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PEST CONTROL

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This invention relates to pest control and is particularly directed to methods and compositions adapted to enhance and improve the applications of insecticides and fungicides to foliage and fruit.

In the application of various types of insecticides and fungicides to plant foliage and fruit for the control of agricultural pests success is largely determined by the characteristics of the deposits obtained on the foliage and fruit. With some materials it is important to obtain high initial loads, with others it is important that the coverage be tenacious and resistant to weathering. With practically all it is important to obtain that degree of spreading action which will provide uniform coverage without excessive run-off during the spraying. These ends should be obtained without decrease in the efficiency of the insecticide or fungicide, without injury to the plant, and in the case of toxic poisons such as lead arsenate without providing coverage so tenacious as to interfere with removal from the fruit prior to marketing.

The load building supplements or adhesive generally available in the art only imperfectly accomplish these objects. Those in general use are materials of an oily nature, either true oils, such as mineral oil or fish oil, or oily fat acids such as oleic acid. These materials, however, are subject to numerous disadvantages in the manner in which they must be applied and in the effect on certain types of insecticides and fungicides and certain types of plants. In order that load building properties be exhibited these materials must be used, not as stable emulsions but as free oils or quick breaking emulsions. This leads to gumming in tank or spray line with consequent cleaning difficulties. In addition to this defect, oily materials are limited in use to certain trees and certain spray materials because of the phytocidal action occurring with oils, particularly in combination with sulfur and some organic insecticides. A third disadvantage of oil supplements is their tendency to fix lead arsenate and cryolite so tightly that washing to tolerance limits becomes impossible if they are employed throughout the season.

I have now found that by incorporating in the dispersed phase of an agricultural spray suspension a minor proportion of an aliphatic amine containing at least eight carbon atoms, improved flocculation, load-building and spreading properties, enhanced tenacity or like desirable characteristics may be obtained. By choice of an amine combination adapted to the particular

character of the insecticide or fungicide I am able to avoid the disadvantages of the prior art. I am able to obtain improved coverage in regard to load building, retention and spreading. These results I believe are intimately associated with the cationic character of the amine.

Amines, including both the free amines and the amine salts, vary in their dispersibility in water from molecular dispersibility to micellar dispersibility, to particle dispersibility. Those amines having at least eight carbon atoms will have either micellar or particle dispersibility, since their true water solubility is so slight as to have virtually no molecular dispersibility. It is with these types of dispersibility that the invention is particularly concerned. The free amines usually form particle dispersions whereas the amine salts commonly form micellar dispersions, though in many cases particle dispersions.

The free liquid amines disperse readily with agitation. The solid free amines are more difficult to disperse but disperse readily when associated with a suitable dispersing agent. For reasons which will subsequently appear such dispersing agents must be cationic. Amine salts which are readily water-soluble give micellar dispersions. Those which are not give dispersions more like the solid amines and may require a suitable cationic dispersing agent.

The amines to which this invention is directed are all characterized by a tendency to form positively charged dispersions. The tendency varies naturally with the nature of the amine and may be strengthened whenever desired by means of a suitable cationic dispersing agent. It is essential to this invention that the adhesive agent be so constituted as to contain both the amine having at least eight carbon atoms and a cationic dispersing agent, but it will be understood that in some cases, as with the water-soluble amine salts and with some of the liquid amines, the amine itself provides the requirement for cationic dispersing agents.

When an amine of the character described is incorporated in the disperse phase of the agricultural spray suspension the particles of that suspension are caused to flocculate, thus placing the spray suspension in a suitable physical condition for building up proper loads on foliage and fruit. Without proper flocculation the particles of this invention would remain dispersed and excessive run-off would result. The same agent which effects the flocculation, namely, the amine, also acts as the adhesive which tends to fix the particles of the insecticide or fungicide to

the foliage or fruit. The free amines, being water-insoluble, generally provide better tenacity, that is, resistance to rainfall, so the water-insoluble amine salts may be expected to function in a like manner.

The advantages of my invention are most pronounced in connection with a hydrophylic material such as lead arsenate, which tends to form negatively charged dispersions. When the positively charged particles of an amine are incorporated in such a dispersion the lead arsenate particles in the spray droplets, apparently under the influence of the positively charged amine particles, are brought to the surface of the droplet and there are readily transferred to the surface of the foliage or fruit and held there by the adhesive nature of the amine. Excellent retention is thus obtained and enhanced tenacity and resistance to weathering result.

The advantages of my invention, however, are obtained in a large measure with materials, such as phenothiazine, which are hydrophobic. When the amine is incorporated in the dispersed phase of spray suspensions of such materials flocculation is obtained. This, coupled with the adhesive character of the amine accomplishes the general purpose of the invention.

Thus the combinations of this invention provide highly versatile adhesives for use in agricultural spray suspensions. Typical compositions and suitable methods of application are illustrated in the following examples, in which the parts are by weight:

Example 1

A crude free stearylamine consisting principally of free n-octadecylamine and free n-hexadecylamine with small amounts of free di-n-octadecylamine is treated with sufficient glacial acetic acid to provide a mixture equivalent to 25 parts crude stearylamine acetate and 75 parts crude free stearylamine. Water is then added with constant kneading until a homogeneous mass containing 10% solids is obtained. The process is carried out at room temperature or at slightly higher temperatures, for example, 40-50° C. 0.02 per cent of blood albumin is included in the water of the paste to make it more fluid.

The product is slightly gelatinous and fluid enough to pour readily from a container. It disperses easily in water with slight agitation. In use it may be mixed first with the dry insecticide or fungicide before it is added to the spray tank, or the paste may be added first to the spray tank and the insecticide added while agitation is in progress. It has the following composition:

	Per cent
Crude free stearylamine.....	7.5
Crude stearylamine acetate.....	2.5
Blood albumin.....	0.02
Water	89.98

When this product is incorporated in the amount of 1 pint per 100 gallons in a lead arsenate spray suspension containing 3 pounds of lead arsenate per 100 gallons by either of the two procedures mentioned above, i. e., by pasting with the dry insecticide and a little water and adding the mixture to the spray tank or by adding directly to the partially filled spray tank either before or after the addition of the insecticide or fungicide, the coverage obtained is a combined blotch and film type coverage. When lime is included in the proportions of 3-5 pounds

per 100 gallons, as is customary, the coverage is smooth and heavy and wholly of the film type.

Example 2

Another suitable composition contains:

	Per cent
Crude free stearylamine.....	2.0
Crude stearylamine acetate.....	2.5
Crude stearylamine oleate.....	5.5
Water	90.0

It is obtained by adding acetic acid and oleic acid to crude free stearylamine as required to give the above proportions and adding the required water with constant kneading at room temperature. This composition displays the same load building character as that of Example 1 but produces a film type coverage even without the addition of lime.

The compositions of Examples 1 and 2 are merely illustrative and variations in proportions and constituency and in method of preparation may be made without departing from the invention. In place of the crude free stearylamine may be substituted any solid, free, aliphatic amine or any water-insoluble, aliphatic amine salt, or mixture of the two. In place of the crude stearylamine acetate may be substituted a water-soluble salt of an aliphatic amine having at least eight carbon atoms. The blood albumin may be omitted or replaced by other colloidal dispersing agents such as egg albumin or gelatin. A suitable formulation may be as follows:

	Per cent
Solid water-insoluble aliphatic amine.....	2-20
Water-soluble aliphatic amine salt having at least 8 carbon atoms.....	2-10
Colloidal dispersing agent.....	0-1
Water	Balance

This range is intended to include a paste of as much as 31% solids, e. g., 20% amine, 10% amine salt and 1% dispersing agent. Such a product would be usable but of a viscosity such that it would not pour from a container. Scooped out and added to the tank, it would disperse all right.

My invention is not limited in the respects enumerated above, however, and the general formula merely represents a preferred embodiment of the invention. Thus, in the broader aspects of my invention I may use any aliphatic amine having at least eight carbon atoms, it being understood, however, that the liquid amines are not so desirable because of their greater toxicity to foliage and that the water-soluble amine salts are not so desirable because of their lowered resistance to weathering. In place of the water-soluble amine salts I may use other cationic dispersing agents such as cetyl pyridinium bromide and like quaternary ammonium compounds. I may also use other dispersing agents to modify the character of the paste. Excessive quantities of anionic dispersing agents must be avoided, however, since these materials tend to destroy the ability of the amine to flocculate the spray suspension. In the broader aspects of the invention the proportions also may be varied.

While I have disclosed my invention with reference to particular materials it will be understood that the invention is not limited thereto and that various materials may be chosen according to the principles of the invention as outlined above and as set forth hereinafter.

Any amine having physical characteristics commensurate with the objects to be obtained may be used, and since the physical characteristics of

the amines rather than the chemical characteristics are utilized in my invention those skilled in the art, following the principles herein outlined, will be enabled to make suitable selections within the spirit and scope of the invention. The physical characteristics which are most desirable and significant are found in those amines which are solid and water-insoluble. These physical characteristics characterize those amines which have a long aliphatic chain and are free of solubilizing groups and shorter chain aliphatic amines which have insolubilizing groups. Those skilled in the art having these principles and the objects and purposes of the invention in mind will be able to select suitable amines of the preferred type. While it is not possible to draw any general specifications of the structure of such amines it nevertheless can be said that the most desirable characteristics are significantly characteristic of those aliphatic free amines in which the amino substituents are selected from the class consisting of hydrogen and hydrocarbon radicals and which have more than 12 carbon atoms in a single hydrocarbon group.

While the solid water-insoluble amines possess unique advantages the invention is not limited thereto and I have observed the characteristics of my invention, in some degree at least, with diamyl amine, octyl amine, lauryl amine, n-hexadecyl amine, n-octadecyl amine, di-octyl amine, di-octadecyl amine, crude stearyl amine and both water-soluble and water-insoluble amine salts thereof. Unsaturated amines such as n-octadecenyl amine are also suitable but are less desirable because of frothing tendencies and in general any aliphatic amine having at least 8 carbon atoms.

Having reference both to foliage tolerance and adhesiveness, maximum efficiency is obtained with those amines which contain more than 12 carbon atoms. Short chain amines appear to be the least desirable and, conversely, the amines having at least one long chain, especially the primary and secondary amines appear to be the most desirable. Similarly, water-soluble amines appear less desirable than water-insoluble amines and the amine salts less desirable than the free amines.

In place of acetic acid I may employ any acid which produces a water-soluble amine. Suitable examples include formic, acetic, hydrochloric adipic, and tannic. Other acids may be em-

ployed to produce water-insoluble amine salts. Thus oleic, stearic, abietic and like high molecular weight organic acids or phosphotungstic, fluosilicic, chlorostannic and like high molecular and complex inorganic acids may be employed.

By the term "water-soluble" I mean to include those compounds which, like soap, dissolve in micellar dispersions and by the term "water-insoluble" I mean to include those that do not but which must be dispersed with the aid of a dispersing agent. The term "amine," unless appearing in the name of a compound or unless otherwise qualified, is intended to include both the salt and the free amine. When I speak of an amine having a designated number of carbon atoms it will be understood that I refer to carbon atoms which are in linear sequence with the amino group. The term "suspension" is to be understood to refer to a soliquid, that is, a dispersion of solid in a liquid.

I claim:

1. A pest control adhesive composition comprising a water-insoluble aliphatic amine containing at least 8 carbon atoms in linear chain with the amino group and a cationic dispersing agent.

2. A pest control adhesive composition comprising a water-insoluble solid free aliphatic amine and a water-soluble aliphatic amine salt containing at least 8 carbon atoms in linear chain with the amino group together with sufficient water to form a paste.

3. A pest control adhesive composition having the following composition:

	Per cent
35 Solid water-insoluble aliphatic amine.....	2-20
Water-soluble aliphatic amine salt having at least 8 carbon atoms in linear chain with the amino group.....	1-10
Colloidal dispersing agent.....	0- 1
40 Water, substantially the balance.	

4. A pest control adhesive composition having the following composition:

	Per cent
45 Solid water-insoluble aliphatic amine.....	2-20
Water-soluble aliphatic amine salt having at least 8 and not more than 18 carbon atoms in linear chain with the amino group	1-10
Colloidal dispersing agent.....	0- 1
50 Water, substantially the balance.	

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