A New Experimental Acaricide and Aphicide

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Holcomb Compound *326* is a new experimental agricultural chemical developed at the J. I. Holcomb Research Laboratories in Indianapolis early in October of 1952. The material is chemically named Diethyldithiocarbamic phosphorodithioic anhydrosulfide *O*, *O*-diisopropyl ester. Compound *326* is compatible with most of the commonly used insecticides with the exception of strongly alkaline materials such as Bordeaux mixture, lime-sulphur and hydrated lime.

Compound *326* has shown no foliage injury to date when applied at the rate of 2 pounds of 25% wettable powder per 100 gallons, to a variety of greenhouse and ornamental plants, and to fruit, vegetable and field crops. Some phytotoxicity, exhibited by chlorotic spots and marginal leaf burn, has been noticed during the course of evaluating numerous experimental emulsions, however none of the injury can be attributed to *326*, but is due to the use of certain emulsifiers and solvents. Entirely safe emulsifiable concentrates can be prepared with *326* but many formulations must be made to select materials that are not only safe, but also effective and economical.

The mammalian toxicity of *326* indicates that it is slightly less toxic than DDT. The acute oral LD_{50} of *326* in propylene glycol to white Swiss mice is 290 mg/Kg of body weight and 320 mg/Kg to white rats. Rats fed 1/10th of the acute oral dosage daily for six weeks showed no damage to the heart, liver or kidneys when sacrificed. Preliminary tests with isolated strips of turtle heart and rabbit intestine failed to indicate cholinesterase inhibition. Quantitative tests to be conducted in the future may indicate that *326* is a weak inhibitor, however it is not unlikely that it doesn't inhibit as a number of organo-phosphorus materials do not have anti-esterase properties. As cited by Metcalf (1948), tetraethylpyrophosphate is an active esterase inhibitor and triethylphosphate is inactive.

Greenhouse foliage immersion tests at the Holcomb laboratories against the two-spotted mite, *Tetranychus bimaculatus* Harvey, indicate that the material is effective against mites in all stages of development including quiescent phases. Good control of adult mites is obtained at dilutions as low as 0.007% and good control of eggs at 0.015%. In contrast, greenhouse spray tests yield 100% adult mite mortality at 0.03% concentration and 90% egg mortality at the same level. A concentration of 0.06% yields 100% mortality to all stages of mites. From the information just given one can see a considerable difference in the data produced by the two methods but each plays an important part in biological evaluations. Our initial screening test on new compounds employs the foliage immersion method in order to be certain that no material that might show promise is missed because of faulty formulation or impure chemicals. Follow-up tests are conducted with materials that show promise in the immersion test, using spray equipment that produces data more nearly related to data that one might expect to accumulate from field experimentation.

Ovicidal evaluations using 2 pounds of 25% wettable powder per 100 gallons have shown 75 to 100% kill of two-spotted and Atlantic spider mite eggs, *Tetranychus atlanticus* McG., and 2½ pounds has given 85 to 100% kill of European red mite eggs, *Metatetranychus ulmi* (Koch). Tests against eggs of the pear psylla and Mexican bean beetle showed very little promise with greater than 90% of the eggs remaining viable after treatment with the two pound dilution.

In addition to two-spotted, Atlantic and European red mites, *326* has also shown promise against the clover mite, *Bryobia praetiosa* Koch, and citrus red mite, *Paratetranychus citri* (McG.). Compound *326* has given good control of the melon aphid, *Aphis gossypii* Glover; pale chrysanthemum aphid, *Rhopalosiphum rufomaculatum* (Wilson); black chrysanthemum aphid, *Macrosiphum sanborni* Gil.; potato aphid, *Macrosiphum solanifolii* (Ashm.); and the Spiraea aphid, *Aphis spiraecola* Patch. The material has also shown considerable promise against the greenhouse thrips. *326* is apparently not effective against the Mexican bean beetle, eggplant flea beetle, potato flea beetle, imported cabbageworm, cross-striped cabbageworm, striped and spotted cucumber beetles, tomato and tobacco hornworms, southern armyworm, pear psylla, house fly or German roaches.

In greenhouse and field studies *326* has displayed a short residual action which demands that thorough application of spray materials is necessary to achieve good control. *326* affords very little protection against a mite buildup three days after application, however due to *326's* quick killing power and ovicidal properties, one application so reduces the total population that a second application 10 days later kills mites hatched from surviving eggs before oviposition takes place.

In an attempt to explain the short residual action of Compound *326*, three 10 gram samples of technical *326* were exposed in open 3 inch petri dishes under four 36 watt long wave ultra violet bulbs for two, four and six hours. Another 10 gram sample was held in an open 3 inch petri dish but was not exposed to ultra violet light. The materials were not agitated during the exposure period but were examined at intervals to check for changes in color and odor. Before formulation the untreated sample was clear and had the characteristic odor of *326*; the sample exposed to ultra violet for two hours was very slightly clouded in appearance with no detectable change in odor; the sample exposed for four hours was greatly clouded and the intensity of its odor was greatly reduced and after six hours exposure the material was nearly opaque and almost odorless. Even though there were significant changes in appearance and odor, biological tests with the treated samples failed to show any significant difference in toxicity to mites over the untreated sample.

Preliminary tests of *326* for systemic activity have failed to show that the material is systemic, however it is possible that further tests may reveal that at least some of the material is absorbed and either degraded by enzymatic action or diluted in the plant so that it is not toxic to feeding mites. As *326* is apparently stable to light, heat and moisture it is difficult to account for its short residual action. With the development of a satisfactory method of analysis it will be much easier to determine the limiting factors and define the effects of the limiting forces on residual deposits.

The results of field evaluations during the 1953 season indicate that *326* will effectively control two-spotted and European red mites when the 25% wettable powder is applied at the rate of 2 to 2½ pounds per 100 gallons of spray material.

Among the fifteen state and federal experiment stations cooperating in the field evaluation of Compound *326* during the 1953 season, grateful acknowledgment is made to the Purdue University Agricultural Experiment Station, Lafayette, Indiana, and to the U. S. D. A., B. E. P. Q., Fruit Insect Research Division, Vincennes, Indiana. Grateful acknowledgment is also extended to the Department of Pharmacology, Butler University, Indianapolis, Indiana, for their mammalian toxicological studies.

Literature Cited

METCALF, R. L. 1948. The Mode of Action of Organic Insecticides. National Research Council.