

1097.825



PATENT SPECIFICATION

NO DRAWINGS

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COMPLETE SPECIFICATION

Novel method for Suppressing Insects

We, AMERICAN CYNAMID COMPANY, a Corporation organized under the laws of the State of Maine, United States of America, of Township of Wayne, State of New Jersey, 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:—

The present invention relates to a novel method for suppressing insect pests and protecting plants against insect attack. More particularly, the invention relates to a method for enhancing the insecticidal activity of O,O-dimethyl phosphorodithioate of diethyl mercaptosuccinate, hereinafter referred to as S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate. Still more particularly, the invention is concerned with methods for suppressing insects by the application of S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate in substantially undiluted, distinct droplet form.

S - (1,2 - Dicarbethoxyethyl) - O,O - dimethyldithiophosphate has been prepared and described as an effective insecticide in Patent Specification No. 699,522. Direct application to a locus has been generally avoided due both to the required use of excessively large quantities of it and to the phytotoxic effect of the concentrated material. Accordingly, it has been formulated in a variety of ways which are amenable to application with all types of equipment. For instance, S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate has been formulated as a dilute dust or wettable powder. It has also been prepared as an emulsifiable concentrate, as a flowable emulsion or in oil-based formulations as well as in granular, bait and paint compositions. To maximize the suppression of insect pests, it has been accepted practice to form a thin film on a surface to be protected. For this reason, adjuvants, such as diluents, spreaders,

[Price 4s. 6d.]

stickers, emulsifiers, penetrants and wetting agents have been incorporated in formulations to obtain extensive coverage on surfaces, such as plant surfaces.

As is known, S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate exhibits relatively short residual activity on plant tissue. It apparently undergoes degradation which appears to be due to the presence of plant enzymes. The latter tend to decarboxylate S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate thereby rendering it ineffective. Further, wetting agents assist in spreading it on a plant surface to cause more rapid degradation. If a procedure could be developed wherein S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate could be applied directly to a surface without diluting its insecticidal effect while increasing its residual activity, such would meet a long-felt need in the art.

According to the present invention there is provided a method for suppressing insects and protecting plants against insect attack, which comprises applying to an area subject to insect infestation technical S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate in its substantially undiluted, adjuvant free form as discrete droplets, whereby it remains as droplets without wetting or penetrating the surface area.

It has been surprisingly found that technical S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate which is undiluted and adjuvant free, can be applied to an area to be protected against insects at a preferred rate from 2 to 32 ounces per acre in the form of a finely divided distinct droplets whereby successful suppression of a large variety of insects and enhanced residual activity on a plant environment are readily achieved. It is apparent that, in the use of S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate remaining in droplet form without wetting or penetrating an applied surface, there



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is a substantial reduction in the likelihood of animal contamination and plant phytotoxicity.

According to a preferred embodiment the process of the invention an area to be protected against insects is sprayed at a rate from 2 to 32 ounces per acre with distinct droplets of undiluted, adjuvant free S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate. Although rates as high as 32 ounces per acre can be applied without adversely affecting treated surfaces, such as plant surfaces, effective suppression of many insects is achieved by applying from 2 to 16 ounces per acre and, preferably, from 4 to 12 ounces per acre thereto.

In general, droplets of S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate should preferably possess a mass median diameter ranging from 25 microns to 150 microns. If the mass median diameter of the droplets is less than 25 microns, the droplets are subject to excessive loss through wind drift. Where the mass median diameter of the droplets exceeds 150 microns, it is difficult, if not impossible, to obtain satisfactory distribution and complete coverage of an area necessary for effective insect suppression. Thus, for optimum results including extended residual activity, there is provided a fine spray which produces droplets having a mass median diameter between 25 microns and 150 microns. This is achieved by employing a variety of nozzle types, such as for instance, flat fan nozzles in conventional spray equipment.

To facilitate a further understanding of the present invention the following illustrative examples are presented. These are not to be taken as limitative of the invention.

EXAMPLE 1

This example illustrates the procedure for suppressing grasshoppers employing S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate at various low levels.

Effective suppression of grasshoppers infesting large areas of range land is demonstrated by the following tests wherein graded levels of undiluted, adjuvant free S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate were distributed over grasshopper infested areas by aerial application as finely divided droplets having a mass median diameter in the range of from 30 to 80 microns. Prior to treatment, individual plots were inspected and grasshopper infestation per square yard determined. A small plane was provided with standard spray equipment with several nozzles adapted to disperse the S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate as finely divided droplets of the indicated mass median diameter. Air and ground temperature and relative humidity in the area of the plots was determined prior to application. Flying at elevations at approximately 35 feet above ground level, predetermined rates of the undiluted, adjuvant free S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate were deposited on the test plots. Swath widths of 75, 150 and 225 feet were used to determine practical limits. At intervals of 3 and 7 days after treatment, the various plots were again examined and grasshopper infestation per square yard of treated area determined and recorded. The results of these tests are tabulated in Table I below.

TABLE I

Swath Width (ft.)	Plot No.	Actual Dosage (Oz./acre)	Temperature (°F.)		Relative Humidity (%)	Wind (m.p.h.)	Grasshoppers/Sq. Yd.		Per Cent Kill After (Days)	
			Air	Ground			Before Treatment	After (Days)	3	7
75	1	9.20	55	52	55	0-2	11.2	1.2	89.5	92.7
	5	8.00	82	102	25	8-15	12.6	0.3	97.9	95.7
	11	12.00	53	52	36	4-5	27.9	0.4	98.7	100.0
	20	11.75	61	60	54	5-8	25.3	0.5	98.2	99.3
	9	6.70	74	73	43	5-8	26.6	0.5	98.0	99.3
150	2	8.00	55	52	55	0-1	20.1	0.9	95.5	95.5
	6	8.00	84	102	24	6-15	25.0	2.7	89.2	96.4
	16	8.00	53	52	64	3-6	34.9	0.1	99.7	99.5
	19	11.75	64	60	22	4-9	27.5	0.5	98.4	99.3
	12	6.70	74	73	43	7-12	33.4	0.6	98.1	99.5
225	3	8.00	56	52	53	0-1	26.6	1.7	93.6	93.6
	7	8.00	85	102	20	8-12	25.4	2.3	91.1	98.2
	13	8.00	53	50	64	1-5	31.9	0.5	98.3	98.6
	18	11.75	65	64	48	7-13	24.2	0.9	96.3	97.8
	14	6.70	79	79	31	8-12	23.9	0.5	97.7	98.9

- From the data presented in the table above ranges from 6.7 to 12 ounces per acre of undiluted, adjuvant free S - (1,2 - dicarboethoxyethyl) - O₂O - dimethyldithiophosphate result in kills between 89.5% and 100%.
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- EXAMPLE 2
- This example illustrates the suppression of cereal leaf beetles.
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- In this test some 26,000 acres were treated with undiluted, adjuvant free S-(1,2-dicarboethoxyethyl) - O₂O - dimethyldithiophosphate applied from the air at the rate of approximately 8 ounces per acre. Prior to treatment, adult cereal leaf beetle counts were made. The planes used for treatment were equipped with standard aerial spraying equipment having flat fan nozzles adapted to disperse the S - (1,2 - dicarboethoxyethyl)-O₂O - dimethyldithiophosphate as finely divided droplets of mass median diameter between 30 and 80 microns. The S-(1,2-dicarboethoxyethyl) - O₂O - dimethyldithiophosphate spray was applied from an elevation of about 35 feet above ground level and at swath widths of approximately 150 feet. Six
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to eight hours after treatment, the area was inspected and mortality rate of adult cereal leaf beetle estimated at approximately 40% to 50%. Twenty-four hours after treatment the area was again examined and substantially complete kill of adult cereal leaf beetles noted. In addition, substantial kills of ground beetles, lady beetles, wasps, flies and ants were observed.

EXAMPLE 3

The procedure of Example 2 was repeated in every detail except that 16 ounces of S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate in one gallon of water was applied in lieu of the undiluted, adjuvant free S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate, no kill and, therefore, no suppression of the cereal leaf beetles were observed.

In this example, the 16 ounces of S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate (diluted in water) was in the form of a 57% emulsifiable concentrate.

EXAMPLE 4

This example illustrates the suppression of mosquitoes in salt marshes.

Mosquito suppression with undiluted, adjuvant free S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate was obtained at rates of approximately 2.6 to 4.5 ounces per acre. However, prior to treatment, infestation of the area was determined by persons who entered the marshes and recorded the number of bites per minute they received. Average bites per minute amounted to 75. The marshes were then sprayed from the air, at an elevation of 125 feet above ground level, with the undiluted, adjuvant free S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate at the rates heretofore indicated. Mass median diameter of the droplets was measured between 25 and 100 microns. Twelve hours after treatment the area was again entered and the number of mosquito bites received determined. At this time it was found possible to remain in one area for as long as seven minutes before a single mosquito bite was received. Suppression of

mosquitoes in the area had thereby been achieved.

EXAMPLE 5

Suppression of cotton boll weevils is attained in the following manner:

Undiluted, adjuvant free S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate is applied to infested areas of nearly mature cotton by spraying from the air with the undiluted, adjuvant free S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate in the form of finely divided droplets at several different rates of application. To determine effective suppression, O,O-dimethyl O - p - nitrophenyl phosphorodithioate (Standard A) and O,O-dimethyl s-[4-oxo-1,2,3 - benzotriazin - 3(4H) - yl methyl] phosphorodithioate (Standard B) were employed as standards at rates known to be effective in suppressing the cotton boll weevil. These products were applied as emulsifiable concentrates in 3 gallons of water in accordance with conventional practice.

Prior to the application of either the present material or the controls, the test plots were examined and the percentage of weevil infested squares determined and recorded. Thereafter, the plots were sprayed at elevations of 35 feet for S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate and at crop level, usually from 8 to 10 feet, for the emulsifiable concentrates which were employed as the standards. Subsequent treatments were applied on a 4 to 5 day schedule and counts were made generally four days after treatment. Spraying of the emulsifiable concentrates in water at crop level is necessitated by the fact that water emulsions readily evaporate and result in ineffective application of the insecticide. It has been observed that this is the situation regardless of the particular insecticide employed. It has been further observed that no wetting or penetrating of the foliage occurs employing undiluted, adjuvant free S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate.

The results of the comparative tests are collated in Table II below.

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dicarbethoxyethyl

adjuvant

TABLE II

Insecticide Actual/Acre	Treatments Formulation	Total Acres Treated	No. of Fields	Per Cent Infested Squares				
				Pre- treatment	Days After Treatment			
					4	4	3	2
Present material ² 9 fl. oz.	Technical	46	4	34	24	17	18	12
Present material ² 14 fl. oz.	Technical	56	2	27	10	15	15	7
Present material ² 18 fl. oz.	Technical	50	5	44	26	18	15	8
Standard A ¹ (8 oz.)	E. C. ¹	32	4	27	19	16	14	16
Standard B ¹ (4 oz.)	E. C. ¹	22	3	39	24	19	20	14

¹ Applied in 3 gallons of water as an emulsifiable concentrate (E. C.).

² S-(1,2-dicarbethoxyethyl)-O,O-dimethyldithiophosphate applied as technical material.

EXAMPLE 6

The suppression of western corn rootworm is illustrated in this example following the procedure employed in Example 1.

Corn fields were sprayed with undiluted, adjuvant free S - (1,2 - dicarbethoxyethyl)-O,O - dimethyldithiophosphate through conventional aerial spray equipment provided with flat fan nozzles to provide droplets having mass median diameters between 25 and 150 microns. Application was made from an elevation of 30 to 50 feet and at swath widths

amounting to 150 feet. Prior to application random individual corn stalks throughout the test area were examined and found to be infested with an average of 25 corn rootworm beetles per stalk. The S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate was applied at from 3 to 5.5 fluid ounces per acre and 24 hours application the corn was examined for corn rootworm infestation. It was observed that 95% to 100% kill had been obtained.



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dicarbethoxyethyl

EXAMPLE 7

In this example horn flies and face flies on pastured cattle are suppressed in the following manner:

- 5 Adjuvant free S - (1,2 - dicarbethoxyethyl)-O,O - dimethyldithiophosphate was sprayed from an airplane over pasture lands in which 60 head of cattle and 13 calves were grazing. The S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate was applied as finely divided droplets of undiluted, adjuvant free material at the rate of 8 ounces per acre at an elevation of between 25 and 35 feet and at 75-foot swath widths. Prior to treatment it was determined that approximately 250 horn flies and 7 face flies per animal were present. From 2 to 55 hours after application to the pasture and animals, complete suppression of both horn flies and face flies was achieved. Seven days after treatment only 5 to 25 horn flies were in evidence.

EXAMPLE 8

- 25 Suppression of green cloverworm in field beans is illustrated by the following test wherein 9 fluid ounces of undiluted, adjuvant free S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate was applied as finely divided droplets from an airplane flying at an elevation of approximately 35 feet. Four days after application the treated areas and adjacent untreated areas were examined for green cloverworm infestation. The treated areas were found to average 8.8 worms per sweep of a net while the untreated areas 35 averaged 37.7 worms.

EXAMPLE 9

- 40 Enhanced activity and extended residual life of S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate is illustrated by the following laboratory tests wherein substantially undiluted S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate is found to be markedly superior to conventional formulations of

S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate.

Undiluted S - (1,2 - dicarbethoxyethyl)-O,O - dimethyldithiophosphate was compared with emulsifiable concentrates at graded levels. In these tests healthy Sieva lima bean plants were sprayed with the undiluted product having a mass median diameter between 25 and 150 microns and either S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate as a 57% emulsifiable concentrate diluted with sufficient water to obtain a 4.75% product, or technical S - (1,2 - dicarbethoxyethyl)-O,O - dimethyldithiophosphate diluted with either an aromatic solvent or triethyl phosphate to obtain a 6% product, the products being applied at sufficient levels to produce 2.5, 5.0 or 10 milligrams of actual S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate per square foot. The sprayed plants were then placed in constant temperature and humidity chambers and maintained for 16 days. Sample leaves were taken at various intervals and placed in Petri dishes with 10 third instar southern armyworm larvae. The Petri dishes were then placed on a bench in a controlled temperature and humidity room and examined 48 hours later. It was noted that leaves placed in the Petri dishes with the armyworm larvae 2 days after treatment with the emulsifiable concentrate were ravaged, for instance, by the larvae, but the leaves treated with the undiluted, adjuvant free product were not damaged. Leaves taken on the fourth day after treatment and placed in Petri dishes with third instar southern armyworm larvae produced even more dramatic results. Such results appear in Table III below. It can be seen that poor or no suppression (i.e., % undamaged leaf area) was achieved with the emulsifiable concentrate at 2.5, 5.0 or 10 milligrams per square foot of product, whereas substantially complete suppression was achieved with the undiluted product at even the lowest rate, 2.5 milligrams per square foot.

TABLE III

Laboratory Test Showing Residual Suppression of Southern Armyworm with Technical and Formulated S-(1,2-Dicarbethoxyethyl)-O,O-Dimethyldithiophosphate

Formulation	Rate of Actual Product* (mg./sq. ft.)	% Suppression after Treatment				
		2	4	8	16 days	
Product*, technical	2-1/2	94	99	74	55	
	5	98	98	87	60	
	10	100	100	95	—	
Product*, 57% E. C., diluted to 4-3/4% with water	2-1/2	15	0	0	—	
	5	63	0	0	—	
	10	73	0	0	—	
Product*, technical, diluted to 6% with Panazol AN-2K (aromatic solvent)	2-1/2	0	0	0	—	
	5	0	0	0	—	
Product*, technical diluted to 6% with triethyl phosphate	4	35	0	0	—	
	10	93	33	0	—	

* S-(1,2-dicarbethoxyethyl)-O,O-dimethyldithiophosphate.

It can be seen from the data presented above that the emulsifiable product diluted with water and the technical product diluted with the aromatic solvent and triethyl phosphate are markedly inferior to the undiluted technical product.

EXAMPLE 10

Extended residual activity of the undiluted, adjuvant free S-(1,2-dicarbethoxyethyl)-O,O-dimethyldithiophosphate is established by the following tests wherein a composition

containing 40 ounces of S-(1,2-dicarb-ethoxyethyl)-O,O-dimethyldithiophosphate (actual) applied as a 57% emulsifiable concentrate in 3 gallons of water was compared with a composition containing 9 ounces of undiluted, adjuvant free S-(1,2-dicarb-ethoxyethyl)-O,O-dimethyldithiophosphate applied as such. In the tests a small airplane applied the test materials to substantially mature cotton fields from an elevation of approximately 35 feet. Following application leaves from cotton plants in each of the

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5 fields were collected, taken to the laboratory, and daily analyzed for the presence of S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate. When it was determined that only 12-1/2 parts per million of S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate remained on the leaves, analysis

was terminated. The results of the analyses are tabulated below and from these it can be seen that the product applied as an emulsifiable concentrate degraded to about 12-1/2 ppm in 4 days, whereas the undiluted, adjuvant free product degraded to essentially the same level in about 9 days.

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TABLE IV

40 oz. product* actual applied as 57% E. C. in 3 gals. of water		9 ounces undiluted, adjuvant free product*	
Parts per million	Hours	Parts per million	Hours
190	0	220	0
96	24	140	28
38	48	120	56
16	96	69	109
		Approx. 12.5	220

* S-(1,2-dicarbethoxyethyl)-O,O-dimethyldithiophosphate.

20 Advantageously, there is a substantial saving to be had in applying undiluted, adjuvant free S - (1,2 - dicarbethoxyethyl) - O,O-dimethyldithiophosphate under most conditions existing in the field. Marked savings result from the elimination of solvents, carriers and other diluents as well as in avoiding cost

attributable to mixing, transportation, and storage. A comparison between the application of undiluted, adjuvant free product and the conventional application of the product at rates which will produce equivalent insect suppression is sufficiently summarized in Table V below.

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succinctly



TABLE V

Low Volume Concentrate Vs. Conventional Aerial Spray to treat 1200 acres (i.e., 0.5 mile in width and 3.75 miles in length).

	Undiluted, Adjuvant Free Product*	Conventional Application of Product*
Application rate/acre	8 fl. oz.	12.5 to 20.4 fl. oz. product* in 3 gal. of water
Effective swath	100 feet	35 feet
Speed	100 mph	100 mph
Load carried per trip	75 gallons	135 gallons
Total Time Required for Treatment (in minutes)	166	666
Ferrying Time: 6 miles round trip (in minutes)	4	97
Spraying and Turning Time (in minutes)	159	453
Loading Time (in minutes)	3	116
Ferry distance, round trip	6 miles	6 miles
Trips required	1	27
Acres treated per load	1200	45
Acres treated per hour	432	108

* S-(1,2-dicarbethoxyethyl)-O,O-dimethyldithiophosphate.

From the data presented above, it is critical in the practice of the invention to utilize distinct droplets of S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate which remain as such on an applied surface without wetting or penetrating the same. As described herein, S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate is employed substantially in its undiluted, adjuvant free form. Of course, any grade of S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate can be employed and tolerated herein, provided that impurities including foreign elements of whatever nature which may be present, do not deduce the surface tension or increase the wetting properties of the S-(1,2-dicarbethoxyethyl) - O,O- dimethyldithiophosphate as applied and contemplated.

WHAT WE CLAIM IS:—

1. A method for suppressing insects and protecting plants against insect attack, which

comprises applying to an area subject to insect infestation technical S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate in its substantially undiluted, adjuvant free form as discrete droplets, whereby it remains as droplets without wetting or penetrating the surface area.

2. A method according to claim 1, wherein the S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate is applied to said surface area at a rate of from 2 ounces to about 16 ounces per acre.

3. A method according to claim 1 or 2, which comprises applying discrete droplets having a mass median diameter between 25 and 150 microns.

4. A method according to claim 1 for suppressing insects and protecting plants against insect attack, substantially as hereinbefore described with reference to the Examples.



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TABLE V

Low Volume Concentrate Vs. Conventional Aerial Spray to treat 1200 acres (i.e., 0.5 mile in width and 3.75 miles in length).

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Application rate/acre	8 fl. oz.	12.5 to 20.4 fl. oz. product* in 3 gal. of water
Effective swath	100 feet	35 feet
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Load carried per trip	75 gallons	135 gallons
Total Time Required for Treatment (in minutes)	166	666
Ferrying Time: 6 miles round trip (in minutes)	4	97
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Loading Time (in minutes)	3	116
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Acres treated per load	1200	45
Acres treated per hour	432	108

* S-(1,2-dicarbethoxyethyl)-O,O-dimethyldithiophosphate.

From the data presented above, it is critical in the practice of the invention to utilize distinct droplets of S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate which remain as such on an applied surface without wetting or penetrating the same. As described herein, S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate is employed substantially in its undiluted, adjuvant free form. Of course, any grade of S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate can be employed and tolerated herein, provided that impurities including foreign elements of whatever nature which may be present, do not deduce the surface tension or increase the wetting properties of the S-(1,2-dicarbethoxyethyl) - O,O - dimethyldithiophosphate as applied and contemplated.

20 WHAT WE CLAIM IS:—

1. A method for suppressing insects and protecting plants against insect attack, which

comprises applying to an area subject to insect infestation technical S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate in its substantially undiluted, adjuvant free form as discrete droplets, whereby it remains as droplets without wetting or penetrating the surface area. 25

2. A method according to claim 1, wherein the S - (1,2 - dicarbethoxyethyl) - O,O - dimethyldithiophosphate is applied to said surface area at a rate of from 2 ounces to about 16 ounces per acre. 30

3. A method according to claim 1 or 2, which comprises applying discrete droplets having a mass median diameter between 25 and 150 microns. 35

4. A method according to claim 1 for suppressing insects and protecting plants against insect attack, substantially as hereinbefore described with reference to the Examples. 40



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