500	6-methyl-3-*sec*-butyl-5,5,6-trichloro hydrouracil
3-cyclohexyl-6-methyluracil	208	chlorine	147	thionyl chloride	500	3-cyclohexyl-6-methyl-5,5,6-trichloro hydrouracil
6-methyl-3-pentyluracil	196	chlorine	147	thionyl chloride	500	6-methyl-3-pentyl-5,5,6-trichloro hydrouracil
3-cyclopentyl-6-methyluracil	194	chlorine	147	thionyl chloride	500	3-cyclopentyl-6-methyl-5,5,6-trichloro hydrouracil
3-cycloheptyl-6-methyluracil	222	chlorine	147	thionyl chloride	500	3-cycloheptyl-6-methyl-5,5,6-trichloro hydrouracil
3-cyclooctyl-6-methyluracil	236	chlorine	147	thionyl chloride	500	3-cyclooctyl-6-methyl-5,5,6-trichloro hydrouracil
6-ethyl-3-isopropyluracil	182	chlorine	147	thionyl chloride	500	6-ethyl-3-isopropyl-5,5,6-trichloro hydrouracil
3-cyclohexyl-6-ethyluracil	222	chlorine	147	thionyl chloride	500	3-cyclohexyl-6-ethyl-5,5,6-trichloro hydrouracil
6-methyl-3-phenyluracil	202	chlorine	147	thionyl chloride	500	6-methyl-3-phenyl-5,5,6-trichloro hydrouracil
6-ethyl-3-phenyluracil	216	chlorine	147	thionyl chloride	500	6-ethyl-3-phenyl-5,5,6-trichloro hydrouracil
6-methyl-3-*p*-tolyluracil	216	chlorine	147	thionyl chloride	500	6-methyl-3-*p*-tolyl-5,5,6-trichloro hydrouracil
3-(*p*-chlorophenyl)-6-methyl-uracil	236.5	chlorine	147	thionyl chloride	500	3-(*p*-chlorophenyl)-6-methyl-5,5,6-trichloro hydrouracil
6-methyl-3-*p*-nitrophenyluracil	247	chlorine	147	thionyl chloride	500	6-methyl-3-*p*-nitrophenyl-5,5,6-trichloro hydrouracil

EXAMPLE 5

The compounds listed in the following table can also be prepared by the foregoing methods:

3 - isopropyl - 6 - cyclohexyloxy - 5,5,6 - trichloro hydrouracil
5 - bromo - 5 - chloro - 3 - cyclohexyl - 6 - ethoxy - 6 - methyl hydrouracil
5,6 - dichloro - 5 - hydroxymethyl - 6 - methoxy - 3 - (4 - methyl - 3 - nitrophenyl) - hydrouracil
3 - (2,6 - dinitrophenyl) - 5,5 - dichloro - 6 - ethoxy - 6 - ethyl hydrouracil
3 - *sec* - butyl - 5,5 - dichloro - 6 - methoxy hydrouracil
5 - bromo - 6 - ethoxy - 6 - benzyl - 5 - nitro - 3 - phenyl hydrouracil
5 - bromo - 5 - chloro - 6 - cyclohexyloxy - 6 - methyl - 3 - phenyl hydrouracil
5 - bromo - 6 - chloro - 3 - cyclohexyl - 6 - methoxy - 5 - nitro hydrouracil
5,5 - dichloro - 6 - ethoxy - 3 - (m - trifluoromethylphenyl) - 6 - methyl hydrouracil
5,5 - dichloro - 6 - ethoxy - 6 - methyl - 3 - (m - perchlorylphenyl)hydrouracil
5 - chloro - 3 - cyclohexyl - 6 - methoxy - 6 - methyl - 5 - methylsulfonyl hydrouracil
5 - chloro - 5 - dimethylcarbamyl - 6 - ethoxy - 6 - methyl - 3 - isopropyl hydrouracil
5 - acetamido - 5 - chloro - 6 - ethoxy - 6 - methyl - 3 - isopropyl hydrouracil
5 - chloro - 5 - dimethylsulfonamido - 6 - ethoxy - 6 - methyl - 3 - isopropyl hydrouracil
5 - chloro - 3 - cyclohexyl - 5 - (*p* - chlorocarbanilyl) - 6 - ethoxy - 6 - methyl hydrouracil
3 - cyclohexyl - 5,5 - dichloro - 6 - ethyl - 6 - hexanoyl hydrouracil
5 - chloro - 6 - isovaleroxy - 6 - methyl - 5 - methylsulfonyl - 3 - phenyl hydrouracil
5,6 - dichloro - 3 - isopropyl - 5,6 - trimethylene hydrouracil
5,6 - dichloro - 3 - isopropyl - 6 - methyl - 5 - nitro hydrouracil
5,6 - dichloro - 6 - ethyl - 5 - methoxymethyl - 3 - phenyl hydrouracil
3 - (2,5 - dimethylcyclohexyl) - 6 - ethyl - 5 - methyl hydrouracil
5,6 - dimethyl - 3 - (2,4 - dimethylcyclohexyl) hydrouracil
3 - (2,5 - dimethylcyclohexyl) - 5,6 - trimethylene hydrouracil
3 - cyclooctyl - 5,6 - pentamethylene hydrouracil

EXAMPLE 6

5,5 - dichloro - 3 - isopropyl - 6 - methoxy - 6 - methyl hydrouracil	80.0%
~~Alkylene~~ naphthalene sulfonate, Na salt	2.0%
Partially desulfonated calcium lignin sulfonate	0.5%
Attapulgite clay	14.5%
Precipitated tricalcium phosphate	3.0%

These components are blended, micropulverized until the particles are under 50 microns in diameter, then reblended.

The same conditioning agents can be used to formulate wettable powders with the following compounds:

3 - cyclohexyl - 5,5 - dichloro - 6 - methoxy - 6 - methyl hydrouracil
3 - *sec* - butyl - 5,5 - dichloro - 6 - methoxy - 6 - methyl hydrouracil
5,5 - dichloro - 6 - methoxy - 6 - methyl - 3 - phenyl hydrouracil
5,5 - dichloro - 6 - hydroxy - 6 - methyl - 3 - phenyl hydrouracil
3 - t.butyl - 5,5 - dichloro - 6 - methoxy - 6 - methyl hydrouracil
3 - cyclopentyl - 5,5 - dichloro - 6 - methoxy - 6 - methyl hydrouracil
5 - chloro - 3 - cyclohexyl - 6 - ethoxy - 6 - methyl - 5 - nitro hydrouracil
3 - t.butyl - 5,5 - dibromo - 6 - hydroxy - 6 - methyl hydrouracil
5,5 - dichloro - 6 - ethoxy - 6 - methyl - 3 - phenyl hydrouracil
6 - (2 - chloroethoxy) - 5,5 - dichloro - 6 - methyl - 3 - phenyl hydrouracil
3 - cyclohexyl - 5,6 - dimethyl hydrouracil
6 - acetoxy - 3 - cyclopentyl - 5,5 - dichloro - 6 - methyl hydrouracil
6 - methyl - 3 - phenyl - 5,5,6 - trichloro hydrouracil
3 - butyl - 5 - chloro - 6 - methyl hydrouracil
3 - (4' - biphenylyl) - 5,5 - dichloro - 6 - methyl - 6 - propoxy hydrouracil
3 - p - chlorophenyl - 5,5 - dichloro - 6 - ethoxy - 6 - methyl hydrouracil
3 - m - tolyl - 5,5 - dichloro - 6 - methoxy - 6 - methyl hydrouracil
5,5 - dichloro - 6 - methoxy - 3 - ethyl hydrouracil
5,5 - dichloro - 6 - methyl - 3 - phenyl - 6 - (2,2,3,3 - tetrafluoropropoxy)hydrouracil
5,5 - dichloro - 3,6 - dimethyl - 6 - methoxy hydrouracil
5,5 - dichloro - 3,6 - dimethyl - 6 - ethoxy hydrouracil
5,5 - dichloro - 3,6 - dimethyl - 6 - isopropoxy hydrouracil
6 - bromo - 3 - cyclohexyl - 5,5 - dichloro - 6 - methyl hydrouracil
6 - bromo - 5,5 - dichloro - 6 - methyl - 3 - phenyl hydrouracil
6 - methyl - 3 - phenyl - 5,5,6 - tribromo hydrouracil
3 - (4' - biphenylyl) - 6 - methyl - 5,5,6 - trichloro hydrouracil
3 - cyclohexyl hydrouracil
5 - methyl - 3 - phenyl hydrouracil
3 - *p* - chlorophenyl - 5 - methyl hydrouracil
3 - (3,4 - dichlorophenyl) - 5 - methyl hydrouracil
6 - methyl - 3 - phenyl hydrouracil
5 - methyl - 3 - (1 - naphthyl)hydrouracil
6 - methyl - 3 - (1 - naphthyl)hydrouracil

5 - methyl - 3 - (4' - biphenyl)hydrouracil
3 - (4' - biphenylyl) - 6 - methyl hydrouracil
6 - methyl - 3 - norbornyl hydrouracil
3 - bornyl - 6 - methyl hydrouracil
1 - methyl - 3 - (p - chlorophenyl) - 5 - bromo hydrouracil
5 - bromo - 6 - methyl - 3 - phenyl hydrouracil
5 - chloro - 3 - cyclohexyl - 6 - methyl hydrouracil
5 - chloro - 6 - methyl - 3 - phenyl hydrouracil
5 - bromo - 6 - methyl - 3 - (1 - naphthyl)-hydrouracil
3 - (4' - biphenylyl) - 5 - bromo - 6 - methyl hydrouracil
5 - bromo - 6 - methyl - 3 - norbornyl hydrouracil
5 - bromo - 6 - hydroxy - 3 - isopropyl - 6 - methyl hydrouracil
5 - bromo - 3 - *sec* - butyl - 6 - hydroxy - 6 - methyl hydrouracil
5 - bromo - 6 - hydroxy - 6 - methyl - 3 - phenyl hydrouracil
5 - bromo - 3 - cyclohexyl - 6 - hydroxy - 6 - methyl hydrouracil
5 - chloro - 6 - hydroxy - 3 - isopropyl - 6 - methyl hydrouracil
5 - chloro - 3 - cyclohexyl - 6 - hydroxy - 6 - methyl hydrouracil
5 - chloro - 6 - hydroxy - 6 - methyl - 3 - phenyl hydrouracil
6 - acetoxy - 3 - (2,3 - dibromopropyl) - 5,5 - dichloro - 6 - ethyl hydrouracil

These formulations, applied at 20 pounds of active ingredient per acre in 100 gallons of water per acre with conventional mechanical sprayers, give excellent control of grasses and broad-leaved weeds around lumber yards and areas where vegetation creates a fire hazard. Such weeds as quack grass, crab grass, foxtail, Johnson grass, lamb's quarters, pigweed, velvet leaf, spurge and purslane are controlled.

When 3 - cyclohexyl - 5,5 - dichloro - 6 - methoxy - 6 - methyl hydrouracil is applied as a pre-emergence wettable powder formulation at 1 to 2 pounds of active ingredient per acre, giant and yellow foxtail, crab grass and chickweed are removed selectively without injury to established Bermuda grass.

EXAMPLE 7

5,5 - dibromo - 6 - hydroxy - 3 - isopropyl - 6 - methyl hydrouracil	50.00%
Dioctyl sodium sulfosuccinate concreted with 15% sodium benzoate	1.00%
Low viscosity methyl cellulose	0.25%
Finely-ground ignited montmorillonoid clay (Pikes Peak clay)	48.75%

These ingredients are blended, micropulverized until the particles are under 50 microns in diameter, then reblended.

This formulation is applied at 40 pounds per acre in 80 gallons of water per acre to a stand of plants constituting a fire hazard around oil storage tanks. The treatment gives excellent control of this plant growth. Such species as wild barley, ryegrass, yellow foxtail, vervain, cinquefoil, wild mustard, quack grass, and seedling Johnson grass are controlled for an extended period.

This formulation, applied at 1 to 2 pound of active ingredient per acre as a pre- or post-emergence spray, also gives excellent selective control of crab grass, annual bluegrass and chickweed without injury to established Weigela, an ornamental plant.

Other compounds which can be formulated in the same manner are:

5,5 - dibromo - 6 - hydroxy - 6 - methyl - 3 - phenyl hydrouracil
3 - *sec* - butyl - 5,5 - dibromo - 6 - hydroxy-6 - methyl hydrouracil
6 - acetoxy - 5,5 - dichloro - 3 - isopropyl-6 - methyl hydrouracil
3 - isopropyl - 6 - methyl - 5,5,6 - trichloro hydrouracil
3 - *sec* - butyl - 6 - (2 - chloroethoxy) - 5,5 - dichloro - 6 - methyl hydrouracil
5,5 - dichloro - 6 - ethoxy - 6 - methyl - 3 - (1 - naphthyl)hydrouracil
5,6 - dimethyl - 3 - butyl hydrouracil
3 - t.butyl - 5,6 - trimethylene hydrouracil
3 - cyclohexyl - 5 - methoxymethyl - 6 - methyl hydrouracil
6 - acetoxy - 3 - cyclohexyl - 5,5 - dichloro-6 - methyl hydrouracil
5 - methyl - 3 - norbornyl hydrouracil
5 - bromo - 6 - methyl - 3 - isopropyl hydrouracil
5 - bromo - 3 - t.butyl - 6 - methyl hydrouracil
3 - ethyl - 6 - methyl - 5,5,6 - trichloro hydrouracil
3 - (4' - biphenylyl) - 5,5 - dichloro - 6 - methoxy - 6 - methyl hydrouracil
3 - bornyl - 6 - methyl hydrouracil
5 - bromo - 3 - (hexahydro - 4,7 - methano-indenyl) - 6 - methyl hydrouracil
5,5 - dibromo - 1,6 - dimethyl - 6 - hydroxy-3 - (3,4 - dibromophenyl)hydrouracil
5 - bromo - 6 - chloro - 5 - fluoro - 6 - hydroxy - 3 - difluoromethylphenyl hydrouracil
3 - cycloheptyl - 5,5 - dibromo - 6 - hydroxy-6 - methyl hydrouracil
3 - cyclooctyl - 5,5 - dibromo - 6 - hydroxy - 6 - methyl hydrouracil
5,5 - dibromo - 6 - hydroxy - 6 - methyl - 3 - p - tolyl hydrouracil
5,5 - dibromo - 6 - ethyl - 6 - hydroxy - 3 - isopropyl hydrouracil
3 - *sec* - butyl - 5,5 - dibromo - 6 - ethyl - 6 - hydroxy hydrouracil
5,5 - dichloro - 6 - hydroxy - 3 - isopropyl - 6 - methyl hydrouracil
5,5 - dichloro - 6 - hydroxy - 6 - methyl - 3 - phenyl hydrouracil
5 - bromo - 6 - hydroxy - 3 - isopropyl - 5 - methoxymethyl - 6 - methyl hydrouracil

5 - bromo - 3 - cyclohexyl - 6 - hydroxy - 5 - methoxymethyl - 6 - methyl hydrouracil
5 - bromo - 5 - methoxymethyl - 6 - methyl - 3 - phenyl hydrouracil
5 - bromo - 3 - isopropyl - 6 - hydroxy - 6 - methyl - 5 - nitro hydrouracil
5 - bromo - 3 - cyclohexyl - 6 - hydroxy - 5 - methoxy - 6 - methyl hydrouracil
5 - bromo - 3 - cyclohexyl - 1,6 - dimethyl - 5 - fluoro - 6 - hydroxy hydrouracil
5 - bromo - 3 - cyclohexyl - 6 - hydroxy - 5 - hydroxymethyl - 6 - methyl hydrouracil
5,5 - dibromo - 3 - ethyl - 6 - hydroxy - 6 - methyl hydrouracil
5,5 - dibromo - 6 - hydroxy - 6 - methyl - 3 - propyl hydrouracil
5,5 - dibromo - 1,6 - dimethyl - 6 - hydroxy - 3 - isopropyl hydrouracil
3 - butyl - 5,5 - dibromo - 6 - hydroxy - 6 - methyl hydrouracil
5,5 - dibromo - 6 - ethyl - 6 - hydroxy - 3 - isopropyl hydrouracil
5,5 - dibromo - 6 - hydroxy - 6 - methyl - 3 - pentyl hydrouracil
5,5 - dibromo - 6 - hydroxy - 6 - methyl - 3 - (2 - methylbutyl) hydrouracil
5,5 - dibromo - 6 - hydroxy - 6 - methyl - 3 - (2 - methylpentyl) hydrouracil
3 - cyclopentyl - 5,5 - dibromo - 6 - hydroxy - 6 - methyl hydrouracil
3 - cyclohexyl - 5,5 - dibromo - 6 - hydroxy - 6 - methyl hydrouracil
3 - cyclohexyl - 5,5 - dibromo - 1,6 - dimethyl - 6 - hydroxy hydrouracil

EXAMPLE 8

5,6 - dimethyl - 3 - isopropyl hydrouracil	25%
Anhydrous sodium sulfate	10%
Alkyl naphthalene sulfonate, Na salt	1%
Calcium, magnesium sub-bentonite	64%

These ingredients are blended and micropulverized, then mixed with 15—20% water, extruded through 1/8 inch dies, cut into 1/8 inch lengths and dried.

This composition is applied by hand around posts supporting highway signs or guardrails, using 1 teaspoonful of material per post. The material gives control of all vegetation around the post, eliminating hand trimming of this area for an extended period.

Other hydrouracils which can be similarly formulated are:

3 - *sec* - butyl - 5,6 - trimethylene hydrouracil
3 - cyclohexyl - 5 - methyl hydrouracil
6 - acetoxy - 5,5 - dichloro - 6 - methyl - 3 - phenyl hydrouracil
3 - t.butyl - 6 - methyl - 5,5,6 - trichloro hydrouracil
3 - cyclohexyl - 5 - methyl hydrouracil
5 - methyl - 3 - isopropyl hydrouracil
5 - bromo - 6 - methyl - 3 - phenyl hydrouracil
5 - bromo - 3 - cyclohexyl - 6 - methyl hydrouracil
3 - *sec* - butyl - 5 - chloro - 6 - methyl hydrouracil
6 - methoxy - 6 - methyl - 3 - phenyl - 1,5,5 - trichloro hydrouracil
6 - acetoxy - 3 - t.butyl - 5,5 - dichloro - 6 - methyl hydrouracil
5 - bromo - 3 - hexahydro - 4,7 - methanoindenyl - 6 - methyl hydrouracil
6 - (2 - chloroethoxy) - 3 - cyclohexyl - 5,5 - dichloro - 6 - methyl hydrouracil
5,5 - dichloro - 6 - methyl - 3 - isopropyl - 6 - (2,2,3,3 - tetrafluoropropoxy)hydrouracil
3 - cyclohexyl - 5,5 - dichloro - 6 - methyl - 6 - (2,2,3,3 - tetrafluoropropoxy)hydrouracil
6 - bromo - 5,5 - dichloro - 6 - methyl - 3 - isopropyl hydrouracil
3 - butyl - 5 - methyl hydrouracil
3 - cyclopentyl hydrouracil
3 - cyclopentenyl hydrouracil
3 - cyclooctyl hydrouracil
3 - butyl - 5 - chloro hydrouracil
3 - (1 - decahydronaphthyl) - 6 - hexyl - 5 - methylsulfonyl hydrouracil
3 - (4 - ethoxycyclohexyl) - 5,6 - tetramethylene hydrouracil
5,6 - dimethyl - 3 - (3,4,5 - trimethoxycyclohexyl)hydrouracil
3 - phenyl - 1 - methyl hydrouracil

EXAMPLE 9

5 - bromo - 3 - isopropyl - 6 - methyl hydrouracil	25%
Low viscosity methyl cellulose	3%
Kaolin clay	72%

These components are blended, micropulverized, mixed with 15—20% water and moist granulated in a granulator, dried, and screened to give 15 to 60 mesh granules.

This formulation, at 25 pounds per acre of active ingredient, gives good control of a wide variety of vegetation in forest fire lanes for an extended period. A wide variety of annual and perennial weeds, such as evening primrose, pokeweed, cocklebur, goose grass, and purple top are controlled.

The following compounds can be similarly formulated:

5 - bromo - 6 - methyl - 3 - phenyl hydrouracil
5 - chloro - 3 - cyclohexyl - 6 - methyl hydrouracil
5 - chloro - 6 - methyl - 3 - phenyl hydrouracil
5 - bromo - 6 - methyl - 3 - norbornyl hydrouracil
6 - acetoxy - 5,5 - dichloro - 6 - methyl - 3 - (1 - naphthyl)hydrouracil
3 - cyclohexyl - 6 - methyl - 5,5,6 - trichloro hydrouracil
3 - (4' - biphenyl) - 6 - methyl - 5,5,6 - trichloro hydrouracil
5,5 - dichloro - 6 - methoxy - 6 - methyl - 3 - phenyl hydrouracil
5,5 - dichloro - 3 - ethyl - 6 - methoxy - 6 - methyl hydrouracil

3 - butyl - 5,5 - dichloro - 6 - methoxy - 6 - methyl hydrouracil
3 - cyclohexyl - 5,5 - dichloro - 6 - (2 - methoxyethoxy) - 6 - methyl hydrouracil
5,5 - dichloro - 6 - (2 - methoxyethoxy) - 6 - methyl - 3 - isopropyl hydrouracil
5,5 - dichloro - 6 - (2 - methoxyethoxy) - 6 - methyl - 3 - phenyl hydrouracil
6 - acetoxy - 5,5 - dichloro - 3 - ethyl - 6 - methyl hydrouracil
3 - ethyl - 6 - methyl - 5,5,6 - trichloro hydrouracil
3 - *sec* - butyl - 5 - methyl hydrouracil
3 - cyclohexyl - 6 - methyl hydrouracil
5 - chloro - 3 - cyclopentyl - 5,6 - dimethoxy-6 - methyl hydrouracil
5 - bromo - 5 - chloro - 6 - hydroxy - 3 - isopropyl - 6 - methyl hydrouracil
5 - bromo - 5,6 - dichloro - 6 - hydroxy - 3 - isopropyl hydrouracil
5 - bromo - 6 - chloro - 6 - hydroxy - 5 - hydroxymethyl - 3 - isopropyl hydrouracil
1 - chloro - 5 - methyl - 3 - phenyl hydrouracil
1 - chloro - 3 - cyclohexyl - 5,6 - trimethylene hydrouracil

EXAMPLE 10

3 - butyl - 5,5 - dichloro - 6 - methyl-6-propoxy hydrouracil	20%
Xylene	80%

This composition is made by mixing the mutually soluble components together.

This composition, applied at 20 pounds of active ingredient per acre in 80 gallons of Diesel oil per acre gives excellent control of vegetation along railroad rights-of way. Quack grass, crab grass, annual bindweed, water grass, blackeyed susan, carpetweed and chickweed are controlled.

Other hydrouracils which can replace the active in this formulation are:

6 - butoxy - 3 - *sec* - butyl - 5,5 - dichloro-6 - methyl hydrouracil
5,5 - dibromo - 6 - methyl - 3 - cyclohexyl-6 - hydroxy - 1 - methyl hydrouracil
6 - ~~acetoxy~~ - 3 - cyclohexyl - 5,5 - dichloro-1 - methyl - 6 - methyl hydrouracil
3 - cyclohexyl - 1,5 - dimethyl hydrouracil
6 - acetoxy - 5,5 - dichloro - 3 - cyclopentyl-1,6 - dimethyl hydrouracil
6 - acetoxy - 3 - t.butyl - 5 - chloro - 1,5,6 - trimethyl hydrouracil
3 - t.butyl - 1,6 - dimethyl - 5,5,6 - trichloro hydrouracil
3 - isopropyl - 1,6 - dimethyl - 5,5,6 - trichloro hydrouracil
1,6 - dimethyl - 3 - phenyl - 5,5,6 - trifluoro hydrouracil
3 - *sec* - butyl - 6 - ethoxy - 6 - methyl - 1,5,5 - trichloro hydrouracil
3 - butyl - 5,5 - dichloro - 1 - ethyl - 6 - methoxy - 6 - methyl hydrouracil
3 - cyclopentyl - 5,5 - dichloro - 1,6 - dimethyl - 6 - methoxy hydrouracil
3 - isopropyl - 1,5,6 - trimethyl hydrouracil
5,5 - dibromo - 1,6 - diethyl - 6 - hydroxy - 3 - isopropyl hydrouracil
5,5 - dichloro - 3 - isopropyl - 6 - methoxy - 6 - methyl - 1 - (trichloromethylthio)hydrouracil
6 - (2 - chloroethoxy) - 5,5 - dichloro - 3 - isopropyl - 6 - methyl hydrouracil
3 - *sec* - butyl - 5,5 - dichloro - 6 - (2 - methoxymethyl) - 6 - methyl hydrouracil
3 - cyclohexyl - 1,6 - dimethyl hydrouracil
3 - *sec* - butyl - 5,5 - dibromo - 6 - methoxy-6 - methyl hydrouracil
3 - ethyl - 6 - methoxy - 6 - methyl - 1,5,5 - trichloro hydrouracil
6 - ethyl - 3 - isopropyl - 6 - methoxy - 1,5,5-trichloro hydrouracil
1 - bromo - 3 - butyl - 5,5 - dichloro - 6 - methoxy - 6 - methyl hydrouracil
3 - *sec* - butyl - 6 - methoxy - 6 - methyl - 1,5,5 - trichloro hydrouracil
3 - *sec* - butyl - 1 - chloro - 5,6 - trimethylene hydrouracil
3 - cyclohexyl - 1,5 - dichloro - 6 - methoxy-5 - methoxymethyl - 6 - methyl hydrouracil

EXAMPLE 11

3 - cyclohexyl - 5,5 - dichloro - 1,6-dimethyl - 6 - methoxy hydrouracil	25%
Alkylated naphthalene	60%
Isophorone	10%
Mixed polyoxyethylene ethers and oil soluble sulfonates	5%

An emulsifiable oil formulation is prepared by mixing these mutually soluble components together.

The composition is extended with 80 gallons of a herbicidal oil, such as Lion Herbicidal Oil No. 6, to form a sprayable oil formulation containing 2%, by weight, of active ingredient. When applied from a pressure sprayer to weeds infesting a railroad right-of-way, good initial and residual control is obtained of mixed vegetation including such weeds as ragweed, pigweed, daisy, lamb's quarters, crab grass, foxtail, quack grass, cheat, witch grass, Jimson weed and button weed.

Other compounds which can replace the active ingredient in this formulation include:

6 - butoxy - 5,5 - dichloro - 6 - methyl - 3 - phenyl hydrouracil
3 - cyclohexyl - 1,6 - dimethyl - 5,5,6 - trichloro hydrouracil
3 - isopropyl - 1,5,6 - trimethyl hydrouracil
3 - t.butyl - 5,5 - dichloro - 1,6 - dimethyl-6 - ethoxy hydrouracil
3 - *sec* - butyl - 5,5 - dichloro - 1,6 - dimethyl - 6 - ethoxy hydrouracil
5,5 - dichloro - 6 - ethoxy - 1 - ethyl - 6 - methyl - 3 - phenyl hydrouracil
6 - (2 - chloroethoxy) - 5,5 - dichloro - 1 - ethyl - 6 - methyl - 3 - phenyl hydrouracil

3 - *sec* - butyl - 1 - methyl - 5,6 - trimethylene hydrouracil
3 - cyclohexyl - 1,6 - dimethyl - 5 - methoxymethyl hydrouracil
3 - t.butyl - 1,6 - dimethyl - 5 - methoxymethyl hydrouracil
3 - *sec* - butyl - 5,5 - dibromo - 1,6 - dimethyl - 6 - hydroxy hydrouracil
3 - *sec* - butyl - 1,6 - dimethyl - 5 - ethoxymethyl hydrouracil
5 - chloro - 3 - cyclohexyl - 1,6 - dimethyl hydrouracil
5,5 - dichloro - 1,6 - dimethyl - 3 - isopropyl-6 - methoxy hydrouracil
3 - butyl - 5,5 - dichloro - 1 - ethyl - 6 - methoxy - 6 - methyl hydrouracil
3 - cyclohexyl - 5,5 - dichloro - 1,6 - dimethyl - 6 - methoxy hydrouracil
5,5 - dichloro - 1,6 - dimethyl - 6 - methoxy-3 - phenyl hydrouracil
6 - acetoxy - 5,5 - dichloro - 3 - (3 - methoxypropyl) - 6 - methyl hydrouracil
6 - acetoxy - 5,5 - dichloro - 3 - cyclohexyl-1,6 - dimethyl hydrouracil
3 - cyclohexyl - 1,6 - dimethyl - 5,5,6 - trichloro hydrouracil
1,5 - dimethyl - 3 - isopropyl hydrouracil
3 - cyclohexyl - 1,5 - dimethyl hydrouracil
3 - (*p* - chlorophenyl) - 1 - methyl hydrouracil
3 - butyl - 6 - methyl hydrouracil
3 - *sec* - butyl - 6 - methyl hydrouracil
1,6 - dimethyl - 3 - norbornyl hydrouracil
5 - bromo - 6 - methyl - 3 - isopropyl hydrouracil
5 - bromo - 3 - butyl hydrouracil
5 - bromo - 3 - *sec* - butyl - 6 - methyl hydrouracil
5 - bromo - 3 - cyclohexyl - 1,6 - dimethyl hydrouracil
5 - chloro - 6 - methyl - 3 - isopropyl hydrouracil
3 - *sec* - butyl - 5 - chloro - 6 - methyl hydrouracil
6 - butoxy - 3 - (3,4 - dibromophenyl) - 5,5 - dichloro - 6 - methyl hydrouracil
5 - chloro - 5 - ethoxymethyl - 6 - hydroxy-6 - methyl - 3 - (p - sulfamoylphenyl)hydrouracil
5,5 - dichloro - 3 - (6 - dimethylsulfamoyl - 1 - naphthyl) - 6 - hydroxy - 6 - methyl hydrouracil
5,5 - dichloro - 6 - (p - bromophenyl) - 6 - hydroxy - 3 - isopropyl hydrouracil

EXAMPLE 12

1 - chloro - 5,5 - dichloro - 3 - isopropyl - 6 - methyl - 6 - methoxy hydrouracil	30%
Trimethyl nonyl ether of polyethylene glycol	10%
Polyoxyethylene ethers plus oil soluble sulfonates	5%
Isophorone	55%

The mutually soluble components are mixed.

Diluted with No. 2 Diesel Oil to a concentration of 8%, by weight, of active ingredient, this mixture is applied at 40 gallons per acre to a stand of weeds around warehouses and in equipment storage yards. Such species as witch grass, crab grass, nimblewill, annual dropseed, velvet leaf, Jimson weed and goldenrod are eliminated.

Other compounds which can replace the active component in this formulation are:
3 - *sec* - butyl - 1 - chloro - 5,5 - dichloro-6 - methoxy - 6 - methyl hydrouracil
1 - chloro - 5,6 - dimethyl - 3 - isopropyl hydrouracil
6 - acetoxy - 3 - *sec* - butyl - 5 - chloro - 1,6-dimethyl - 5 - nitro hydrouracil
6 - acetoxy - 5,5 dichloro - 1,6 - dimethyl-3 - isopropyl hydrouracil
6 - acetoxy - 5,5 - dichloro - 1,6 - dimethyl-3 - phenyl hydrouracil
3 - *sec* - butyl - 1,6 - dimethyl - 5,5,6 - trichloro hydrouracil
3 - cyclopentyl - 1,6 - dimethyl - 5,5,6 - trichloro hydrouracil
5 - bromo - 3 - cyclohexyl - 1,6 - dimethyl hydrouracil
5 - bromo - 3 - *sec* - butyl - 1,6 - dimethyl hydrouracil
5 - bromo - 3 - t.butyl - 1,6 - dimethyl hydrouracil
5 - chloro - 3 - cyclohexyl - 1,6 - dimethyl hydrouracil
3 - *sec* - butyl - 5 - chloro - 1,6 - dimethyl - 5 - fluoro hydrouracil
3 - t.butyl - 5 - chloro - 6 - ethoxy - 1,5,6 - trimethyl hydrouracil
3 - cyclohexyl - 5,5 - dichloro - 6 - methoxy-6 - methyl - 1 - (trichloromethylthio)hydrouracil
5,5 - dichloro - 6 - methoxy - 6 - methyl - 3 - phenyl - 1 - (trichloromethylthio)hydrouracil
3 - isopropyl - 6 - methyl - 5,5,6 - tribromo hydrouracil
5 - chloro - 3 - cyclooctyl - 1,6 - dimethyl hydrouracil
3 - isopropyl - 6 - methoxy - 6 - methyl - 1,5,5 - trichloro hydrouracil
3 - cyclohexyl - 6 - methoxy - 6 - methyl - 1,5,5 - trichloro hydrouracil
1 - bromo - 5,5 - dichloro - 3 - isopropyl - 6 - methoxy - 6 - methyl hydrouracil
1 - chloro - 5,6 - dimethyl - 3 - isopropyl hydrouracil
1 - chloro - 3 - cyclohexyl - 5,6 - dimethyl-hydrouracil
3 - cyclohexyl - 6 - ethoxy - 6 - methyl - 1,5,5 - trichloro hydrouracil

EXAMPLE 13

3 - cyclohexyl - 5,5 - dichloro - 6 - methoxy - 6 - methyl hydrouracil	20%
Sodium dodecyl benzene sulfonate	35%
Synthetic fine calcium silicate	45%

These components are blended and micropulverized until the hydrouracil particles are under 50 microns in diameter. This composi-

tion is applied as a directed post-emergence spray at the rate of 1.5 pounds of active ingredient and 2.6 pounds of surfactant per acre in 35 gallons of water to a vigorously growing population of annual weeds growing in sugarcane.

Excellent control of velvet leaf, lamb's quarters, watergrass, crab grass, foxtail and annual morning-glory is obtained.

EXAMPLE 14

3 - isopropyl - 5,5 - dichloro - 6 - methoxy - 6 - methyl hydrouracil	80.0%
Alkyl naphthalene sulfonate, Na salt	2.0%
Partially desulfonated calcium lignin sulfonate	.5%
Attapulgite clay	14.5%
Precipitated tricalciumphosphate	3.0%

These ingredients are blended and micropulverized until the hydrouracil particles are under 50 microns in diameter.

Fifteen pounds of this formulation is mixed with 6 pounds of trimethylnonyl polyethylene glycol ether in 60 gallons of water.

This mixture is applied to a fence-row infested with crab grass, foxtail barnyard grass, pigweed, lamb's quarters and wild mustard. The treatment gives quick contact kill of the vegetation with excellent residual control.

EXAMPLE 15

5,5 - dichloro - 3 - isopropyl - 6 - methoxy - 6 - methyl hydrouracil	40%
3 - (3,4 - dichlorophenyl) - 1,1 - dimethylurea	40%
Alkyl aryl polyether alcohol 40%, extended on a silica powder	4%
Substituted acetylenic glycol	1%
Partially desulfonated sodium lignin sulfonate	2%
Kaolin clay	10%
Synthetic fine silica	3%

These components are blended in a ribbon blender, micropulverized until the particles are under 50 microns in diameter, then reblended.

This formulation is added to 100 gallons of water and applied at the rate of 25 pounds of active ingredient per acre for the control of spurge, beggartick, goldenrod, broomsedge, dallis grass, crab grass and love grass growing in lumber yards. This treatment gives excellent kill of foliage and has extended residual activity in the soil.

EXAMPLE 16

3 - *sec* - butyl - 5,5 - dichloro - 6 - methoxy - 6 - methyl hydrouracil	32.00%
2 - chloro - 4 - ethylamino - 6 - isopropylamino - s - triazine	48.00%
Alkyl naphthalene sulfonic acid	1.75%
Methyl cellulose	0.25%
Attapulgite clay	18.00%

These components are blended in a ribbon blender, micropulverized until the particles are under 50 microns in diameter, then reblended.

This formulation is applied in 125 gallons of water at the rate of 21 pounds of active ingredient per acre for the control of broadleaf and grass species growing along ditch banks. A spring application to vigorous growing weeds gives outstanding control of bromegrass, ryegrass, crab grass, quack grass, common ragweed, speedwells, broadleaf plantain, oxeye daisy, and dandelion.

EXAMPLE 17

5,5 - dibromo - 6 - hydroxy - 3 - isopropyl - 6 - methyl hydrouracil	50%
5 - bromo - 3 - *sec* - butyl - 6 - methyluracil	25%
Oleyl ester of sodium isethionate	1%
Alkyl naphthalene sulfonic acid, Na salt	1%
Kaolin clay	20%
Synthetic fine silica	3%

These components are blended in a ribbon blender, micropulverized until the particles are under 50 microns in diameter, then reblended.

This formulation is used for the control of weeds around telephone poles. When used at rates of 15 to 25 pounds of active ingredients per acre in 100 gallons of water, good control of goldenrod, pigeon pea, crab grass, foxtail, barnyard grass, pigweed, chickweed and carpetweed is obtained.

EXAMPLE 18

3 - cyclohexyl - 5,5 - dichloro - 6 - methoxy - 6 - methyl hydrouracil	15.0%
3 - (3,4 - dichlorophenyl) - 1 - methyl - 1 - n - butylurea	15.0%
Modified polyacrylic acid, Na salt	0.4%
Low viscosity polyvinyl alcohol	1.0%
Water	68.6%

These components are wet-milled until the particle diameters are under 10 microns.

This formulation is applied to lawn areas at a rate of 4 pounds of active ingredient per acre. Crab grass, annual bluegrass, chickweed, pigweed, foxtail and white clover is controlled selectively without injury to established Bermuda grass.

EXAMPLE 19

6 - butoxy - 5,5 - dichloro - 6 - methyl - 3 - phenyl hydrouracil	40%
2,4,5 - trichlorophenoxy acetic acid propylene glycol butyl ether ester	10%
Mixed polyoxyethylated sorbitan monooleate and ethylene diamine dodecyl benzene sulfonate	5%
Synthetic fine silica	45%

These ingredients are blended, micropulverized, and reblended.

The resulting oil dispersible powder is used for maintaining weed-free areas along electric power line rights-of-way. An application of 18 pounds of active ingredient per acre in 60 gallons of Diesel oil gives excel-

lent control of purple top, crab grass, poison ivy, blackberry, honeysuckle, butter and eggs and horse nettle.

EXAMPLE 20

5,6 - dimethyl - 3 - isopropyl hydro-uracil	3.3%
1, 1- dimethyl - 3 - phenylurea	6.7%
California Ca, Mg sub-bentonite	75.0%
Anhydrous sodium sulfate	15.0%

These components are blended, micro-pulverized, pug-milled with about 20% water, moist ~~granulater~~ granulated, dried and screened to 15—30 mesh granules.

The composition is applied by hand around isolated clumps of brush, using 2 teaspoonsful of material per clump. Oak seedling, maple seedlings, willow trees, winged elm and sweet gum are controlled.

EXAMPLE 21

5,5 - dichloro - 6 - ethoxy - 3 - isopropyl - 6 - methyl hydrouracil	15%
2,3,6 - trichlorobenzoic acid, Na salt	5%
Anhydrous sodium sulfate	10%
California sub-bentonite	70%

These ingredients are blended and micro-pulverized until the particles are under 50 microns in diameter. The blend is then pug-milled with 15—20% water and extruded through 1/8-inch to 9/64-inch holes. These extrusions are cut into 1/8-inch lengths and dried.

This formulation is useful for controlling perennial and woody vines.

An application of 20 pounds of active ingredient per acre gives excellent control of broomsedge, Indian grass, purple top, Virginia creeper, annual bindweed and isolated clumps of honeysuckle.

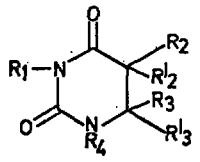
EXAMPLE 22

Twelve pounds of 5 - chloro - 3 - isopropyl-6 - methoxy - 6 - methyl - 5 - nitro hydro-uracil as an 80% wettable powder and 3 pounds of 4,6 - dinitro - ortho - *sec* - butyl-phenyl in 4 gallons of oil are blended as a tank mix and applied at the rate of 15 pounds of active ingredient per acre in 80 gallons of water to annual and perennial weeds growing along a fence row. Good kill with excellent residual weed control is obtained.

2,2-Dichloropropionic acid, sodium salt (85%) at 15 pounds per acre or ammonium sulfamate at 35 pounds per acre can be substituted for 4,6 - dinitro - ortho - *sec* - butyl-phenyl with satisfactory results.

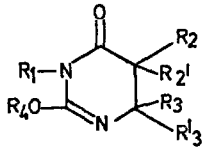
WHAT WE CLAIM IS:—

1. A herbicidal composition comprising a diluent which is at least in part an oil and in association therewith at least one 3-substituted hydro-uracil which is a compound of the general formula



I

or the corresponding isomeric formula



II

wherein R_1 represents a radical having a molecular weight up to 350 which is an alkyl radical containing 1 to 10 carbon atoms, a substituted alkyl radical containing 1 to 8 carbon atoms, an aryl radical containing 5 to 10 carbon atoms, a substituted phenyl radical, a substituted naphthyl radical, an aralkyl radical containing 5 to 13 carbon atoms, a substituted aralkyl radical containing 7 to 13 carbon atoms, an alkenyl radical containing 3 to 8 carbon atoms, a cycloalkyl radical containing 3 to 12 carbon atoms, a cycloalkenyl radical containing 4 to 12 carbon atoms, a substituted cycloalkyl radical containing 3 to 13 carbon atoms, a substituted cycloalkenyl radical containing 4 to 13 carbon atoms, a cycloalkyl alkyl radical containing 4 to 13 carbon atoms, a cycloalkenyl alkyl radical containing 5 to 13 carbon atoms, a (substituted cycloalkyl)alkyl radical containing 5 to 14 carbon atoms or a (substituted cycloalkenyl)alkyl radical containing 5 to 14 carbon atoms;

R_2 represents a radical having a molecular weight up to 250 which is a hydrogen, chlorine, fluorine, bromine or iodine atom, a methyl radical, an ethyl radical, a propyl radical, a butyl radical, a methoxy radical, an ethoxy radical, a propoxy radical, a butoxy radical, a nitro radical, an alkoxymethyl radical containing 2 to 6 carbon atoms, a hydroxy alkyl radical containing 1 to 6 carbon atoms, an alkylthio radical containing 1 to 4 carbon atoms, a methylthiomethyl radical, a dimethylcarbamyl radical, a dimethylsulphanamido radical, a methylsulphonyl radical, an acetamido radical or a *p*-chlorocarbanilyl radical;

R_2' represents a hydrogen, chlorine or bromine atom;

R_3 represents a radical having a molecular weight up to 200 which is a hydrogen, chlorine, or bromine atom, an alkyl radical

lent control of purple top, crab grass, poison ivy, blackberry, honeysuckle, butter and eggs and horse nettle.

EXAMPLE 20

5,6 - dimethyl - 3 - isopropyl hydrouracil	3.3%
1, 1- dimethyl - 3 - phenylurea	6.7%
California Ca, Mg sub-bentonite	75.0%
Anhydrous sodium sulfate	15.0%

These components are blended, micropulverized, pug-milled with about 20% water, moist ~~granulater~~ granulated, dried and screened to 15—30 mesh granules.

The composition is applied by hand around isolated clumps of brush, using 2 teaspoonsful of material per clump. Oak seedling, maple seedlings, willow trees, winged elm and sweet gum are controlled.

EXAMPLE 21

5,5 - dichloro - 6 - ethoxy - 3 - isopropyl - 6 - methyl hydrouracil	15%
2,3,6 - trichlorobenzoic acid, Na salt	5%
Anhydrous sodium sulfate	10%
California sub-bentonite	70%

These ingredients are blended and micropulverized until the particles are under 50 microns in diameter. The blend is then pug-milled with 15—20% water and extruded through 1/8-inch to 9/64-inch holes. These extrusions are cut into 1/8-inch lengths and dried.

This formulation is useful for controlling perennial and woody vines.

An application of 20 pounds of active ingredient per acre gives excellent control of broomsedge, Indian grass, purple top, Virginia creeper, annual bindweed and isolated clumps of honeysuckle.

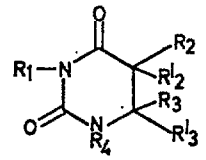
EXAMPLE 22

Twelve pounds of 5 - chloro - 3 - isopropyl-6 - methoxy - 6 - methyl - 5 - nitro hydrouracil as an 80% wettable powder and 3 pounds of 4,6 - dinitro - ortho - *sec* - butylphenyl in 4 gallons of oil are blended as a tank mix and applied at the rate of 15 pounds of active ingredient per acre in 80 gallons of water to annual and perennial weeds growing along a fence row. Good kill with excellent residual weed control is obtained.

2,2-Dichloropropionic acid, sodium salt (85%) at 15 pounds per acre or ammonium sulfamate at 35 pounds per acre can be substituted for 4,6 - dinitro - ortho - *sec* - butylphenyl with satisfactory results.

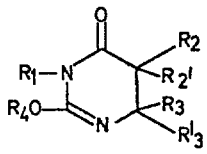
WHAT WE CLAIM IS:—

1. A herbicidal composition comprising a diluent which is at least in part an oil and in association therewith at least one 3-substituted hydro-uracil which is a compound of the general formula



I

or the corresponding isomeric formula



II

wherein R_1 represents a radical having a molecular weight up to 350 which is an alkyl radical containing 1 to 10 carbon atoms, a substituted alkyl radical containing 1 to 8 carbon atoms, an aryl radical containing 5 to 10 carbon atoms, a substituted phenyl radical, a substituted naphthyl radical, an aralkyl radical containing 5 to 13 carbon atoms, a substituted aralkyl radical containing 7 to 13 carbon atoms, an alkenyl radical containing 3 to 8 carbon atoms, a cycloalkyl radical containing 3 to 12 carbon atoms, a cycloalkenyl radical containing 4 to 12 carbon atoms, a substituted cycloalkyl radical containing 3 to 13 carbon atoms, a substituted cycloalkenyl radical containing 4 to 13 carbon atoms, a cycloalkyl alkyl radical containing 4 to 13 carbon atoms, a cycloalkenyl alkyl radical containing 5 to 13 carbon atoms, a (substituted cycloalkyl)alkyl radical containing 5 to 14 carbon atoms or a (substituted cycloalkenyl)alkyl radical containing 5 to 14 carbon atoms;

R_2 represents a radical having a molecular weight up to 250 which is a hydrogen, chlorine, fluorine, bromine or iodine atom, a methyl radical, an ethyl radical, a propyl radical, a butyl radical, a methoxy radical, an ethoxy radical, a propoxy radical, a butoxy radical, a nitro radical, an alkoxymethyl radical containing 2 to 6 carbon atoms, a hydroxy alkyl radical containing 1 to 6 carbon atoms, an alkylthio radical containing 1 to 4 carbon atoms, a methylthiomethyl radical, a dimethylcarbamyl radical, a dimethylsulphanamido radical, a methylsulphonyl radical, an acetamido radical or a *p*-chlorocarbanilyl radical;

R_2' represents a hydrogen, chlorine or bromine atom;

R_3 represents a radical having a molecular weight up to 200 which is a hydrogen, chlorine, or bromine atom, an alkyl radical

* C L M S *

containing 1 to 5 carbon atoms, a chloroalkyl radical containing 1 to 4 carbon atoms, a bromoalkyl radical containing 1 to 4 carbon atoms, a *p*-bromophenyl radical or an alkoxy radical containing 1 to 5 carbon atoms; or

R_2 and R_3 together represent a divalent alkylene radical of formula $(CH_2)_n$ where n is 3, 4 or 5;

R_3' represents a hydrogen or chlorine atom, an hydroxy radical, an alkoxy radical containing 1 to 6 carbon atoms, an acyloxy radical containing 1 to 6 carbon atoms, a substituted acyloxy radical containing 1 to 6 carbon atoms, a benzyl radical, a cyclohexyloxy radical, a hexanoyl radical, a 2-chloroethoxy radical, a 2,2,3,3, tetrafluoropropoxy radical, a 2-methoxyethoxy radical, a methoxymethyl radical or a methyl radical; and

R_4 represents a hydrogen, chlorine or bromine atom, an alkyl radical containing 1 to 5 carbon atoms, a substituted alkyl radical containing 1 to 5 carbon atoms, a trichloromethylthio radical or an alkenyl radical containing 2 to 5 carbon atoms; with the proviso that the molecular weight of the hydrouracil is less than 500.

2. A herbicidal composition comprising at least one 3-substituted hydrouracil as defined in claim 1 associated with a diluent which is at least in part a solid.

3. A herbicidal composition according to Claim 1 which contains a surface-active agent.

4. A herbicidal composition according to Claim 2 which contains a surface-active agent.

5. A herbicidal composition comprising at least one 3-substituted hydrouracil as defined in claim 1 associated with a surface-active agent and a diluent which is a liquid other than an oil.

6. A herbicidal composition according to Claim 5 wherein the liquid is water.

7. A herbicidal composition comprising at least one 3-substituted hydrouracil as defined in Claim 1 associated with a surface-active agent.

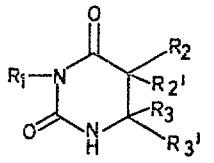
8. A herbicidal composition according to any one of Claims 3 to 7 which contains 1 to 10% by weight of the surface-active agent.

9. A herbicidal composition according to any one of the preceding claims which contains, in addition to the 3-substituted hydrouracil, another compound having herbicidal properties.

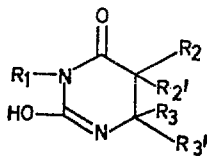
10. A herbicidal composition comprising at least one 3-substituted hydrouracil as defined in Claim 1 in association with a diluent and another compound having herbicidal properties.

11. A herbicidal composition according to any one of Claims 1 to 10 wherein R_1 represents a radical having a molecular weight of at most 350 which is an alkyl radical containing 1 to 6 carbon atoms, a substituted alkyl radical containing 1 to 6 carbon atoms, a phenyl radical, a substituted phenyl radical, a naphthyl radical, a substituted naphthyl radical, a cycloalkyl radical containing 5 to 10 carbon atoms, a cycloalkenyl radical containing 5 to 10 carbon atoms. R_2 represents a hydrogen or halogen atom, a nitro radical, a methy or ethyl radical, an alkoxy radical containing 1 to 5 carbon atoms, a hydroxymethyl radical, a methoxymethyl radical, or an ethoxyethyl radical; R_2' represents a hydrogen, chlorine or bromine atom; R_3 represents a hydrogen or chlorine atom, an hydroxy radical, an alkoxy radical containing 1 to 6 carbon atoms, a haloalkoxy radical containing 1 to 6 carbon atoms, an acyloxy radical containing 1 to 6 carbon atoms or a substituted acyloxy radical containing 1 to 6 carbon atoms. R_3' represents a hydrogen or chlorine atom or a methyl or ethyl radical; or R_2 and R_3 together form a divalent alkylene radical of formula $(CH_2)_n$ where n is 3, 4 or 5; and R_4 represents a chlorine or bromine atom or a methyl, ethyl or trichloromethylthio radical.

12. A herbicidal composition according to any one of Claims 1 to 10 wherein the 3-substituted hydrouracil is a compound of the formula



or the corresponding isomeric formula



wherein R_1 represents an alkyl radical containing 3 to 6 carbon atoms; a cycloalkyl radical containing 5 to 10 carbon atoms or a cycloalkenyl radical containing 5 to 10 carbon atoms; R_2 represents a hydrogen, chlorine, bromine or fluorine atom, a nitro radical, a methyl radical, an ethyl radical, a methoxy radical, a $-CH_2OH$ radical or a $-CH_2OC_2H_5$ radical; where R_2' represents a chlorine, bromine or hydrogen atom; R_3 represents a chlorine atom or a methyl or ethyl radical; or R_2 and R_3 together form a divalent alkylene radical of formula $(CH_2)_n$ wherein n is 3, 4 or 5; and R_3' represents a hydrogen atom, an acyloxy radical containing 1 to 6 carbon atoms, a substituted acyloxy radical containing 1 to 6 carbon atoms or

an alkoxy radical containing 1 to 6 carbon atoms with the proviso that when one but not both of R_2 and R_2' is hydrogen, R_3' is hydrogen and when each of R_2, R_2' and R_3' is hydrogen, R_1 is a cycloalkenyl radical of 5 to 8 carbon atoms or a cycloalkyl radical of 5 to 8 carbon atoms.

13. A herbicidal composition according to claim 11 wherein if R_1 represents a substituted alkyl radical the or each substituent is a methoxy radical or a bromine atom; if R_1 represents a substituted phenyl radical the or each substituent is a chlorine or bromine atom, a methyl radical, a fluoromethyl radical, a perchloryl radical or a phenyl radical; if R_1 represents a substituted naphthyl radical it represents a dimethyl sulphamoyl naphthyl radical; if R_1 represents a substituted cycloalkyl radical the or each substituent is a methyl or ethoxy radical; if R_3 represents a haloalkoxy the or each halogen atom is a chlorine or fluorine atom; and if R_3 represents a substituted acyloxy radical, the or each substituent is a chlorine atom.

14. A herbicidal composition according to any one of claims 1 to 10 wherein the 3-substituted hydrouracil is one of the compounds specifically named herein.

15. A herbicidal composition according to any one of claims 1 to 12 wherein if R_1 represents a substituted alkyl radical the or each substituent is a methoxy radical or a bromine atom; if R_1 represents a substituted phenyl radical the or each substituent is a chlorine, fluorine or bromine atom, an alkyl radical containing 1 to 5 carbon atoms, a chloroalkyl radical, a chloroalkoxy radical, a perchloryl radical or a phenyl radical; if R_1 represents a substituted benzyl radical, the or each substituent is preferably a chlorine atom, an alkyl radical containing 1 to 4 carbon atoms, a nitro radical or an alkoxy radical containing 1 to 4 carbon atoms; if R_1 represents a substituted cycloalkyl cycloalkenyl, cycloalkyl alkyl or cycloalkenyl alkyl radical the or each substituent is a chlorine or bromine atom, an alkyl radical containing 1 to 4 carbon atoms, a methoxy radical or an ethoxy radical; if R_3 represents a haloalkoxy radical the or each halogen atom is a chlorine or fluorine atom; and if R_3 represents a substituted acyloxy radical, the or each substituent is a chlorine atom.

16. A herbicidal composition according to any one of the preceding claims which contains one of the known herbicides specifically hereinbefore named.

17. A herbicidal composition according to any one of the preceding claims in the form of a concentrate which requires dilution before use as a herbicide.

18. A herbicidal composition according to any one of the preceding claims substantially as hereinbefore described.

19. A herbicidal composition according to any one of claims 1 to 17 substantially as described in any one of the foregoing Examples 6 to 22.

20. A method of controlling the growth of weeds at a locus which comprises applying to the locus a herbicidally effective quantity of at least one 3-substituted hydrouracil as defined in any one of claims 1 and 11 to 15.

21. A method according to claim 20 wherein the 3-substituted hydrouracil is applied in the form of a herbicidal composition as claimed in any one of claims 1 to 19, after dilution where appropriate.

22. A method of controlling the growth of weeds at a locus which comprises applying to the locus a herbicidally effective quantity of at least one 3-substituted hydrouracil as defined in any one of claims 11 to 14.

23. A method according to claim 19 wherein the 3-substituted hydrouracil is applied in the form of a herbicidal composition as claimed in any one of claims 11 to 14, after dilution where appropriate.

24. A method according to claim 21 or 22 wherein the growth of the weeds specified in any one of Examples 6 to 22 is controlled by the application of the 3-substituted hydrouracil specified in that Example.

25. A method according to claim 20 substantially as hereinbefore described.

26. As a new compound a 3-substituted hydrouracil as defined in claim 12.

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