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(19) THE PATENT OFFICE LONDON

(54) BENZODITHIOLE DERIVATIVES

(71) We, THE ANSUL COMPANY, a corporation organized and existing under the laws of the State of Wisconsin, United States of America, having a place of business at Marinette, Wisconsin, 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 concerns benzodithiole derivatives. More specifically, it provides certain 1,3-benzodithiole-2-one compounds which may be prepared by an unusual but simple and convenient cyclization reaction and which are biocidally active.

The compounds of this invention may be used in treating pests associated with growing plants in order to beneficially enhance the growth and/or yield-potential of said growing plants. This is accomplished by applying a biocidally active amount of the subject compound to soil, seed or the growing plant. The term " pests " as used herein is meant to include plant pests such as weeds and fungi, and animal pests such as arachnids, nematodes, or insects.

The concentration, rate and physical form of the administered compound are determined by the particular application, said application comprising one or more of the following:

(1) herbicidal
(2) fungicidal
(3) acaricidal
(4) nematocidal
(5) insecticidal

Generally, for each particular application, there will be a preferred range with respect to concentration, a preferred amount with respect to rate and a preferred type with respect to formulation.

For purposes of this disclosure and for the sake of convenience and clarity, certain terms used herein are defined as follows:

The phrase " treating pests associated with growing plants " signifies the application of a compound as herein defined to pests associated with growing plants which embraces germinating plants, e.g. seeds, sprouts, seedlings, and fully grown plants. The mode of application will depend on the desired end use. For example, if the treatment is for pre-emergent herbicidal use, the compound will be administered to the soil which contains the growing seeds. In contrast, when used as a post-emergent herbicide, the compound will be applied to the growing plants after seeds have germinated.

When treatment comprises foliar fungicidal application, the compound is administered, as a spray, directly onto the leaves and other above ground portions of diseased plants.

For use as an acaricide, the compound may be applied by contacting the leaves (or plant) directly or as a soil incorportion in the soil where the plant is growing.

For use as a soil or seed treatment fungicide, the compound is usually applied as a seed treatment, or as a drench and/or incorporation in the soil containing the seed or the growing plant.

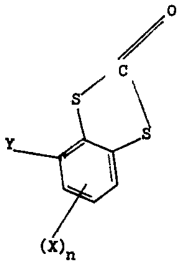
For use as a nematocide, the compound is normally applied directly as a drench and/or incorporation in the soil containing the growing plant.

For use as an insecticide, the compound is usually applied topically to the above ground portions of infested plants and/or to the soil containing the growing plants.

All of the aforesaid treatments, whatever the objective, have a unitary result. That is, they beneficially enhance or improve the growth and/or yield potential of the treated plant.

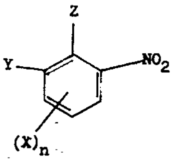
The term "biocidally active amount" means an amount of compound which effectively permits the desired objective.

According to the invention, there is provided a process for preparing compounds of the formula:



(I)

wherein Y is selected from hydrogen, cyano, alkylsulfonyl, nitro and trifluoromethyl; X is selected from alkyl and alkenyl of up to 6 carbon atoms, nitro, trichloromethyl, trifluoromethyl, trifluoromethoxy, trifluoromethylthio, trifluoromethylsulfoxyl, trifluoromethyl-sulfonyl, methoxymethyl, cyano, carboxy, carbamyl, halogen (F, Cl, Br, I), hydroxy, acetylamino, amino, N-phenylamino, N,N-diallylamino, alkoxy, N-morpholino, N-piperidino, N-piperazino, N-pyrrolidino, dimethylaminodithiocarbamyl, carboalkoxy, alkylthio, mono- and dialkylamino, N-alkylcarbamyl, N,N-dialkylcarbamyl, alkylsulfoxy, alkylsulfonyl, said alkyl groups containing from 1 to 4 carbon atoms; and n is 0 or an integer from 1 to 3, which comprises reacting a nitrobenzene of the formula:



(II)

wherein Z is halogen (F, Cl, Br, I) or alkoxy, Y, X and n are as defined above;

with an N,N-dialkyldithiocarbamic acid or acid salt thereof, each of said alkyl groups containing from 1 to 4 carbon atoms and being straight or branched-chained, and recovering the product.

The products defined above are *per se* part of this invention subject to the provisos that when n is 0, Y is not hydrogen and that when there is no substituent at ring positions 4 and 7, there is no nitro group at ring position 5 or 6.

Of particular interest are compounds as shown above wherein Y is nitro and n is 1, such as:

6-methyl-4-nitro-1,3-benzodithiole-2-one
4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one
4,6-dinitro-1,3-benzodithiole-2-one
6-fluoro-4-nitro-1,3-benzodithiole-2-one
6-chloro-4-nitro-1,3-benzodithiole-2-one
6-cyano-4-nitro-1,3-benzodithiole-2-one

Other preferred compounds include those as shown above wherein Y is nitro and n is 2 such as:

6-chloro-7-methyl-4-nitro-1,3-benzodithiole-2-one
7-dimethylaminodithiocarbamyl-4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one
7-chloro-4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one.

Still others which are preferred are those as shown above wherein Y is nitro and n is 3 such as:

5,7-dimethyl-4,6-dinitro-1,3-benzodithiole-2-one.

Another compound which is preferred as shown above wherein Y is nitro and n is 0 is:

4-nitro-1,3-benzodithiole-2-one.

Still others which are preferred are those as shown above wherein Y is trifluoromethyl and n is 1 such as:

6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

Still others which are preferred are those as shown above wherein Y is trifluoromethyl and n is 2 such as:

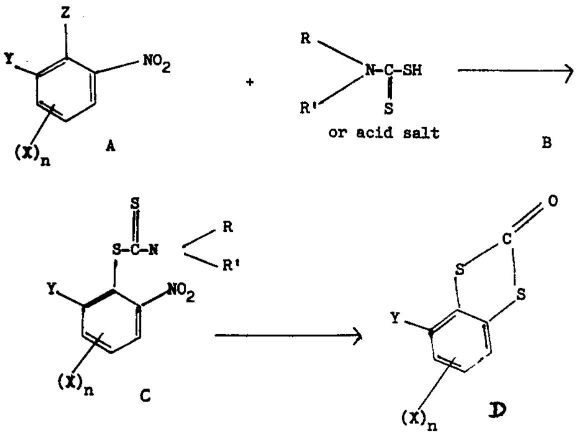
7-di-n-propylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-monoisopropylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-mono-n-propylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-diethylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-n-propylthio-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-isopropylthio-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-diallylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-methylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-monobutylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-dibutylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-monophenylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
6-nitro-7-piperidino-4-trifluoromethyl-1,3-benzodithiole-2-one
7-morpholino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
6-nitro-7-pyrrolidino-4-trifluoromethyl-1,3-benzodithiole-2-one.

Still others which are preferred are those as shown above wherein Y is trifluoromethyl and n is 3.

Still others which are preferred are those as shown above wherein Y is hydrogen and n is 1 such as:

5-nitro-1,3-benzodithiole-2-one
5-trifluoromethyl-1,3-benzodithiole-2-one.

The process of the invention can be expressed by the following reactions:

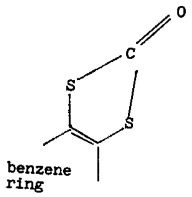


wherein Y is selected from hydrogen, cyano, alkylsulfonyl, nitro and trifluoromethyl; X is selected from alkyl and alkenyl of up to 6 carbon atoms, nitro, trichloromethyl, trifluoromethyl, trifluoromethoxy, trifluoromethylthio, trifluoromethylsulfoxyl, trifluoromethylsulfonyl, methoxymethyl, cyano, carboxy, carbamyl, halogen (F, Cl, Br, I), hydroxy, acetylamino, amino, N-phenylamino, N,N-diallylamino, alkoxy, N-morpholino, N-piperidino, N-piperazino, N-pyrrolidino, dimethylaminodithiocarbamyl, carboalkoxy, alkylthio, mono- and dialkylamino, N-alkylcarbamyl, N,N-dialkylcarbamyl, alkylsulfoxy, alkylsulfonyl, said alkyl groups containing from 1 to 4 carbon atoms and n is 0 or an integer from 1 to 3; Z is halogen (F, Cl, Br, I) or alkoxy, and R and R′ are each alkyl groups, straight- or branch-chained, containing from 1 to 4 carbon atoms.

Starting material A is typically a halobenzene derivative, many of which are commercially available. If not, one can easily synthesize the desired compound using well-documented chemical techniques. As is apparent, the halo group (Z) and the adjacent nitro group both undergo substitution thereby effecting cyclization to form the heterocyclic 5-membered ring. The other reagent, B, is an N,N-dialkyldithiocarbamic acid or acid salt, such as the sodium salt.

The attractiveness of the above process is that under relatively mild conditions, using generally available or easily accessible reagents and in a single step, one can obtain the desired compounds in good yields. The intermediate product C of this reaction can in many preparations be isolated. In others it undergoes the cyclization reaction, even at low temperatures, to produce final product D, the substituted 1,3-benzodithiole-2-ones.

The novelty of this synthetic method is clearly evident to one skilled in the art. It enables one to fuse onto a benzene ring containing adjacent nitro and halo groups a cyclic ring having the structure:



Importantly, it allows one to do this under mild conditions and using various chlorobenzene derivatives so that almost any desired substituted compound results.

The reaction process may be carried out in the temperature range of from 0°C to 200°C. In many instances, the reaction proceeds at room temperature or lower, whereas, in some cases, elevated temperatures may be desired in order to accelerate the reaction.

The reaction is usually carried out in a solvent, although the solvent may be omitted if effective dissolution of materials is possible. A solvent is generally preferred, however, and it can be any solvent which does not enter into the reaction and in which the reactants are soluble to some extent. Suitable solvents are dimethylformamide, dimethylsulfoxide, acetone and methyl isobutyl ketone.

The mole ratio of reagents A and B is normally 1 to 1, however, it is generally preferred to use a slight excess of reagent B to ensure more complete reaction.

A co-product E (structure unknown) is usually formed during the formation of desired product D. This co-product is easily separated from product D using solvent differential properties. It is converted to compound D by treatment under basic conditions, such as sodium hydroxide in an aqueous solution or suspension containing solvent. A typical solvent for such conversion is dimethylsulfoxide.

The work-up is standard — product is obtained by precipitation, washing, drying and recrystallization if necessary.

The biocidal processes of this invention comprise applying a biocidally effective amount of a compound disclosed herein to soil, seed or growing plant. The compounds are formulated for use either as sprays made up by adding water to emulsifiable concentrates of wettable powders, as granules or as dispersions on carriers such as attapulgite clay granules, peat moss, fertilizer and vermiculite. The compounds are quite insoluble in water, and hence, for the preparation of emulsions or wettable powders, the compounds are preferably formulated with wetting agents.

The invention thus extends to a method of treating pests associated with growing plants to beneficially enhance the growth and/or yield-potential of said growing plants which comprises treating soil, seed or said plants with a biocidally active amount of a compound according to the invention.

Since numerous compounds disclosed herein are free bases and acids, they can be converted to acid salts (free bases) and base salts (free acids).

The acid-addition and base-addition salts are within the purview of this invention. The acid-addition salts are easily prepared by treating the amine base with a substantially equimolar amount of a chosen acid in an aqueous solution or in a suitable organic solvent such as methanol or ethanol. The only restriction on the acid used is that it provides acceptable ions, i.e., those which do not deleteriously affect the growing plants. The base-addition salts are prepared in a similar manner except that base instead of acid is added. The same restriction with respect to acceptable ions applies.

For herbicidal use, the compounds disclosed herein are applied at a rate of from 0.5 lbs a.i./acre to 8.0 lbs a.i./acre (a.i. = active ingredient).

For soil fungicidal use, the compounds disclosed herein are applied at a rate of from 0.25 to 40.0 lbs a.i./acre.

For seed treatment fungicidal use the compounds disclosed herein are applied at a rate of from 2.0 to 10.0 ounces per 100 lbs. of crop seed.

For foliar fungicidal use, the compounds disclosed herein are applied at a rate of about 200 parts per million in a suitable solvent, such as water.

For acaricidal use, the compounds disclosed herein are applied at a rate of from 30 to 1000 parts per million in a suitable solvent, such as water.

For nematocidal use, the compounds disclosed herein are applied at a rate of from 15 to 20 parts per million in a suitable solvent, such as water.

For insecticidal use, the compounds disclosed herein are applied at a rate of from 0.2% to 10.0% in a suitable solvent, such as water.

EXAMPLE I.

4-Nitro-6-trifluoromethyl-1,3-benzodithiole-2-one

To a magnetically stirred solution of 2,6-dinitro-4-trifluoromethyl-chlorobenzene (445 g., 1.65 M) in acetone (3300 ml.) was added N,N-dimethyldithiocarbamic acid sodium salt dihydrate (295 g., 1.65 M) and the reaction mixture was maintained at 0—5°C. during addition.

After addition, the reaction mixture was stirred at 5—10°C. for 90 minutes and thereafter for 18 hours at room temperature.

The acetone-insoluble solids were suction filtered, washed well with water, dried and soxhlet-extracted with hexane overnight. The hexane extract was stripped free of solvent on a rotary evaporator under vacuum yielding 6.5 g. of desired product. A co-product (223.4 g., M.P. 222—224°C. — structure unknown) remained unextracted.

The acetone filtrate was stripped free of solvent under vacuum and the residual solid washed with ethanol (100 ml.) and suction filtered. The solid was soxhlet extracted with hexane overnight. Removal of solvent from the hexane extract yielded the desired product (188.5 g., 40.7% theory, M.P. 110—111°C.).

EXAMPLE II.

Conversion of the co-product of Example I to 4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one

To a stirred suspension of the co-product from Example I (3.26 g.) in dimethylsulfoxide (30 ml.) was added a solution of NaOH (0.88 g., 0.022 M) dimethylsulfoxide (15 ml.) and water (5 ml.). The reaction mixture was allowed to stir at room temperature under nitrogen gas for 22 hours.

The resulting solution was poured into water (300 ml.), made acidic by addition of conc. HCl, solid filtered off, washed with water and dried. Recrystallization from hot hexane yielded pure 4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one. (Confirmed by mixed M.P. and I.R. spectra).

EXAMPLE III.

The procedure of Example I is repeated wherein the following chlorobenzene derivatives are used in place of 2,6-dinitro-4-trifluoromethyl-chlorobenzene to provide the corresponding products:

chlorobenzene derivative	Product
2,6-dinitro-4-methyl-chlorobenzene	6-methyl-4-nitro-1,3-benzodithiole-2-one M.P. 163–164°C.
2,4,6-trinitro-chlorobenzene	4,6-dinitro-1,3-benzodithiole-2-one M.P. 129–131°C.
2,6-dinitro-4-fluoro-chlorobenzene	6-fluoro-4-nitro-1,3-benzodithiole-2-one M.P. 98–100°C.
4-chloro-2,6-dinitro-chlorobenzene	6-chloro-4-nitro-1,3-benzodithiole-2-one M.P. 152–153°C.
1,4-dichloro-3-methyl-2,6-dinitro-chlorobenzene	6-chloro-7-methyl-4-nitro-1,3-benzodithiole-2-one M.P. 147–148°C.
3-dimethylaminothiocarbamyl-2,6-dinitro-4-trifluoromethylchlorobenzene	7-dimethylaminodithiocarbamyl-4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one M.P. 138–141°C.
3-chloro-2,6-dinitro-4-trifluoromethylchlorobenzene	7-chloro-4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one M.P. 87–89°C.
2,6-dinitrochlorobenzene	4-nitro-1,3-benzodithiole-2-one M.P. 110–111°C.
3,5-dimethyl-2,4,6-trinitrochlorobenzene	5,7-dimethyl-4,6-dinitro-1,3-benzodithiole-2-one M.P. 130–131°C.
2,4-dinitro-6-trifluoromethylchlorobenzene	6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one M.P. 117–118.5°C.
3-di-n-propylamino-2,4-dinitro-6-trifluoromethylchlorobenzene	7-di-n-propylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one M.P. 60–61°C.
2,4-dinitro-3-monoisopropylamino-6-trifluoromethylchlorobenzene	7-monoisopropylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one M.P. 71.5–72.5°C.
2,4-dinitro-3-mono-n-propylamino-6-trifluoromethylchlorobenzene	7-monopropylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one M.P. 72–74°C.

chlorobenzene derivative	Product
3-diethylamino-2,4-dinitro-6-trifluoromethyl chlorobenzene	7-diethylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one M.P. 61–63°C.
2,4-dinitro-3-n-propylthio-6-trifluoromethyl chlorobenzene	6-nitro-7-n-propylthio-4-trifluoromethyl-1,3-benzodithiole-2-one M.P. 90–91°C.
2,4-dinitro-3-isopropylthio-6-trifluoromethyl chlorobenzene	7-isopropylthio-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one M.P. 79.5–80.5°C.
4-cyano-2,6-dinitrochlorobenzene	6-cyano-4-nitro-1,3-benzodithiole-2-one M.P. 173–175°C.
3-diallylamino-2,4-dinitro-6-trifluoromethyl chlorobenzene	7-diallylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one a liquid
2,4-dinitro-3-methylamino-6-trifluoromethyl chlorobenzene	7-methylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one M.P. 171–173°C.
2,4-dinitro-3-monobutylamino-6-trifluoromethyl chlorobenzene	7-mono-n-butylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one a liquid
3-dibutylamino-2,4-dinitro-6-trifluoromethylchlorobenzene	7-di-n-butylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one a liquid
2,4-dinitro-3-monophenylamino-6-trifluoromethylchlorobenzene	7-monophenylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one M.P. 121–122°C.
2,4-dinitro-3-piperidino-6-trifluoromethylchlorobenzene	6-nitro-7-piperidino-4-trifluoromethyl-1,3-benzodithiole-2-one M.P. 155–157°C.
2,4-dinitro-3-morpholino-6-trifluoromethylchlorobenzene	7-morpholino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one M.P. 178–180°C.
2,4-dinitro-3-pyrrolidino-6-trifluoromethyl chlorobenzene	6-nitro-7-pyrrolidino-4-trifluoromethyl-1,3-benzodithiole-2-one M.P. 104–105°C.

chlorobenzene derivative	Product
2,4-dinitrochlorobenzene	5-nitro-1,3-benzodithiole-2-one M.P. 131–136°C.
2-nitro-4-trifluoromethyl chlorobenzene	5-trifluoromethyl-1,3-benzodithiole-2-one M.P. 36–42°C.

EXAMPLE IV.

The procedure of Example I is repeated wherein the following N,N-dialkyldithiocarbamic acid compounds in stoichiometric equivalent amounts are used in place of N,N-dimethyldithiocarbamic acid sodium salt dihydrate with comparable results:

N,N-dimethyldithiocarbamic acid potassium salt
N,N-diethyldithiocarbamic acid sodium salt
N,N-diisopropyldithiocarbamic acid sodium salt
N,N-dibutyldithiocarbamic acid sodium salt
N-ethyl-N-methyldithiocarbamic acid sodium salt

EXAMPLE V.

The procedure of Example I is repeated wherein the following solvents are used in place of acetone with comparable results:

dimethylsulfoxide
dimethylformamide
methylisobutyl ketone

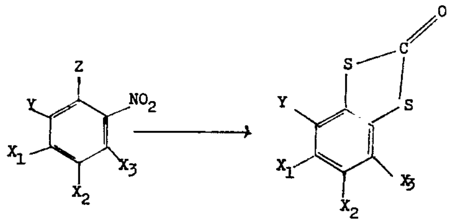
EXAMPLE VI.

The compound of Example I is prepared in the following manner: To a magnetically stirred solution of 16.2 g (60 mmoles) 2,6-dinitro-4-trifluoromethylchlorobenzene in 60 ml dimethylsulfoxide was added dropwise a solution of 10.74 g (60 mmoles) sodium dimethyldithiocarbamic acid. The reaction is mildly exothermic and accompanied by evolution of oxides of nitrogen. After allowing the reaction mixture to stir for 3 hours, 450 ml water and 225 ml chloroform are added and, after shaking well in an extraction funnel, the chloroform extract was withdrawn and the aqueous phase similarly extracted with two more 220 ml portions of chloroform. The combined chloroform extract was washed thrice with 750 ml portions of water, and dried over anhy. Na_2SO_4. After removing the solvent on a rotary evaporator, the residue was chromatographed over 180 g Silica-Gel. Elution with hexane-benzene (1:1) yielded 7.3 g (43.3%) 4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one, m.p. 103—107°C. One recrystallization from ethanol yielded product, m.p. 111—112°C.

Elemental Analyses % Found: C = 33.9; H = 0.9; N = 4.9
% Calc: C = 34.2; H = 0.71; N = 5.0
NMR ($CDCl_3$): 8.16 δ (1H,m); 8.6 δ (1H,m)

EXAMPLE VII.

The procedure of Example VI is repeated wherein the following halobenzene derivatives are used in place of 2,6-dinitro-4-trifluoromethylchlorobenzene to provide corresponding products:



halobenzene derivative

Z	Y	X_1	X_2	X_3
Cl	NO_2	allyl	H	H
Br	NO_2	hexyl	H	H
F	NO_2	H	CCl_3	H
Cl	NO_2	H	CF_3O	H
Cl	CF_3	H	CH_3SO_2	H
Cl	NO_2	H	CF_3S	H
Cl	NO_2	H	CF_3SO	H
Cl	NO_2	H	CN	H
Cl	NO_2	H	CF_3SO_2	H
Cl	NO_2	H	H	H
Cl	NO_2	H	CH_3OCH_2	H
Cl	CF_3	H	CN	H
Cl	CF_3	H	COOH	H
Cl	CF_3	H	OH	H
Cl	CF_3	H	NH_2	H

EXAMPLE VIII.

For determination of herbicidal activity for the herein disclosed compounds, the following screen was used: The candidate compound is applied at 8 lb/A in 40 gal/A to one foot square flats containing seeds or plants of the test plant species. Visual rating of phytotoxicity are made after 7 and 14 days. The phytotoxicity rating system is based on 0 = no control and 10 = complete kill or 100% control.

For post emergent use, the flats are planted with the desired plant species 7—9 days prior to spraying. By spraying time a well established flat of plants is ready for spraying. For incorporated pre-emergence use, the flats are prepared and planted with seed of the various species. A sheet of plastic is then placed over the seed and a measured quantity of screened soil normally used for covering the seed is placed on top. The flat is then ready for spraying. After spraying, the soil on top of the sheet of plastic is mixed thoroughly and spread evenly over the surface of the flat.

The plant species used in herbicide screening are corn (*Zea mays* L.), wheat (*Triticum avesticum* L.), cotton (*Gossypium hirsutum* L.), soybeans (*Glycine max* L.), barnyardgrass (*Echinochloa crusgalli* L. Beauv), foxtail (*Setaria viridis* L. Beauv), morningglory (*Ipomea purpurea* L. Roth), and pigweed (*Amaranthus retroflexus* L.).

The following compounds exhibited herbicidal properties:

7-di-n-propylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-diethylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-diallylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one

EXAMPLE IX.

For determination of soil fungicidal activity for the herein disclosed compounds, the following screen was used: Two potato-dextrose-agar plates of the desired fungal organism are blended in a Waring blender with 50 mls of sterile water. The resulting mixture is added to 3000 g of sterile soil in a plastic bag and thoroughly blended.

Cucumber seeds are planted in 4 oz. cups containing a measured amount of the inoculated soil mixture. Finally, 10 mls of the candidate compound at 40 lb/A is atomized as a drench over the prepared soil. After 14 days evaluations are made based on the number of surviving seedlings in the treated cup compared to the untreated check.

The organisms used in the primary soil fungicide screen are *Rhizoctonia solani* and *Pythium ultimum.*

The following compounds exhibited soil fungicidal properties:

4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one
4-nitro-1,3-benzodithiole-2-one
6-fluoro-4-nitro-1,3-benzodithiole-2-one
7-chloro-4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one
7-monoisopropylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-mono-n-propylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-diethylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-methylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
6-nitro-7-piperidino-4-trifluoromethyl-1,3-benzodithiole-2-one
7-n-propylthio-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-isopropylthio-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-dimethylaminodithiocarbamyl-4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one
5-trifluoromethyl-1,3-benzodithiole-2-one
1,3-benzodithiole-2-one

EXAMPLE X.

For determination of foliar fungicidal activity for the herein disclosed compounds, the following screen was used. The candidate compound is applied at 200 ppm to Bonny Best variety of tomato plants which have 2—4 true leaves. The treated plants are held at a relative humidity of 100% for 48 hours allowing ideal conditions for fungal invasion to occur. The plants are removed to the greenhouse bench and held for 7—10 days after which visual ratings are made. Ratings are by Infection Index (I I) where 0=no infection or 100% control and 10=100% infection or no control.

To inoculate the plants, a spore suspension of early blight fungus (*Alternaria solani*) is prepared and sprayed on the plant until it reaches the point of runoff.

The following compounds exhibited foliar fungicidal properties:

4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one
4,6-dinitro-1,3-benzodithiole-2-one .
5-trifluoromethyl-1,3-benzodithiole-2-one
1,3-benzodithiole-2-one
6-cyano-4-nitro-1,3-benzodithiole-2-one

EXAMPLE XI.

For determination of acaricidal activity for the herein disclosed compounds, the following screening procedure was used: To evaluate a compound as a contact acaricide, the solution is sprayed at 15 psi onto the leaves of bean seedlings infested with mites as a 0.1% concentration. The sprayed plants are inoculated 24 hours later. In the case of systemic testing, the chemical is added to the nutrient solution in which the bean seedling is growing at a concentration of 20 ppm. After three days, mites are added to the leaves grown in the treated solution. In both cases, five days later counts are made and percent kill determined.

Two spotted spider mites (*Tetranychus urticae*) are used in these tests and pinto beans (*Phaseolus vulgaris*) in the cotylendonary stage is the host plant species used.

The following compounds exhibited acaricidal properties:

4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one
4,6-dinitro-1,3-benzodithiole-2-one
6-methyl-4-nitro-1,3-benzodithiole-2-one
4-nitro-1,3-benzodithiole-2-one
6-fluoro-4-nitro-1,3-benzodithiole-2-one
7-chloro-4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one
7-di-n-propylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-monoisopropylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-monopropylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-diethylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-methylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-mono-n-butylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
7-diallylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
6-nitro-7-n-propylthio-4-trifluoromethyl-1,3-benzodithiole-2-one

7-isopropylthio-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one
5-nitro-1,3-benzodithiole-2-one
5-trifluoromethyl-1,3-benzodithiole-2-one
1,3-benzodithiole-2-thione.

EXAMPLE XII.

For determination of nematocidal activity for the herein disclosed compounds, the following screening procedure was used: The roots of established tomato plants, grown in the presence of root knot (*Meloidogyne incognita*) nematodes and with adequately galled roots, are cut into small segments. The root segments are added to sterile soil and thoroughly mixed. The root knot infested soil is allowed to set for three days. During this period many larva will emerge from the decaying plant roots yielding a high potential of root knot inoculum soil. A quantity of the soil mixture is added to 8 oz. cups. Finaly, 10 mls of the candidate nematocide at 20 ppm is added to the infested soil and thoroughly blended. The treated soil is removed from the jar and placed in an 8 oz. cup. The treated soil is allowed to aerate for 48 hours. Finally, cucumber seeds are planted in the treated soil. After 3—4 weeks, evaluations are made based on the galls occurring on the developing cucumber seedlings. The system used is the Root-Knot Index (RKI) based on a 0—10 rating where 0 = No galls and 10 = 100% galling.

The following compounds exhibited nematocidal properties:
4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one
4,6-dinitro-1,3-benzodithiole-2-one
6-methyl-4-nitro-1,3-benzodithiole-2-one
4-nitro-1,3-benzodithiole-2-one
6-fluoro-4-nitro-1,3-benzodithiole-2-one
5-nitro-1,3-benzodithiole-2-one

EXAMPLE XIII.

For determination of insecticidal activity for the herein disclosed compounds, the following screening procedure was used:

A. *Screwworm Test*

The candidate compound was evaluated as an insecticide on screwworms at rates of 0.3125—10.0%. The solutions were applied on 1st, 2nd, and 3rd instar larvi and on eggs.

Two reps of each larvi instar and the eggs were placed on black filter paper in petri dishes and sprayed with 5 ml total volume at each concentration. Ratings were made 48 hours following application.

B. *White Fly Test*

White fly infested tobacco (Nicotiana) plants were sprayed with a 1% solution of candidate test compound. Within 12 hours after application of the chemical, all white flies were either dead or had left the tobacco plants. White fly populations were too large to make quantitative counts, so visual observations were made.

The following compound exhibited insecticidal properties in A and B above:
4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one

C. *Pea Aphid Test*

The candidate compounds were applied in a 0.5% solution to pea aphids and pea seedling plants in a contact test using a Waters vertical spray tower. The spray descends through an 8 inch stainless steel cylinder to the test insects and plants 44 inches below the atomizer. The spray tower is operated at 10 p.s.i. and discharges about 30 milliliters of spray per minute through a Devilbiss atomizer. The insects and seedlings were sprayed for a 15 second period and held for forty-eight hour mortality determinations.

D. *Southern Armyworm Test*

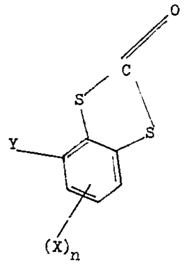
Excised lima bean leaves were dipped into 0.05% solutions of the candidate compounds and when dry were offered to 10 larvae of the Southern armyworm (late third instar) for a 48 hour feeding period.

The following compounds exhibited insecticidal properties in C and D above:
4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one
6-fluoro-4-nitro-1,3-benzodithiole-2-one
7-chloro-4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one
6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one

Because of Section 9 of the Patents Act 1949, attention is drawn to our copending divisional patent application No. 7 906 507 (Serial No. 1 567 482).

WHAT WE CLAIM IS:—

1. A compound of the formula



wherein Y is selected from hydrogen, cyano, nitro, trifluoromethyl and alkylsulfonyl; X is selected from alkyl and alkenyl of up to 6 carbon atoms, nitro, trichloromethyl, trifluoromethyl, trifluoromethoxy, trifluoromethylthio, trifluoromethylsulfoxyl, trifluoromethylsulfonyl, methoxymethyl, cyano, carboxy, carbamyl, halogen (F, Cl, Br, I), hydroxy, acetylamino, amino, N-phenylamino, N,N-diallylamino, alkoxy, N-morpholino, N-piperidino, N-piperazino, N-pyrrolidino, dimethylaminodithiocarbamyl, carboalkoxy, alkylthio, mono- and dialkylamino, N-alkylcarbamyl, N,N-dialkylcarbamyl, alkylsulfoxy, alkylsulfonyl, said alkyl groups containing from 1 to 4 carbon atoms; n is 0 or an integer from 1 to 3 with the provisos that when n is 0, Y is not hydrogen and that when there is no substituent at ring positions 4 and 7, there is no nitro group at ring position 5 or 6; or such a compound in salt form.

2. A compound as claimed in claim 1 wherein Y is nitro and *n* is 0.

3. The compound as claimed in claim 2 which is 4-nitro-1,3-benzodithiole-2-one.

4. A compound as claimed in claim 1 wherein Y is nitro and *n* is 1.

5. The compound as claimed in claim 4 which is 6-methyl-4-nitro-1,3-benzodithiole-2-one.

6. The compound as claimed in claim 4 which is 4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one.

7. The compound as claimed in claim 4 which is 4,6-dinitro-1,3-benzodithiole-2-one.

8. The compound as claimed in claim 4 which is 6-fluoro-4-nitro-1,3-benzodithiole-2-one.

9. The compound as claimed in claim 4 which is 6-chloro-4-nitro-1,3-benzodithiole-2-one.

10. The compound as claimed in claim 4 which is 6-cyano-4-nitro-1,3-benzodithiole-2-one.

11. A compound as claimed in claim 1 wherein Y is nitro and *n* is 2.

12. The compound as claimed in claim 11 which is 6-chloro-7-methyl-4-nitro-1,3-benzodithiole-2-one.

13. The compound as claimed in claim 11 which is 7-dimethylaminodithiocarbamyl-4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one.

14. The compound as claimed in claim 11 which is 7-chloro-4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one.

15. A compound as claimed in claim 1 wherein Y is nitro and *n* is 3.

16. The compound as claimed in claim 15 which is 5,7-dimethyl-4,6-dinitro-1,3-benzodithiole-2-one.

17. A compound as claimed in claim 1 wherein Y is trifluoromethyl and *n* is 1.

18. The compound as claimed in claim 17 which is 6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

19. A compound as clamed in claim 1 wherein Y is trifluoromethyl and *n* is 2.

20. The compound as claimed in claim 19 which is 7-di-n-propylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

21. The compound as claimed in claim 19 which is 7-monoisopropylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

22. The compound as claimed in claim 19 which is 7-mono-n-propylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

23. The compound as claimed in claim 19 which is 7-diethylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

24. The compound as claimed in claim 19 which is 6-nitro-7-n-propylthio-4-trifluoromethyl-1,3-benzodithiole-2-one.

25. The compound as claimed in claim 19 which is 7-isopropylthio-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

26. The compound as claimed in claim 19 which is 7-diallylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

27. The compound as claimed in claim 19 which is 7-methylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

28. The compound as claimed in claim 19 which is 7-mono-n-butylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

29. The compound as claimed in claim 19 which is 7-di-n-butylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

30. The compound as claimed in claim 19 which is 7-monophenylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

31. The compound as claimed in claim 19 which is 6-nitro-7-piperidino-4-trifluoromethyl-1,3-benzodithiole-2-one.

32. The compound as claimed in claim 19 which is 7-morpholino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

33. The compound as claimed in claim 19 which is 6-nitro-7-pyrrolidino-4-trifluoromethyl-1,3-benzodithiole-2-one.

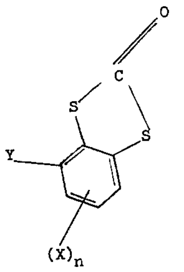
34. A compound as claimed in claim 1, as named or shown in any of Examples I to III.

35. A pesticidal composition comprising a compound as claimed in any preceding claim and an inert diluent therefor.

36. A composition as claimed in claim 35 wherein the diluent is attapulgite clay granules, peat moss, fertilizer or vermiculite.

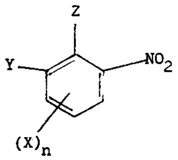
37. A composition as claimed in claim 35 or 36 which comprises a wetting agent.

38. A process for preparing compounds of the formula:



(I)

wherein Y is selected from hydrogen, cyano, alkylsulfonyl, nitro and trifluoromethyl; X is selected from alkyl and alkenyl of up to 6 carbon atoms, nitro, trichloromethyl, trifluoromethyl, trifluoromethoxy, trifluoromethylthio, trifluoromethylsulfoxyl, trifluoromethylsulfonyl, methoxymethyl, cyano, carboxy, carbamyl, halogen (F, Cl, Br, I), hydroxy, acetylamino, amino, N-phenylamino, N,N-diallylamino, alkoxy, N-morpholino, N-piperidino, N-piperazino, N-pyrrolidino, dimethylaminodithiocarbamyl, carboalkoxy, alkylthio, mono- and dialkylamino, N-alkylcarbamyl, N,N-dialkylcarbamyl, alkylsulfoxy, alkylsulfonyl, said alkyl groups containing from 1 to 4 carbon atoms; and n is 0 or an integer from 1 to 3, which comprises reacting a nitrobenzene of the formula:



II

wherein Z is halogen (F, Cl, Br, I) or alkoxy, Y, X and n are as defined above; with an N,N-dialkyldithiocarbamic acid or acid salt thereof, each of said alkyl groups containing from 1 to 4 carbon atoms and being straight- or branched-chained, and recovering the product.

39. The process of claim 38 wherein said reaction is carried out in the presence of a solvent.

40. The process of claim 38 or 39 wherein said reaction is carried out at a temperature of from 0°C to 200°C.

41. The process of claim 38 wherein said acid salt of N,N-dialkyldithiocarbamic acid is an alkali metal salt.

42. The process of claim 41 wherein said alkali metal is sodium.

43. The process of claim 38 wherein said N,N-dialkyldithiocarbamic acid salt is N,N-dimethyldithiocarbamic acid sodium salt.

44. The process of claim 38 for preparing a compound having formula I wherein Y is nitro and n is 0 which comprises reacting a nitrohalobenzene of formula II wherein Y is nitro and n is 0 with said N,N-dialkyldithiocarbamic acid or acid salt thereof and recovering the product.

45. The process of claim 44 for preparing 4-nitro-1,3-benzodithiole-2-one wherein 2,6-dinitrochlorobenzene is reacted with N,N-dimethyldithiocarbamic acid sodium salt dihydrate.

46. The process of claim 38 for preparing compounds having formula I wherein Y is nitro and n is 1 which comprises reacting a nitrohalobenzene of formula II wherein Y is nitro and n is 1 with said N,N-dialkyldithiocarbamic acid or acd salt thereof and recovering the product.

47. The process of claim 46 for preparing 6-methyl-4-nitro-1,3-benzodithiole-2-one wherein 2,6-dinitro-4-methylchlorobenzene is reacted with N,N-dimethyldithiocarbamic acid sodium salt dihydrate.

48. The process of claim 46 for preparing 4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one wherein 2,6-dinitro-4-trifluoromethylchlorobenzene is reacted with N,N-dimethyldithiocarbamic acid sodium salt dihydrate.

49. The process of claim 46 for preparing 4,6-dinitro-1,3-benzodithiole-2-one wherein 2,4,6-trinitrochlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

50. The process of claim 46 for preparing 6-fluoro-4-nitro-1,3-benzodithiole-2-one wherein 2,6-dinitro-4-fluorochlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

51. The process of claim 46 for preparing 6-chloro-4-nitro-1,3-benzodithiole-2-one wherein 4-chloro-2,6-dinitrochlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

52. The process of claim 46 for preparing 6-cyano-4-nitro-1,3-benzodithiole-2-one wherein 2,6-dinitro-4-cyano-chlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

53. The process of claim 38 for preparing compounds having formula I wherein Y is nitro and n is 2 which comprises reacting a nitrobenzene of formula II wherein Y is nitro and n is 2 with said N,N-dialkyldithiocarbamic acid or acid salt thereof and recovering the product.

54. The process of claim 53 for preparing 6-chloro-7-methyl-4-nitro-1,3-benzodithiole-2-one wherein 4-chloro-2,6-dinitro-3-methylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

55. The process of claim 53 for preparing 7-chloro-4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one wherein 3-chloro-2,6-dinitro-4-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

56. The process of claim 53 for preparing 7-dimethylaminodithiocarbamyl-4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one wherein 3-dimethylaminodithiocarbamyl-2,6-dinitro-4-trifluoromethylchlorobenzene is reacted with N,N-dimethyldithiocarbamic acid or acid salt thereof.

57. The process of claim 38 for preparing compounds having formula I wherein Y is nitro and n is 3 which comprises reacting a nitrobenzene of formula II wherein Y is nitro and n is 3 with said N,N-dialkyldithiocarbamic acid or acid salt thereof and recovering the product.

58. The process of claim 57 for preparing 5,7-dimethyl-4,6-dinitro-1,3-benzodithiole-2-one wherein 3,5-dimethyl-2,4,6-trinitrochlorobenzene is reacted with said N,N- dialkyldithiocarbamic acid or acid salt thereof.

59. The process of claim 38 for preparing compounds having formula I wherein Y is trifluoromethyl and n is 1 which comprises reacting a nitrobenzene of formula II wherein Y is trifluoromethyl and n is 1 with said N,N-dialkyldithiocarbamic acid or acid salt thereof and recovering the product.

60. The process of claim 59 for preparing 6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one wherein 2,4-dinitro-6-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

61. The process of claim 38 for preparing compounds having formula I wherein Y is trifluoromethyl and n is 2 which comprises reacting a nitrobenzene of formula II wherein Y is trifluoromethyl and n is 2 with said N,N-dialkyldithiocarbamic acid or acid salt thereof and recovering the product.

62. The process of claim 61 for preparing 7-di-n-propylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one wherein 3-di-n-propylamino-2,4-dinitro-6-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

63. The process of claim 61 for preparing 7-monoisopropylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one wherein 2,4-dinitro-3-monoisopropylamino-6-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

64. The process of claim 61 for preparing 7-monopropylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one wherein 2,4-dinitro-3-mono-n-propylamino-6-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

65. The process of claim 61 for preparing 7-diethylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one wherein 3-diethylamino-2,4-dinitro-6-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

66. The process of claim 61 for preparing 6-nitro-7-n-propylthio-4-trifluoromethyl-1,3-benzodithiole-2-one wherein 2,4-dinitro-3-n-propylthio-6-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

67. The process of claim 61 for preparing 7-isopropylthio-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one wherein 2,4-dinitro-3-isopropylthio-6-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

68. The process of claim 61 for preparing 7-diallylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one wherein 3-diallylamino-2,4-dinitro-6-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

69. The process of claim 61 for preparing 7-methylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one wherein 2,4-dinitro-3-methylamino-6-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

70. The process of claim 61 for preparing 7-mono-n-butylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one wherein 2,4-dinitro-3-mono-n-butylamino-6-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

71. The process of claim 61 for preparing 7-dibutylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one wherein 3-dibutylamino-2,4-dinitro-6-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

72. The process of claim 61 for preparing 7-monophenylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one wherein 2,4-dinitro-3-monophenylamino-6-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

73. The process of claim 61 for preparing 6-nitro-7-piperidino-4-trifluoromethyl-1,3-benzodithiole-2-one wherein 2,4-dinitro-3-piperidino-6-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

74. The process of claim 61 for preparing 7-morpholino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one wherein 2,4-dinitro-3-morpholino-6-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

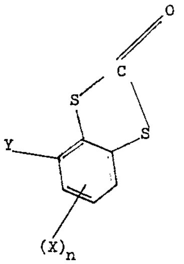
75. The process of claim 61 for preparing 6-nitro-7-pyrrolidino-4-trifluoromethyl-1,3-benzodithiole-2-one wherein 2,4-dinitro-3-pyrrolidino-6-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

76. The process of claim 38 for preparing compounds having formula I wherein Y is hydrogen and n is 1 which comprises reacting a nitrobenzene of formula II wherein Y is hydrogen and n is 1 with said N,N-dialkyldithiocarbamic acid or acid salt thereof and recovering the product.

77. The process of claim 76 for preparing 5-trifluoromethyl-1,3-benzodithiole-2-one wherein 2-nitro-4-trifluoromethylchlorobenzene is reacted with said N,N-dialkyldithiocarbamic acid or acid salt thereof.

78. A method of treating pests associated with growing plants to beneficially enhance the growth and/or yield-potential of said growing plants which comprises

treating soil, seed or said plants with a biocidally active amount of a compound of the formula:



wherein Y is selected from hydrogen, cyano, alkylsulfonyl, nitro and trifluoromethyl; X is selected from alkyl and alkenyl of up to 6 carbon atoms, nitro, trichloromethyl, trifluoromethyl, trifluoromethoxy, trifluoromethylthio, trifluoromethylsulfoxyl, trifluoromethylsulfonyl, methoxymethyl, cyano, carboxy, carbamyl, halogen (F, Cl, Br, I), hydroxy, acetylamino, amino, N-phenylamino, N,N-diallylamino, alkoxy, N-morpholino, N-piperidino, N-piperazino, N-pyrrolidino, dimethylaminodithiocarbamyl, carboalkoxy, alkylthio, mono- and dialkylamino, N-alkylcarbamyl, N,N-dialkylcarbamyl, alkylsulfoxy, alkylsulfonyl, said alkyl groups containing from 1 to 4 carbon atoms; n is 0 or an integer from 1 to 3 with the provisos that when n is 0, Y is not hydrogen and that when there is no substituent at ring positions 4 and 7, there is no nitro group at ring position 5 or 6; or such a compound in salt form.

79. The method as claimed in claim 78 wherein said compound has the formula as shown in claim 78 above in which Y is nitro and n is 0.

80. The method as claimed in claim 79 in which the compound is 4-nitro-1,3-benzodithiole-2-one.

81. The method as claimed in claim 78 wherein said compound has the formula as shown in claim 78 above in which Y is nitro and n is 1.

82. The method as claimed in claim 81 in which the compound is 6-methyl-4-nitro-1,3-benzodithiole-2-one.

83. The method as claimed in claim 81 in which the compound is 4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one.

84. The method as claimed in claim 81 in which the compound is 4,6-dinitro-1,3-benzodithiole-2-one.

85. The method as claimed in claim 81 in which the compound is 6-fluoro-4-nitro-1,3-benzodithiole-2-one.

86. The method as claimed in claim 81 in which the compound is 6-chloro-4-nitro-1,3-benzodithiole-2-one.

87. The method as claimed in claim 81 in which the compound is 6-cyano-4-nitro-1,3-benzodithiole-2-one.

88. The method as claimed in claim 78 wherein said compound has the formula as shown in claim 78 above in which Y is nitro and n is 2.

89. The method as claimed in claim 88 in which the compound is 6-chloro-7-methyl-4-nitro-1,3-benzodithiole-2-one.

90. The method as claimed in claim 88 in which the compound is 7-dimethylamino-dithiocarbamyl-4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one.

91. The method as claimed in claim 88 in which the compound is 7-chloro-4-nitro-6-trifluoromethyl-1,3-benzodithiole-2-one.

92. The method as claimed in claim 78 wherein said compound has the formula as shown in claim 78 above in which Y is nitro and n is 3.

93. The method as claimed in claim 92 in which the compound is 5,7-dimethyl-4,6-dinitro-1,3-benzodithiole-2-one.

94. The method as claimed in claim 78 wherein said compound has the formula as shown in claim 78 above in which Y is trifluoromethyl and n is 1.

95. The method as claimed in claim 94 in which the compound is 6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

96. The method as claimed in claim 78 wherein said compound has the formula as shown in claim 78 above in which Y is trifluoromethyl and n is 2.

97. The method as claimed in claim 96 in which the compound is 7-di-n-propylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

98. The method as claimed in claim 96 in which the compound is 7-monoisopropylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

99. The method as claimed in claim 96 in which the compound is 7-mono-n-propylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

100. The method as claimed in claim 96 in which the compound is 7-diethylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

101. The method as claimed in claim 96 in which the compound is 6-nitro-7-n-propylthio-4-trifluoromethyl-1,3-benzodithiole-2-one.

102. The method as claimed in claim 96 in which the compound is 7-isopropylthio-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

103. The method as claimed in claim 96 in which the compound is 7-diallylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

104. The method as claimed in claim 96 in which the compound is 7-methylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

105. The method as claimed in claim 96 in which the compound is 7-mono-n-butylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

106. The method as claimed in claim 96 in which the compound is 7-di-n-butylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

107. The method as claimed in claim 96 in which the compound is 7-monophenylamino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

108. The method as claimed in claim 96 in which the compound is 6-nitro-7-piperidino-4-trifluoromethyl-1,3-benzodithiole-2-one.

109. The method as claimed in claim 96 in which the compound is 7-morpholino-6-nitro-4-trifluoromethyl-1,3-benzodithiole-2-one.

110. The method as claimed in claim 96 in which the compound is 6-nitro-7-pyrrolidino-4-trifluoromethyl-1,3-benzodithiole-2-one.

111. The method as claimed in claim 78 wherein said compound has the formula as shown in claim 78 above in which Y is hydrogen and n is 1.

112. The method as claimed in claim 111 in which the compound is 5-trifluoromethyl-1,3-benzodithiole-2-one.

113. The method of any one of claims 78 to 112 wherein said compound is combined with an inert diluent.

114. The process of claim 38 wherein co-produced material separated from compound I by solvent differential is converted to compound I by treatment under basic conditions and the product recovered.

115. The process of claim 114 wherein said treatment is effected with sodium hydroxide in the presence of aqueous dimethylsulfoxide at room temperature.

116. The process of claim 76 for preparing 5-nitro-1,3-benzodithiole-2-one wherein 2,4-dinitrochlorobenzene is reacted with said N,N-dialkdithiocarbamic acid or acid salt thereof.

117. A process as claimed in claim 38 substantially as described in any of Examples I to VII.

118. A compound of formula I as defined in claim 38 when prepared by a process as claimed in any one of claims 38 to 77 and 114 to 117.

119. A method as claimed in claim 78 substantially as described in any of Examples VIII to XIII.

120. A method of treating pests associated with growing plants to beneficially enhance the growth and/or yield-potential of said growing plants which comprises treating soil seed or said plants with a biocidally active amount of a compound according to claim 118.

121. The method of claim 120 wherein said compound is combined with an inert diluent.

122. A pesticidal composition comprising a compound as claimed in claim 118 and an inert diluent therefor.

123. A composition as claimed in claim 122 wherein the diluent is attapulgite clay granules, peat moss, fertilizer or vermiculite.

124. A composition as claimed in claim 122 or 123 which comprises a wetting agent.

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