How Parathion Aerosol Works

Report of Research of Dr. J. R. Hoffman, Roses, Inc. Fellowship, at Cornell*

Precision experiments with a range of parathion dosages showed that the optimum dosage of parathion for control of the spider mite on roses is around 1 gram of the technical material of 95% purity per 1,000 cubic feet. This is approximately the dosage that has been recommended in the use of a 10% parathion aerosol at a dosage of 1 pound to 50,000 cubic feet. Very little increase in kill was obtained by increasing the dosage twice this amount. When the dosage was reduced to one-half, the initial kill of active stages remained fairly high (around 90%). However, the kill of hatching larvae was greatly reduced and the kill at the end of 7 days had dropped to 60% of the population.

10% Formula Most Effective and Economical

Dr. Floyd F. Smith and his co-workers reported increased unit effectiveness of HETP and TEPP aerosols by reducing the percentage in the aerosol formula. In other words, a formula containing 5% HETP and 95% methyl chloride was more effective per gram of HETP used than a 10% HETP formula. This increase in effectiveness was attributed to smaller aerosol particles resulting with the 5% formula. Mr. Hoffman's experiments indicate that this is not the case with parathion aerosol. The kill obtained with a 5% parathion formula was about the same as the kill obtained with the same dosage of actual parathion applied in the form of a 10% aerosol. This means that a 5% parathion aerosol would have to be used at double the dosage of a 10% aerosol to give the same degree of control. This would greatly increase the cost for methyl chloride propellant without any compensating advantage.

Little Difference in Particle Size Between 5% and 10% Parathion Aerosol

Because of the importance attached to aerosol particle size in relation to effectiveness and possibly plant safety, Mr. Hoffman conducted experiments to determine the relative range of particle sizes obtained with 5% as compared with a 10% parathion aerosol formula. He found very little difference in the aerosol particle size obtained with the two different concentrations. The mass mean diameter of parathion particles from the 5% aerosol was 6 microns, and with the 10% aerosol about 7 microns. A micron is one twenty-five thousandth of an inch. These and other experiments indicate that the gas pressure in the aerosol bomb is more important in determining particle size than the percentage of parathion in the aerosol formula. Small particle size can be most readily obtained by warming the aerosol bomb before use, but it should not be warmed to more than 100°F.

Vapor Concentration and Fumigation Effect

Experiments were conducted to determine the concentration of parathion vapor in the air of the greenhouse during and following parathion aerosol treatments, also to determine the importance of the fumigation effect of parathion vapor in control of the mites.

Analysis showed that even during the first half hour after release of the parathion aerosol the concentration of parathion vapor in the air of the greenhouse was below the saturation point, and that it dropped sharply during a 6-hour period with the ventilators closed following application. During this period, the vapor concentration was sufficient to give a rather high kill of active stages of the mites by fumigation. This was checked by comparison with laboratory experiments in an air flow fumigation apparatus. However, the fumigation effect was not sufficient to account for nearly all of the kill of active stages obtained with parathion aerosol treatments.

Analyses made during a 2½ hour period with ventilators closed, 24 hours following the application, showed a very low vapor concentration, and a corresponding low fumigation kill of mites on untreated plants which were introduced into the greenhouse during this period.

By 48 hours after the aerosol application the vapor concentration was too low to be detected by the method used and practically no fumigation kill was obtained of untreated mites confined in the enclosed greenhouse for a 2½ hour period. This indicates that the residual killing effect against hatching larvae involves something beside fumigation effect.

The very low concentrations of parathion vapor found in the air of the greenhouse indicate that there is little or no danger of ill effects to greenhouse workers from the vapors following ventilation after the initial fumigation period.

Aerosol Deposits on Upper Side of Leaves

Since the above experiments indicated that the deposit of parathion on the foliage was

* A summary prepared by Dr. W. E. Blauvelt of research on the action of parathion aerosols, carried on by Dr. J. R. Hoffman, under the Roses, Incorporated Fellowship, for pest control on greenhouse roses at Cornell. Dr. Hoffman received his Ph.D. degree from Cornell University in June 1949 and is now on the staff of the Department of Entomology, Michigan Agricultural Station, East Lansing, Michigan.

important in killing the mites, experiments were conducted to determine the location of this deposit. Great difficulties were encountered in attempting to get accurate chemical analyses that would show the relative deposits on the upper and lower surfaces of the leaves. Finally a method was devised of determining this visually by incorporating a highly fluorescent material in the aerosol insecticide and examining the treated foliage by means of ultra violet light. By this means it was determined that almost all of the insecticide deposit from aerosol treatment is on the upper side of the leaf.

Kill Through Leaf Penetration

Since it had previously been determined that the fumigation effect of parathion aerosols was insufficient to account for all of the very high kill of mites obtained, experiments were undertaken to determine how the parathion deposit on the upper surface of the leaf could kill the mites on the lower surface with little or no opportunity for direct contact. By means of long tubes sealed against the leaf surfaces, mites on the under surface of the leaves were protected from any possible fumigation effect of the material through the air and from any direct contact with the deposit. It was discovered that application of parathion to the upper surface could give a 100% kill of active stages of the mites on the lower surface of the leaves entirely by action through the leaf itself. Since it was determined that parathion vapor would not penetrate through the leaf, it was apparent that the liquid parathion deposit itself was absorbed into the leaf, and acted either as a stomach poison or by some other means. Only mites on leaves that were directly treated were affected, indicating that the material is not translocated within the plant to any great extent.

In other experiments, infested rose leaves which were exposed to the fumigation effects of a parathion aerosol treatment, but which were protected from a deposit of the material on the upper surface by means of lead foil coverings, showed much lower kills of the active stages of the mites than unprotected leaves which also received the aerosol deposit on the upper surface.

Analyses of Parathion Residue on Rose Foliage

Large numbers of chemical analyses of parathion deposits on rose leaves have been made by Mr. Hoffman at various intervals after parathion aerosol applications. The purpose of these analyses was (1) to determine the duration of the deposit in relation to residual effectiveness against hatching mites and insects, and (2) to determine whether there is enough parathion deposited on the leaf surfaces to make them dangerous for workers to handle.

The analyses showed that in general about 50% of the deposit was lost in the first three days or so after an application and 75% in a week's time. The deposit completely disappeared in about three weeks' time. Loss of the residue occurred both by vaporization of the deposit and by plant absorption and breakdown. Loss was more rapid in hot weather than in cool weather and on exposed foliage as compared with protected foliage on the inside of the benches. The deposit was sufficiently great for residual killing of hatching mites and for continued insect control for a week or more following the application.

It was concluded that the parathion residue on the foliage of aerosol treated plants was not great enough to be a hazard to the greenhouse workers handling the plants or to the people sorting, packing, or otherwise handling the cut.

No Parathion Build-up in Soil

A large number of analyses have been made by Mr. Hoffman to determine the parathion residue in soil in aerosol treated greenhouses. These analyses show that most of the parathion residue is lost from the soil in about three weeks' time and that there is no accumulative build-up of parathion in the soil from a regular schedule of treatments made at approximately one month intervals. Included in these analyses are houses which have been under regular parathion aerosol treatment for nearly two years. It was felt that this work was very important to determine definitely whether there was any possibility of accumulation of the material in the soil that might eventually prove harmful to the plants. The results show that there definitely is not. Roses have been found to tolerate an application as high as 32 pounds of actual technical parathion per acre in a single application. This is as much parathion as would be applied in aerosol form in rose houses in a three-years' time, even if it all reached the soil and remained there.

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Your Editor,

Kenneth Post