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INSECTICIDAL COMPOSITION COMPRISING NICOTINE SULFATE AND 4,4'-DICHLORODIPHENYL SULFIDE

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2 Claims. (Cl. 167—30)

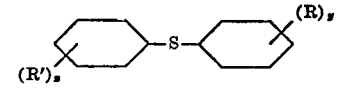
(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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This application is made under the act of March 3, 1883, as amended by the act of April 30, 1928, and the invention herein described, if patented in any country, may be manufactured and used by or for the Government of the United States of America for governmental purposes throughout the world without the payment to us of any royalty thereon.

This invention relates to insecticides. It particularly relates to synergistic additaments for nicotine, nicotine salts, and other nicotine complexes and compounds, which make it possible to attain the same or higher degree of toxicity with substantially smaller amounts of active ingredients.

We have found that synergistic insecticidal action results when insecticidal compounds are used in conjunction with aromatic sulfides as synergists therefor. Thus, synergistic insecticidal action results when an insecticidal composition containing nicotine or a nicotine compound as an active ingredient is used in conjunction with an organic sulfide in which the sulfur atom is linked to identical or to different aromatic hydrocarbon radicals free from substituents other than halogen. Suitable aromatic sulfides include for instance compounds corresponding to the general formula:



wherein R and R' are alkyl radicals, or halogen, for example, chlorine or bromine and X and Y each represent zero or a small integer such as, 1, 2, 3, 4, or 5.

This invention is illustrated by the following tabulated experimental data obtained by using insecticidal compositions comprising nicotine sulfate, as an example of an insecticidal agent, and 4,4' - dichlorodiphenyl sulfide (4,4' - dichlorodiphenyl thio ether) as a synergist therefor, incorporated in an inert dust, as an illustrative carrier for these active ingredients. These data also include tests made by employing dust compositions containing nicotine sulfate alone and also containing 4,4'-dichlorodiphenyl sulfide alone. The tests were conducted on the third instar larvae of the diamondback moth by methods similar to those described by Swingle ("Laboratory procedures in studies of the chemical control of insects," Am. Assoc. Adv. Sci. 20, 82–84 [1943]).

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The individual insecticidal effects of nicotine sulfate and of 4,4'-dichlorodiphenyl sulfide, at various concentrations, are shown in Table I, following:

Table I

Nicotine Sulfate		4,4'-Dichlorodiphenyl Sulfide	
Concentration, micrograms per square centimeter	Average mortality, per cent	Concentration, micrograms per square centimeter	Average mortality, per cent
5.1	80	15.0	57
3.6	68	11.0	48
1.8	31	5.5	14

The results obtained using compositions containing nicotine sulfate in admixture with 4,4'-dichlorophenyl sulfide are shown in Table II, following:

Table II

Concentration of Active Ingredients, micrograms per square centimeter		Average Mortality
1.1 nicotine sulfate+1.1	4,4'dichlorodiphenyl sulfide	29
2.2 nicotine sulfate+2.2	do	80
3.0 nicotine sulfate+3.0	do	90

Synergistic insecticidal action resulting from the use of nicotine sulfate in conjunction with 4,4'-dichlorodiphenyl sulfide is evidenced on evaluating the data listed in Tables I and II by the method of Wadley ("The evidence required to show synergistic action of insecticides and a short cut in analysis;" ET–223, Mimeo. Pub., 1945, United States Department of Agriculture, Bureau of Entomology and Plant Quarantine).

The evaluated results thus obtained, showing that the effect of the nicotine sulfate-4,4'-dichlorodiphenyl sulfide mixtures is significantly greater than the maximum effect predictable

from separate actions of the two insecticidal agents, are indicated in Table III, following:

Table III

Nicotine Sulfate Concentration, micrograms per sq. cm.	4,4'-dichlorodiphenyl sulfide concentration micrograms per sq. cm.	Nicotine Equivalent [1]	Mortality	
			Actual	Interpolated
1.1	1.1	1.34	29	20
2.2	2.2	2.68	80	51
3.0	3.0	3.66	90	68

[1] Calculated on the basis of a 0.22 nicotine equivalent for 4,4'-dichlorodiphenyl sulfide at the dosage giving 50 percent mortality (L. D. 50).

Analogous results showing a pronounced synergistic action were obtained when various insecticidal compositions containing mixtures of nicotine, or nicotine compounds, with 4,4'-dichlorodiphenyl sulfide were tested against the armyworm, alder flea beetle, pea aphid, green dock beetle, and California oakworm. This synergistic action has been demonstrated against all insects employed as test subjects in this study.

Compounds chemically similar to 4,4'-dichlorodiphenyl sulfide, such as phenyl sulfide (diphenyl thioether), p-tolyl sulfide, 2,5-xylenyl sulfide, 4,4'-dibromophenyl sulfide, and 2,4,4'-tribromophenyl sulfide were employed in synergistic admixture with nicotine, or with nicotine salts or other nicotine compounds.

The relative proportions of active ingredients may vary within wide limits. Thus, for example, the data tabulated above show results obtained using a nicotine-4,4'-dichlorodiphenyl sulfide ratio of 1 to 1. In tests against the alder flea beetle pronounced synergistic action was observed when this ratio was about 2.5 to 1.

Synergistic action resulted when the above described aromatic sulfides or substituted aromatic sulfides were employed with nicotine, or with nicotine compounds such as nicotine sulfate, nicotine bentonite, cuprous nicotine cyanide, zinc nicotine thiocyanate, and cupric nicotinamino laurate in the manner stated above.

Insecticidal compositions containing one or more of the aromatic sulfides or substituted aromatic sulfides as the synergist can be combined with solvents, diluents and carrier media, adhesives, spreading, wetting and emulsifying agents and other similar ingredients. They may be advantageously utilized in dusts, sprays, aerosol mixtures, fumigant compositions, insecticidal coating compositions and in general applied by methods commonly used for control or eradication of insects and other pests.

The insecticidal compositions of our invention make it possible to attain the same degree of toxicity with substantially smaller amounts of active ingredients than that required under similar conditions, when analogous compositions are used which do not contain aromatic sulfides or aromatic sulfides substituted with chlorine or bromine, as synergists.

Having thus described our invention, we claim:

1. An insecticidal composition comprising nicotine sulfate and 4,4'-dichlorodiphenyl sulfide in the proportions by weight of about 1 to 2.5 parts of the sulfate to 1 of the sulfide.

2. An insecticidal composition comprising nicotine sulfate and 4,4'-dichlorodiphenyl sulfide as synergist therefor.

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