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Parathion Aerosol For Greenhouse Pest Control

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The new insecticide known as Parathion or Thiophos 3422 shows promise of being the most important material yet discovered for greenhouse pest control, based on extensive experiments carried on by the writers over the past seven months. Applied by the speedy, convenient aerosol method it has proved superior to the HETP aerosol for red spider mite control on roses and other crops; and highly effective against aphids, thrips, mealy bugs, white fly, broad mite, cyclamen mite (on exposed surfaces), greenhouse leaf tyer, rose leaf roller, tussock moth and woolly bear caterpillars on roses, cockroaches, greenhouse millipeds, sowbugs and pillbugs - in fact every pest against which it has so far been tested. It can also be used effectively in either spray or dust form on both greenhouse and field-grown florist crops. It has so far shown a good margin of safety from plant injury at effective dosages on roses, chrysanthemums, carnations, gardenias, snapdragons, and a wide range of other florist crops. Although Parathion is a highly poisonous material and must be handled with great care, it can be used safely if proper precautions are followed.

A WARTIME DISCOVERY

Parathion, as an insecticide, was discovered by chemists and entomologists of the I. G. Farbin Corp. in Germany during the war, as a result of preparing and testing over 300 phosphorus compounds, following earlier work on phosphorus - fluorine compounds for war gases. They called the material E-605.

Information on E-605 as well as many other materials being investigated as insecticides was picked up by both American and British science teams sent into Germany immediately after the war. The information was made available in this country through special reports published by the Department of Commerce. The German reports contained little information on E-605 to indicate that the material would be of any great importance as an insecticide and it was actually stated that the material was not effective against red spider mites.

The American Cyanamid and Chemical Corp. has pioneered in the development and testing of Parathion (E-605) in the United States. They adopted the trade name of Thiophos 3422 for their product. During the past season they have produced and supplied a considerable quantity of the material for experimental purposes. Experiments with this material by over thirty-five State and Federal Experiment Stations have shown that it is highly effective against a very wide range of insects and promising for control of many pests of agricultural crops. The company expects to be able to make the material available commercially early in 1948 and have indicated that they plan to sell the technical grade material to other insecticide manufacturers for making into sprays and dusts, and into aerosol form for greenhouse use. Several other American chemical companies are experimenting with the manufacture of Parathion and expect to produce it commercially.

Applied by the speedy, convenient aerosol method, Parathion is outstanding in effectiveness and plant safety.

Chemically, Parathion is O,O-diethyl O-p-nitrophenyl thiophosphate, spoken as diethyl paranitrophenyl thiophosphate. Because the chemical name is long and unwieldy, Parathion (pronounced Para-thigh-own) was selected as the approved common name for this compound. Along with the name Parathion and the chemical name, insecticide manufacturers will use various registered trade names such as Thiophos 3422 of the American Cyanamid and Chemical Corp. to designate their particular products.

SEVEN MONTHS' EXPERIMENTS

Experimental work with Parathion for control of greenhouse pests was started by the writers in May 1947 at the time samples of the material first became available. The early experiments showed such great promise that most of the available time and funds have been devoted to an intensive program of research with this material for the past seven months. The work has been financed in part by the new State appropriation for research on florist problems obtained through the efforts of the New York State Flower Growers Inc. and in part by the research Fellowships provided by Roses Incorporated and by the New York Florists' Club.

In addition to many experiments made in the small Insectary greenhouses at the College to determine the effectiveness and safety on various plants and to investigate the effect of different formulations, dosages, temperatures and other factors, over eighty-five commercial greenhouse treatments with Parathion aerosols have been made to date in eight ranges in various parts of the state. The greenhouses treated ranged from 60,000 to 200,000 cubic feet; and as many treatments on various pests and crops were made as the limited supplies of material would allow. The following have cooperated in these experiments: Harold Koenig, United States Cut Flower Corp.; E. S. Boerner, Jackson & Perkins; Carl Bertanzel, Wheatley Gardens; Joe Baker, Frank Baker & Sons; Morton Goldfarb, Arcadian Rose Gardens; Richard Hart and Charles Butler, George B. Hart, Inc.; Mel Dauernheim, Dauernheim Corp; and Hubbard White, White Bros. Rose Corporation.

Many trials have also been made in the experimental greenhouses of the Floriculture Department at Cornell with the cooperation of Fred Horton and Dr. Kenneth Post; and during the past several months a regular program of treatment with Parathion aerosol has been followed on all the crops grown in these houses.

AEROSOL METHOD USED

Because of the great advantage shown by the aerosol bomb in speed and convenience of application and labor saving compared with conventional spraying, most of our experimental work has been devoted to Parathion in liquefied gas aerosols, similar to the now familiar DDT and HETP aerosols.

The experimental work to date indicates that a formula of 10 per cent by weight of Parathion and 90 per cent of liquefied methyl chloride gas, used at the rate of 1 pound of the aerosol to each 50,000 cubic feet of greenhouse space, is probably the best dosage for control of resistant pests such as red spider mite, mealy bugs, and leaf rollers with few applications and considering plant safety and safety to the operators and greenhouse workers. This formula and dosage was used in most of the commercial greenhouse trials with very satisfactory results. Methyl chloride, as used also in HETP aerosols was selected in preference to Freon because of its cheapness and availability and its superior solubility for Parathion. Technical grade Thiophos 3422, a dark colored liquid, containing 94 to 98 per cent of pure Parathion supplied by the American Cyanamid and Chemical Corporation was used in all the experiments, and the aerosol mixtures were prepared by the writers.

The Parathion aerosol is applied in the same manner as the HETP aerosol, through an applicator consisting of a flexible hose, brass rod and oil burner nozzle, directing the aerosol mist into the air above the plants. Since the suggested dosage is also the same as for HETP and since both materials require the use of a gas mask and protective clothing the use of Parathion aerosol would involve no change in method of treatment.

Greatest effectiveness is obtained with temperatures of 75°F or above at the time of application and with vents kept closed for four hours, although excellent kills have been secured at temperatures as low as 65° and with vents closed for only two hours. Depending on outside temperatures, treatments have been made either at night or on cloudy or sunny days with apparently equal plant safety. Houses have frequently been left closed over night with no ventilation and the temperature allowed to drop to normal following afternoon or evening treatment with no plant injury.

The technical grade Parathion (Thiophos 3422) so far produced has a strong, disagreeable odor. However, this has not been objectionable as it disappears rapidly following application and has generally not been noticeable the day after treatment. In fact it is actually an advantage as a warning odor in case the gas mask is not functioning properly or the material has contacted the skin.

BOTH A CONTACT POISON AND FUMIGANT

Parathion has been found to act not only as a contact poison and stomach poison, but also as a fumigant. The fumigation effect has been demonstrated by placing infested leaves and plants in closed containers in which Parathion was simply allowed to vaporize or evaporate without heating. High kills of aphids and mites resulted with no contact between the material and the pests except through the Parathion vapor in the air.

Considerable evidence indicates that much of the kill obtained with Parathion aerosols is due to fumigation action, particularly during the period while the vents are kept closed following the treatment. The aerosol method of application distributes the insecticide throughout the air of the greenhouse in the form of great numbers of very tiny droplets, and thus provides ideal conditions for vaporization and resulting fumigant action. The higher the temperature the greater is the fumigation effect, since vapor concentration increases rapidly with increase in temperature. The fumigation effect is especially important with red spider mite since most of the mites are on the under side of the

leaves, while most of the deposit of aerosol particles needed for killing by contact action, settles on the upper surface.

The contact poison effect of Parathion results from absorption of the poison through the skin of the insect. Contact is either from the aerosol particles which settle directly on the body of the insect or through contact of the insect with the deposit on plant surfaces as the insect crawls about.

Unlike HETP, which loses its killing power soon after application due to chemical reaction with moisture, Parathion remains effective for a week or more both as a contact and stomach poison, and to some extent through continued fumigation effect as the material vaporizes from the plants. This continued or residual killing effect is very important in giving better control of many pests with fewer applications.

SPIDER MITE CONTROL ON ROSES

Since the common red spider mite, or two-spotted spider mite as entomologists now prefer to call it, is the most important pest of greenhouse crops and is most difficult to control on roses, much of the work was devoted to this problem.

The experimental work to date indicates that Parthion in aerosol form is the best material so far tested for control of the two spotted spider mite on roses. It has proved far more effective than the HETP or TEPP aerosol with equal or greater plant safety and has not caused any bleaching or reduction in color of the buds as frequently results from azobenzene fumigation.

The HETP aerosol, although highly effective against the active stages of the mite has little effect on the eggs or on the inactive pre-molting stages. There are three pre-molting stages during the period of development of each mite. Since the eggs and pre-molt stages greatly outnumber the active mites the kill in terms of the total population obtained by a single treatment with HETP is relatively low, and frequent applications are needed for control.

In a large number of experiments Parathion aerosols at the dosage mentioned earlier have consistently given kills of 95 to over 99 per cent of the entire population including eggs and pre-molt stages. Two treatments one to two weeks apart have given practically complete clean-up of heavy infestations. A program of single applications made at intervals of one to two months depending on temperature has kept houses completely free of the mite.

COMMERCIAL GREENHOUSE TRIALS

The first commercial trial of Parathion aerosol against spider mite on roses was made June 16 in cooperation with Harold Koenig at the United States Cut Flower Company range, Elmira, New York. Results were so promising that, as soon as sufficient material was available, five houses in the range were given over to a long-time trial program with Parthion aerosol treatments in comparison with the HETP aerosol program used in the rest of the range. Following two treatments made August 5 and 12 to start the program, Parathion applications were made September 3, October 2, November 3, and December 22. With the exception of one house which was very loose and which had received only two-thirds the standard dosage no living mites or eggs have been found in any of the Parathion treated houses since the middle of September in spite of careful search of the houses for signs of mite injury and microscopic examination of samples of from one hundred to two hundred and fifty leaves from individual houses at monthly intervals. Undoubtedly the interval between treatments could have been lengthened considerably if desired.

In October four additional houses in which rather heavy spot infestations of spider mite had built up in spite of the HETP aerosol program were included in the Parathion aerosol program and received treatments October 2, November 3 and December 22. These resulted in complete control. On December 22, six additional houses were treated, making a total of fifteen houses treated with Parathion aerosol at that time.

For satisfactory control of spider mite with HETP aerosol in the same range it was found necessary to follow closely the recommended program of four applications at three-day intervals at the start followed by treatments at one to two-week intervals depending on the temperature. Where longer intervals were tried the spider mite infestation usually built up to a point where it was necessary to repeat the schedule of four treatments at three-day intervals to get it under control again. The experience here and in the other ranges where a program of treatments has been tested indicate that Parathion aerosol gives complete control of spider mite on roses with about one-fourth the number of treatments required with HETP aerosol.

Through the cooperation of Eugene Boerner another long-time trial program on roses has been carried on in the commercial trail greenhouse of Jackson and Perkins, Newark, New York. This provided an exceptional opportunity to determine the effect of the treatment on a very wide range of rose varieties under varying seasonal weather conditions. In addition to over twenty named varieties of commercial importance the house contains around three hundred propagated trial varieties and great numbers of seedling varieties.

Parathion aerosol treatments at the "standard" dosage of one pound per 50,000 cubic feet were made August 8 and 15, September 5, October 3, and November 12. This program gave apparently complete control of spider mite, and no infestation has yet developed eight weeks after the latest application.

The following named rose varieties were represented in the commercial greenhouse trials with Parathion aerosols, most of them being present in the above long range trials: Ballet, Better Times, Briarcliff, Celebrity, Diamond Jubilee, Fantasia, Fashion, Garnet, Geranium

Red, Golden Rapture, Goldilocks, Hildegard, Joanna Hill, New Yorker, Peter's Briarcliff, Pink Bountiful, Pink Delight, Pinnochio, Red Pearl, Serenade, Starlight, Talisman, and Yellow Gloria.

PLANT SAFETY ON ROSES

It is still too early to draw final conclusions on the safety of Parathion aerosols to greenhouse roses under all conditions. Roses are notoriously subject to such a variety of effects from insecticides and other factors and these effects are so greatly influenced by cultural practices and weather conditions that a year or more of extensive commercial usuage as well as careful experimentation under controlled conditions is necessary to tell the whole story with any new material.

However, the experience to date is very encouraging from the long time trials and a total of over seventy-five commercial rose greenhouse treatments, There has been no injury to soft growth with the exception of two instances of moderate tipburn and crinkling of young leaves of a few varieties, notably Diamond Jubilee and Garnet, which may well have been due to vaporized sulfur rather than the Parathion. Some yellowing and dropping of mature leaves has occurred fairly commonly and equally with both Parathion and HETP aerosols in the same ranges, mainly on older plants. Most of this is believed to be natural ripening of older leaves. Indications are that both materials tend to increase leaf drop somewhat when plants are in a susceptible contion from other causes. A moderately heavy drop of yellowed leaves occurred on Garnet, Better Times, and Briarcliff with both materials during a period of excessively hot, sunny weather following treatments in August.

Production and quality has been excellent in the experimental rose greenhouse at Cornell which has been under Parathion aerosol treatment for the past five months, as well as the Jackson and Perkins trial greenhouse and other houses under treatment. In the most extensive long-time trial at the United States Cut Flower range, production was equally good with both Parathion and HETP aerosols and has been the highest ever obtained for the range.

So far Parathion aerosol treatment has given no hormone-type of bud injury such as has occurred with HETP sprays and to a lesser degree with HETP aerosols during the cloudy, short-day conditions of late fall and winter. At the United States Cut Flower range small numbers of such buds appeared in November and December in houses receiving HETP aerosol treatments but not in the Parathion treated houses.

CONTROLS MANY OTHER ROSE PESTS

Parathion aerosol has given practically complete kills of the common pink and green rose aphid and other species of aphids occurring on roses. It has given excellent aphid control with even the widely-spaced treatments used in the long-time trial program for red spider mite.

This program has also given excellent control of the onion thrips which is the species commonly injuring buds of greenhouse roses.

Leaf Roller

The rose leaf roller, known by the scientific Latin name Sparganothis flavidana, is another major pest of greenhouse roses against which Parathion has been found highly effective. Although there are many species of leaf rollers reported as injuring greenhouse roses, the flavidana species now appears to be the most common and serious one, and is very destructive to developing shoots and buds. It has proved highly resistant to DDT and HETP as well as to lead arsenate and benzene hexachloride. Much of the experimental work on this pest was done by Mr. Wilfred P. Hathaway on the New York Florists' Club Fellowship in Entomology at Cornell and will be reported in more detail later.

The principal experiment on control of this pest was made in cooperation with Carl Bertanzel, Wheatley Gardens, Long Island, New York. Two houses of 150,000 cubic feet each, one of which was heavily infested were treated. Two applications of Parathion aerosol, July 1 and 15, gave nearly a complete cleanup. A few newly-hatched larvae were found in spots in late August and a third application was made August 23. The three treatments completely eradicated the pest so far as could be determined. The first application killed practically 100 per cent of the larvae worms of all ages together with the moths and some of the eggs. Most of the larvae died within 24 to 48 hours after the treatment. (The inactive pupae in tightly rolled leaves were not killed.)

A single treatment in a 200,000 cubic foot house at the Arcadian Rose Gardens in August at a somewhat lower dosage also gave a nearly complete kill of leaf roller larvae and moths.

Roaches and Other Pests

Parathion aerosol as well as spray applications have proved highly effective against the dark colored Surinum cockroach which girdles the stems of the plants in many rose houses. Single applications of Parathion aerosol in several greenhouse experiments in different commercial ranges have given as high as 95 per cent kill of the roaches in 24 to 48 hours and around 99 per cent at the end of a week. Eggs in the soil are not killed, but where treatments have been made at monthly intervals or longer the pest has been practically eliminated. Parathion was also highly effective against the large brown American roach present in some houses.

Parathion aerosol was also given nearly complete kills of a variety of pests present in the rose greenhouses including sowbugs and pillbugs, millipeds, crickets, tussock moth and yellow wooly bear caterpillars, spiders, manure flies and fungus gnats, and ants. It killed all Japanese beetles present at the time of treatment and those flying in for a

week or more following.

PROMISING ON
CHRYSANTHEMUMS AND CARNATIONS

Parathion aerosol is very effective against many of the pests attacking chrysanthemums and it is safe on the wide range of varieties grown. In addition to the red or two-spotted spider mite, it has proved very effective against the black chrysanthemum aphid, the common and very resistant green chrysanthemum aphid (R. rufomaculatum), another green aphid (Anuraphis helicrysi) suspected of spreading the new and serious stunt disease, the chrysanthemum thrips, the onion thrips which injure the growing tips, the greenhouse leaf tyer, and the Mexican mealybug, as well as the broad mite, the cyclamen mite, and other pests mentioned here and sometimes serious on chrysanthemums.

Repeated applications of Parathion aerosol were made without injury to foliage, buds, or blooms of twenty-six varieties of chrysanthemums and pompons. These were in all stages of development in two 30,000 cubic foot greenhouses devoted to experiments on year-around production at the College. Six treatments with the material have been made to date under various seasonal weather conditions, and since new plantings are made at monthly intervals each treatment has included a range of development from recently planted cuttings of flowering plants. The following varieties were present in these experiments including Nevada which is quite subject to injury from HETP sprays and aerosol: Albatross, Apricot Valencia, Arcadia, Barcarole, Brocade, Cassandra, Dark Pink Orchid Queen, Detroit News, Golden Jane, Goldsmith, Good News, Indianoplis Bronze, Indianapolis White, Indianapolis Yellow, Lakme, Linda Lou, Matchless, Marie Depetris, Marketeer, Nevada, October Rose, Pinocchio, Silver Sheen, Sunnyside, Vesper and White Mensa.

On carnations Parathion aerosol has given excellent control of spider mite with fewer treatments than are required with HETP aerosol, It has also been highly effective again against aphids and the onion thrips attacking the buds. Repeated applications have caused no injury to foliage or crop on the varieties Northland and Virginia Rose in the Floriculture greenhouses. No injury resulted from a single treatment made in a commercial greenhouse containing the varieties King Cardinal, Olivette, Virginia Rose, Pelargonium and Millers Yellow. More extensive commercial trials on a greater range of varieties are planned for the near future.

CONTROLS MEALY BUGS AND OTHER PESTS

Parathion aerosol has proved highly effective against mealy bugs which are very resistant to most insecticides. In an experiment at Cornell a moderate infestation of mealy bug on Melior Begonias was completely eliminated by two applications spaced two weeks apart and the plants have remained clean for over three months without further treatment. An experiment in control of the common citrus mealy bug on Gardenias is being made at the George B. Hart range, Fairport, New York in cooperation with Richard Hart and Charles Butler. The house is 160,000 cubic feet capacity. The plants had become heavily infested with mealy bugs in spite of weekly treatments with HETP aerosol. Two applications of Parathion aerosol on December 9 and 17 have so far resulted in over 99 per cent clean up of the entire population. The first application killed over 85 per cent of the mealy bugs of all ages within one week after the treatment. Those not killed were older mealy bugs that were protected by heavy masses of wax and were located under bud scales and other protection. Although the eggs were not killed the young mealy bugs were killed soon after hatching by the insecticide residue. Additional treatments will be made as required for a long time control program.

Promising results have been obtained with preliminary tests of Parathion aerosols against a number of other greenhouse pests but much more research is needed on these. It has given high kills of the broad mite and the cyclamen mite on exposed surfaces of plants but apparently not those inside rather tight buds It also appears promising against various species of scale insects on ferns, pot oranges, palms, and various other plants subject to these pests.

SAFETY TO PLANTS

Our experience has been very encouraging as to the safety of Parathion aerosol to a wide variety of plants. No injury has resulted to any of the following common florist crops treated with the "standard" formula and dosage as previously given with the exception of possibly some increase of normal leaf drop on roses as discussed earlier:- Agerstum, Asparagus plumosa, Azalea (Indicas, Kurumes and others), Begonia (semperflorens, Rex and tuberous kinds), Boston fern, Chrysanthemum, Calla, Calceolaria, Calendula, Camellia, Carnation, Centaurea, Cineraria, Coleus, Cyclamen, Dracaena, Ervatamia, Euphorbia, Fuchsia Geranium, Hydrangea, Iris, Ivy, Kalanchoe, Lily, Narcissi, Orchid, Ornithogalum, Oxypetalum, Peperomia, Philodendron, Poinsettia, Primula, Saintpaulia, Snapdragons, Vinca and Zinnia. Many additional plants often grown by florists are included in the conservatory list below.

Through the cooperation of Russell Mott of the Floriculture Department, Parathion aerosol treatments were made to the Cornell collection of orchids and in the department conservatory containing a wide range of ornamental plant material. No injury of any kind was noted on any of the plants from the treatments.

The orchid collection contains many representative species and hybrids of all the principal groups of orchids including Cattleya Coelogyne, Cymbidium, Cypripedium, Dendrobium, Odontoglossum, Oncidium, Phalaenopsis and Vanda.

The conservatory collection contained a large range of genera and species of ornamental plants, of which the following list gives only the genera grown to a considerable ex-

tent commercially, and omitting ones already listed above. In most instances there were a number of representative species of each genus. Abutilon, Acalypha, Adiantum, Agave, Aglaonema, Aloe, Alsophila, Amaryllis, Anthericum, Anthurium, Araucaria, Ardisia, Asclepias, Asplenium ferns, Aucuba, Beloperone, Blechnum, Bromeliaceae, Bougainvillea, Cibotium, Cissus, Citrus (Otaheite orange), Clivia, Cocos palms, Colocasia, Crassula, Croton, Davallia fern, Dieffenbachia, Echeveria, Eucharis, Ficus, Gasteria, Haworthia, Hibiscus, Howea palms, Hymenocallis, Impatiens, Ixora, Jasminum, Kleinia, Mesembryanthemum, Oleander, Oplismenus, Osmanthus, Oxalis, Passiflora, Pellaea ferns, Phlebodium, Phoenix palms, Platycerium ferns, Plumbago, Pomegranate, Pteris ferns, Ruellia, Sansevieria, Sedums, Selaginella, Smithiantha, Spathiphyllum, Stapelia, Stenotaphrum, Stephanotis, Strelitzia, Strobilanthes, Tradescantia.

SAFETY TO MAN

In its great effectiveness against most greenhouse pests and in safety to plants Parathion appears to be a nearly ideal insecticide for greenhouse pest control. The principal question in connection with its use is that of safety to man. The experiments with laboratory animals have shown that Parathion is a highly poisonous material and must be handled with great care. Recent experiments with rabbits made by the U. S. Public Health service indicate that it may be twice as poisonous as HETP while other work showed about the same toxicity for the two materials. Much additional work is under way on this matter and will be reported later. Like HETP the material is absorbed through the skin and rubber gloves should be worn when handling the material. In making aerosol applications the operator must wear an approved type of gas mask such as the Industrial Full Vision Gas Mask made by the Mines Safety Appliance Company, or similar Army or Navy gas masks, with GMC-1 or GMA cannisters as used with HETP, together with protective clothing and hat. Any material spilled on the skin should immediately be washed off with soap and water.

From the experience so far, indications are good that Parathion like HETP can be used quite safely for greenhouse aerosol treatment if proper precautions are followed. Neither the writers nor any of the growers who have helped in applying the material in commercial greenhouse trials have experienced any ill effects from the material; nor has there been any indication of ill effects to the men working in the treated houses from the temporary residue or deposit of material left on the plants. No ill-effects from applying rather large amounts of Parathion sprays and dusts to orchards and field crops have been reported by 65 entomologists in 40 states who worked experimentally with the material in 1947.

Much additional research is needed to determine more definitely the safety limits of greenhouse use of Parathion aerosols through analysis of deposits on the plants, determination of Parathion vapor concentration in greenhouse air, and effect on laboratory animals exposed to various concentrations of Parathion aerosols and kept in treated houses. Work along these lines is being carcarr on by the United States Bureau of Entomology, by the manufacturers, and by the writers at Cornell and will be continued.

PARATHION AEROSOL NOT YET AVAILABLE

Present indications are that Parathion in aerosol form will probably not be available for grower use for some months. Production of technical grade Parathion (Thiophos 3422) by the American Cyanamid and Chemical Corporation is still limited to a small "pilot plant" and is not even sufficient to supply the extensive experimental requirements. The company hopes to be in position to start commercial scale production by March but has already contracted for the entire first year's supply to various insecticide companies who plan to make it up into wettable spray powders and dusts for agricultural use. Several other chemical companies are experimenting with production of Parathion but it is likely to be some time before they can produce it commercially.

Before Parathion aerosol bombs can be produced commercially for sale to growers, the formula must be approved by the United States Bureau of Entomology which holds "public service" patents covering the liquefied gas aerosol method which they developed and regulate in the public interest. Dr. Floyd F. Smith, entomologist and Dr. R. A. Fulton, chemist of the Bureau of Entomology who developed the DDT and HETP greenhouse aerosols, have also been experimenting with Parathion aerosols for greenhouse pest control with very encouraging results as to effectiveness and plant safety. The prospects appear good for Bureau approval of commercial Parathion aerosol production as soon as sufficient additional information is obtained on the matter of safety to man, as discussed earlier.

SPRAYS AND OTHER METHODS

Although most of the research carried on by the writer has been devoted to aerosol use of Parathion because of the speed, convenience, and labor saving advantages of this method, preliminary experiments indicate that it can be used with equal effectiveness and plant safety in the form of sprays and dusts. A report on this work and suggestions on dosages, etc. will be given in a future issue of the Bulletin.

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GERANIUMS IN A HURRY

1. Take no leaves from the cutting.
2. Use vermiculite for rooting.
3. Keep the rooting media wet.
4. Pot direct to 4-inch pots by March 15.
5. Root at 65° grow at 60°.
6. Keep the soil wet.