Station Circular of
Information No. 436

September
1948

CONTROL OF COMMON INSECT PESTS OF INDOOR PLANTS

by

R. G. Rosenstiel,
Assistant Entomologist

AGRICULTURAL EXPERIMENT STATION
Oregon State College
Wm. A. Schoenfeld, Director
Corvallis

AGRICULTURAL EXPERIMENT STATION
Oregon State College
Wm. A. Schoenfeld, Director
Corvallis

Circular of Information No. 436 September 1948

CONTROL OF COMMON INSECT PESTS OF INDOOR PLANTS

by
R. G. Rosenstiel, Assistant Entomologist

INTRODUCTION

Both the commercial flower grower and the home owner who raises potted house plants have a continuous problem in trying to protect their plants from the injurious action of various insects. In this circular recent studies in control of some of our pests are discussed as a progress report which summarizes two seasons of experimental work with new insecticides on our most common indoor plants. In subsequent years control methods will change as better insecticides and control methods are worked out. More research on greenhouse plant insect pest control is needed so that Oregon growers can be furnished with the most economical control measures.

PRECAUTIONS WITH NEW INSECTICIDES

PLANT INJURY

New insecticides have recently received considerable publicity and many of them appear promising. Plant owners would be wise to try any new insecticidal material on a very few plants and observe them for possible plant injury for at least a week or two before treating their whole stock. The use of separate spray cans or dusters for the application of herbicides (weed killers) and insecticides is good practice as even traces of some herbicides may severely injure valuable plants.

HEALTH HAZARDS

There is very little really reliable information to date about the effect on the human body of frequent or continuous exposure to these newer chemicals. Until we know more about the dangers involved in applying new insecticides we should consider them all to be very poisonous and use precautions accordingly.

Wash off concentrated insecticides immediately if you spill some accidentally on your skin. Do not take any insecticide into your mouth; remove clothing that becomes soaked with unfamiliar insecticides because some of them are absorbed through the skin. Respirators or other devices

to keep dusts or sprays out of the nose are somewhat troublesome to wear, but they do prevent excessive accumulation of chemicals on the delicate membranes of the nose. Respirators should be worn wherever a possibility of danger exists in a chemical application procedure.

Secure storage places for insecticides should be provided to prevent accidents to children or animals. Avoid excessive exposure to chemicals, particularly in closed houses. Plan work so that the house will not have to be reentered until possible danger is past. Where possible at least two people should work together in order to speed up the operation and help each other in emergencies. In case an insecticide handler feels faint, dizzy, sick, or has an unusual headache or any other abnormal feeling, he should stop at once and get out to fresh air and assistance. A doctor should be consulted if there are any severe or recurrent abnormal feelings.

AVOID USING NEW CHEMICALS ON EDIBLE PLANTS

Where new insecticides are mentioned in the following pages they are not suggested for use on any edible plant. As information regarding the health hazard of new insecticides on food plants is obtained it will be made available from the Experiment Station. The manufacurer's recommendations on the insecticide container should be carefully studied as special handling or other precautions may be necessary with various brands of new insecticides.

COMMON INDOOR PLANT PESTS AND CONTROL SUGGESTIONS

TWO-SPOTTED MITE (RED SPIDER) CONTROL

Minute greenish-yellow spider mites, commonly called "red spiders," cause annual losses of thousands of dollars to greenhouse operators when they are not controlled. They should not be serious in houses where regular inspection and good control practices are followed. The two-spotted mite is about a fiftieth of an inch long and has a large blackish spot on each side. These mites are generally found on the under side of the leaves where they spin a fine silken webbing that is difficult to penetrate with insecticides. The pale yellow spherical eggs are deposited on the leaves and the tiny spiders have only six legs when they hatch. By the time they are fully grown they have four pairs of legs and can run rapidly across their feeding grounds. Under favorable conditions a generation may be produced in about four weeks. Both nymphs and adults injure plants by sucking out the cell contents. This action causes the plant to wither away and eventually the leaves turn brown and the plant dies.

One of the principal control practices of value against this mite is frequent examination of the leaves with a good hand lens that magnifies 10 to 14 times. After the average person has observed a known infestation of two-spotted mites with a hand lens he should be able to intercept the early stages of an infestation. This mite is fairly easy to control at the beginning of an outbreak but is difficult

after it becomes widespread and has spun a tangled labyrinth of silken strands over its feeding places. In control measures special efforts should be made to contact the bottom of the leaves with force sufficient to penetrate the silken webbing.

The best chemical to date for controlling the mite is Parathion[1], which should be on the market in 1948. Dust containing one quarter of a percent of the active Parathion gave reliable control. Spray was effective when one pound of the 15 percent powdered concentrate was used in 100 gallons of water. This chemical kills most of the eggs and inactive mites as well as the active ones. At these dosages it has shown residual toxicity to the mites for about two weeks under greenhouse conditions. The non-alkaline wetting agent "B-1956" or "Dreft" added to the spray at the rate of four ounces per 100 gallons would increase the chances of contacting well established infestations.

Alkaline hand or laundry soap should not be used as a wetting agent with insecticides mentioned in this circular except nicotine.

Another chemical that may be used in controlling two-spotted mites is commonly called HETP. This is another powerful new organic insecticide containing tetra ethyl pyro phosphate (TEPP), which is the main active ingredient. It may be used effectively at the rate of one pint of the 50 percent liquid concentrate to 100 gallons of water. HETP begins to break down chemically as soon as it is put into water, so the spray should be applied immediately after it is mixed.

Used at the above dosage HETP remained reasonably effective for an hour in greenhouse tests on the two-spotted mite. It seems to have no effect on the mite eggs so it must be used every 4 to 6 days in a severe infestation and should be repeated several times in even a light infestation. The addition of B-1956 or some other good non-alkaline wetting agent to the spray will increase the efficiency of the control.

Another chemical which greenhouse operators may use on hardy plants is DN-111, another powerful organic chemical. It will "burn" some plants so it should be tried out first on a few plants of each kind and observations made for plant injury for 10 days to two weeks before many plants are treated. When used at one pound per 100 gallons of water DN-111 gave good residual control for at least 15 days. A non-alkaline wetting agent increased the efficiency of the chemical by assisting in penetration of the silken webbing.

---

[1]Note - brief discussion of special characteristics of each chemical mentioned, plant tolerance, and a dilution table may be found at the end of this circular.

GREENHOUSE APHID CONTROL

Growers of delicate indoor plants often find small, green, black or pale yellow insects which they may call "plant lice" sucking the vital plant sap from their cherished flowers. A few aphids would not be serious but unfortunately for the grower the aphids generally are all females and they lay living young aphids. That means that they may increase greatly in numbers in a few days if conditions are favorable. Aphids have six delicate legs and two "feelers" on their heads. Their body is generally globular and 1/16 to 1/8 inch in length. Their life histories are often complex, and at some stage the aphids generally have wings and can fly to new plant "pastures."

Aphids vary in habits but most of them may be found on plant stems, beneath leaves, or on tender terminal tips of their host. They injure the plants by sucking out the cell sap which devitalizes the host and causes it to wilt, turn yellow, and may kill it. Flowers infested with aphids make poor growth and produce small blooms that are sometimes not salable.

The efficient grower who examines his plants frequently and carefully will generally notice the beginning of an aphid infestation and often he can stop their spread by treating only a few plants. Aphids are sucking insects so insecticides must be used on them which kill by contact. Stomach poisons like lead arsenate would be of no value against aphids.

Parathion was found in greenhouse tests to be quite effective against pea aphids, black bean aphids, grain aphids, and green peach aphids. One-half pound of the 15 percent Parathion concentrate in 100 gallons of water or one-eighth of a percent dust were very effective in controlling the mentioned aphids. The length of time that the chemical residue remains effective in the case of Parathion was not worked out for aphids but the growers would not need to repeat the treatment until the infestation started up again.

Nicotine sulfate is very effective against aphids at 1 pint of 40 percent nicotine sulfate concentrate to 100 gallons of water.[1] Part of the toxic effect of nicotine depends on the nicotine vapor or gas which is released when the nicotine comes in contact with alkaline chemicals.[2] Soap generally is alkaline and also a good wetting agent. It activates the nicotine and assists in contacting the waxy surface of

---

[1]For dilution data see - Spray and dust dilution table at the end of this circular.

[2]See the section - Special characteristics of certain insecticides - for notes on nicotine.

the bodies of the aphids. A recurved or "gooseneck" nozzle will assist the applicator in directing the spray upward from beneath the plant so that the under sides of the leaves are thoroughly treated.

One of the newer chemicals, HETP, is effective against aphids if the aphids are "wetted" by the spray. This chemical was used effectively on aphids at one pint of the 50 percent concentrate in 100 gallons of water. Precautions about prompt spray use with HETP have been mentioned under two-spotted mite control. HETP has shown some superiority over nicotine when used at low wintertime temperatures. It is effective in laboratory tests at temperatures as low as 40° F.

MEALY BUG CONTROL METHODS

Growers who see the familiar cottony white mass of mealy bug infestation on their plants are up against one of the most difficult insects to control that they are apt to encounter in greenhouses. The "cotton" over the body of this pest is really a mass of waxen rods which prevent most sprays from contacting the insect. Constant vigilance in detecting these insects and treating as soon as they appear is good practice and should pay dividends in "clean," attractive plants. The eggs of mealy bugs are laid in masses of 300 to 400 in egg sacs and are covered with a mass of wax by the female. The eggs hatch in about 10 to 20 days and the young mealy bugs crawl away and start to suck out the plant juice and soon produce a wax covering over their bodies. The egg masses are particularly hard to eliminate and are the main reason for repeating the treatments mentioned below. The body of the mealy bug is generally light yellow and the adult females are about a quarter of an inch long. The adults do not move around much although they can crawl for short distances. Mealy bugs like to feed in crevices, leaf axils and on new growth.

After mealy bugs are sprayed the operator should wait for about 12 to 15 days and then spray the plants vigorously again. In a severe infestation a third application may be necessary to kill the young mealy bugs as they hatch and leave their protective egg sac.

Parathion spray used at 1 pound of the 15 percent concentrate in 100 gallons of water has effectively controlled the mealy bug. In these tests the sprays were applied forcefully enough to penetrate the wax threads and were repeated to control the young bugs. Wetting agents such as "B-1956" or "Dreft" should be used at the rate of eight ounces per 100 gallons in mealy bug sprays to assist in wetting the insect.

The chemicals known as thiocyanates are quite effective in controlling mealy bugs in greenhouses but unfortunately they may cause some foliage injury to tender plants. "Lethane 60" is one of the thiocyanates designed for maximum greenhouse insect toxicity and minimum plant injury. This material contains 50 percent thiocyanate and 50 percent refined oil. It is effective when used at one pint of stock concentrate in 100 gallons of water. In severe infestations "Lethane 60" could be used at one pint to 600 gallons of water but this dosage may cause

foliage injury to some plants. A non-alkaline wetting agent may be added to this spray to promote wetting. Thiocyanates should be tried out on a few plants for at least 10 days, especially in warm weather, and any plant injury observed before a large number of plants are treated.

CONTROL OF GREENHOUSE WHITEFLIES

Small snow-white four-winged insects that fly up from beneath shaken plants in greenhouses are probably whiteflies. They are not particular in their choice of hosts but seem to become especially numerous on geraniums, tomato plants, and tobacco plants. The adults and nymphs of the whitefly suck plant juices and may devitalize common greenhouse plants if they are present in numbers. The minute yellow eggs are elongate-oval in shape and always extend upward from the leaves. The nymphs are flat and nearly transparent and resemble scale insects except that they have waxen threads radiating from their body. The adult whitefly is about a twenty-fifth of an inch long and appears to have fine white dust on its wings.

The characteristic flight of the adult insects when they are disturbed makes it difficult to hit them with a contact insecticide. For this reason all the plants in a house should be treated at one time so that the whiteflies will have to alight on a treated leaf surface. Experience has shown insecticidal sprays containing a wetting agent to be more effective than dusts against these pests.

Parathion used at 1 pound of the 15 percent active concentrate per 100 gallons of water gave good control of whitefly for at least a month in greenhouse tests on tobacco plants. The insecticide "Lethane 440" which contained 24 percent thiocyanate and 39 percent refined petroleum oil was effective when used at two pints per 100 gallons. Lethane 60 has generally replaced the older Lethane 440 in greenhouse use. A wetting agent such as "B-1956" or "Dreft" at 4-8 ounces per 100 gallons of spray would assist in contacting the insects with the spray.

AZALEA LEAF MINER CONTROL

Larvae of the azalea leaf miner are by far the most important pests of evergreen azaleas grown in greenhouses and lath houses. Sometimes they are even serious on sheltered outdoor plants. The pretty golden tan-colored moths are 3/16 of an inch in length. Undisturbed moths hide during the day on the host foliage or beneath benches. They fly actively in daylight when the plants are shaken or sprinkled with water and may be detected in this way. Eggs are laid on the under side of the leaves and the larvae hatched from them bore directly into the leaf and form ugly blotch mines. Older larvae curl up the side or tip of the leaves and feed externally on the underneath surface. During the summer all stages of the moths may be present in greenhouses. Outdoors or in lath houses the insect overwinters as a well developed larva in a curled up leaf.

DDT used at the rate of 1 pint of the 25 percent concentrate in a refined petroleum oil per 100 gallons of water is very effective in giving control. The residual toxic effect seems to last for at least 3 to 4 weeks. Larvae apparently do not do much feeding outdoors or in lath houses until mid-March of normal years so chemical treatment outdoors should be delayed until about that time unless earlier feeding is detected. Spray containing DDT and oil has caused no injury to date to azaleas in tests and leaves no visible residue. Growers wishing to use an unfamiliar oil-DDT combination on broad-leaved evergreens should first test the chemical on a few plants. The spray should be directed upward so that the underneath sides of the leaves are thoroughly wetted.

ORANGE TORTRIX AND ITS CONTROL

The small tan-colored orange tortrix moth produces greenish "worms" with brown heads. They have been present in Oregon greenhouses for some time and are present in infested houses throughout the year. They feed on almost any greenhouse plant and sometimes damage cane fruits outdoors. The larvae tie a tender leaf or two together with silk and feed on the webbed foliage. Holes they chew in the leaves or blossoms are not desired by growers as such injury seriously reduces the salability of the plants. Eggs of this pest are laid generally on the under side of smooth leaves or on smooth plant stems. Smaller larvae are pale yellow but they change to green after they have fed for a few days.

The best control measure to date has been to spray the infested plants with 2 pounds of 50 percent concentrated wettable D-3, sometimes called "Rhothane" to 100 gal. of water. On foliage difficult to wet the addition of 6 ounces of "B-1956" or "Dreft" wetting agent to 100 gallons of water would be advisable. This material has some residual toxicity so it could be used at about 10-day intervals in severe infestations as long as needed. A dust containing 3 or 5 percent "D-3" was also effective against the tortrix. Experience has shown that DDT is not very effective against this pest.

SPECIAL CHARACTERISTICS OF CERTAIN INSECTICIDES

PARATHION

Avoid using Parathion on edible plants or on soil where edible plants will be grown until its effects on people have been worked out. This very powerful synthetic organic chemical has been recently developed in this country. It is much more toxic to warm-blooded animals than DDT. It should not be used at all in closed spaces in aerosol form (fog), according to our present knowledge. Greenhouse workers should wear respirators when applying this chemical and should walk backward away from the treated plants as they progress so that they always avoid unnecessary contact with the chemical in a spray or dust. Do not enter treated greenhouses until they have been aired out for 2 to 3 hours unless an efficient gas mask is worn. Parathion

has some fumigant action so the concentrate containers should be kept closed tightly and spilled concentrate should be cleaned up and discarded at once. The cautions mentioned under "Precautions with new insecticides" at the beginning of this circular apply to Parathion particularly because it is new and very powerful and may be taken up by plant roots to some extent.

Among the newer chemicals Parathion is outstanding in efficiency because it is effective at low concentrations on many of our most important greenhouse insect pests. The Parathion sprays mentioned in this circular leave only a barely discenible residue on plants which may easily be removed with a water spray when necessary. Numerous common greenhouse plants including Boston ferns, African violets, sweet peas, and poinsettias have been treated with Parathion sprays and dusts. No plant injury has appeared to date.

HETP (HEXAETHYL TETRA PHOSPHATE)

HETP is another new organic insecticide that should be handled cautiously. The main active ingredient is tetra ethyl pyro phosphate (TEPP). In tests it did not retain its insecticidal effect much more than an hour in the greenhouse after it had been mixed with water and agitated. This chemical has a tendency to corrode metal so the spray machine should be rinsed with water several times after each time HETP is used. Avoid storing this chemical in metal cans. Be sure the container lid fits tightly and is securely fastened when not in use.

DN-111 (DI NITRO ORTHO CYCLO HEXYL PHENOL - 20 PERCENT)

DN-111 has the drawback of injuring some of our greenhouse plants so it should be tested out carefully on a few plants before it is used on a large scale. The injury is most frequent in warm weather so this chemical should generally not be used in greenhouses during the hot summer months. DN-111 leaves a yellowish residue on plants which would sometimes be objectionable to commercial growers. At the dosage of 1/800 DN-111 spray caused slight leaf burn at 75 to 80° F. in greenhouse tests (Oct. - Dec.) as follows:

Plant	Condition	Percent Injury
Rose (Hadley)	buds present	2
Chrysanthemum	budding	none
Pansy	blooming	none
Nasturtium	blooming	none
Sweet peas	8 in. high	none

NICOTINE SULPHATE

Nicotine sulphate is not a new chemical but is still very effective against aphids when properly mixed and applied. Nicotine is commonly manufactured as a 40 percent concentrate of nicotine sulphate under various trade names. Nicotine is most effective as an insecticide when it is mixed with alkaline material such as hydrated lime, ammonia, or old-fashioned soap. Common household bar soap is generally alkaline but some of the new powdered laundry "soaps" consist of complex wetting agents that are not alkaline. When nicotine sulphate is used as a spray, a small amount of alkaline soap equivalent to the nicotine sulfate in volume should be dissolved in warm water and the dissolved soap should be poured into the water in the spray can before the nicotine sulphate is added. After the soap is stirred in the spray can, the required amount of nicotine sulphate should be added and mixed into the water. Spraying should be started immediately as the nicotine fumes will begin to form as soon as the nicotine sulphate contacts the alkaline soap solution. Nicotine sulphate spray cannot be stored efficiently after it is mixed with an alkali so surplus spray should be discarded. The best results with nicotine are obtained on warm afternoons above 70° F. when the air is still. Nicotine sulphate sprays are generally safe to use on greenhouse plants when used as suggested in this circular.

LETHANE 60 (ALIPHATIC THIOCYANATE)

Lethane 60 may cause plant injury on delicate plants. It should first be tried on a small scale before many plants are treated. The thiocyanates have some fumigant action but are mainly contact poisons. Some of the thiocyanates have injured poinsettias in the greenhouse. Lethane 60 at 1/600 slightly injured roses, burned 10 to 40 percent of young sweet pea leaves, and did not injure cyclamen or amaryllis lilies. All the treated plants recovered. The concentrate should be handled carefully as suggested for most insecticides at the beginning of this circular.

DDT IN OIL

DDT is generally obtainable on the market in mixtures containing 25 percent of DDT in a refined petroleum oil. The oil assists in spreading the DDT over the surface of the plant and insects and prolongs the residual toxicity of the DDT. This mixture does not leave a visible residue on treated plants. It should not be used more than is really needed in greenhouses because it is ineffective against most spider mites and aphids and may result in their increase. There have been reports that the mixture injured broadleaf evergreens so it should be used cautiously on those plants. It has not injured common greenhouse plants in tests to date where oil alone did not cause injury.

D-3, TRI-D OR RHOTHANE (DICHLORO DIPHENYL DICHLOROETHANE)

Rhothane has a chemical structure similar to DDT, but it is distinctly different in its effect on some insects. D-3 dust and wettable powder have not injured common greenhouse plants and should be safe to use at the dosage

mentioned under the orange tortrix discussion. A 3 and 5 percent D-3 dust is available but will seldom be used in greenhouses. If D-3 emulsion is desired it should be tried out thoroughly before it is generally applied as the solvents in the emulsion may injure plants.

SPRAY AND DUST DILUTION TABLE

The following table should assist the grower in accurately measuring his insecticides. An overdosage of some of the chemicals might cause severe plant injury. If a certain amount of insecticide is effective, it does not always hold true that more of it will increase its effectiveness. Generally such an assumption is wasteful if put into practice and may be dangerous.

Growers who use a clay pot for measuring out liquid insecticides should paint the inside of the pot with melted paraffin. The paraffin coating will prevent absorption of chemicals in the porous clay that otherwise might cause an error in measuring.

A plant grower wishing to learn how much chemical at 1/800 to use in a 3-gallon spray can should look in the left hand column of the following dilution chart until he locates the 1/800 dilution row. Then he would look beneath the figure 3 in the top row until he came to the 1/800 dilution row, where he would find that 2.8 teaspoons was the proper amount to use.

The following abbreviations have been used:

fl. oz. - fluid ounces
pt. - pint
cc. - cubic centimeter
qt. - quart
gal. - gallon
cu. in. - cubic inches
gm. - grams
tsp. - teaspoon
tbs. - tablespoon

SPRAY DILUTION CHART

Dilution	Amount of Final Spray						
	100 gal.	50 gal.	10 gal.	5 gal.	3 gal.	1 gal.	1 qt.
	Amount of chemical to use for the amount of final spray desired at the proper dilution						
1-1600	½ pt. or 8 fl. oz. or 1 cup	¼ pt. or 4 fl. oz. or 8 tbs.	23.7 cc. or 0.8 fl. oz. or 4.7 tsp.	11.8 cc. or 2.3 tsp. or 11.3 gm.	7.1 cc. or 1.4 tsp. or 6.8 gm.	2.4 cc. or 0.5 tsp. or 2.25 gm.	0.59 cc. 0.56 gm.
1-800	1 pt. or 16 fl. oz. or 2 cups	½ pt. or 8 fl. oz. or 16 tbs.	47.3 cc. or 1.6 fl. oz. or 3.2 tbs.	23.7 cc. or 4.6 tsp. or 22.6 gm.	14.2 cc. or 2.8 tsp. or 15 gm.	4.7 cc. or 0.9 tsp. or 5 gm.	1.18 cc. 1.13 gm.
1-600	1½ pt. or 24 fl. oz. or 3 cups	3/4 pt. or 12 fl. oz. or 1-½ cups	71.0 cc. or 2.4 fl. oz. or 4.8 tbs.	35.5 cc. or 6.9 tsp. or 33.9 gm.	21.3 cc. or 4.2 tsp. or 21.8 gm.	7.1 cc. or 1.4 tsp. or 7.25 gm.	1.77 cc. 1.69 gm.
1-400	2 pt. or 32 fl. oz. or 4 cups	1 pt. or 16 fl. oz. or 32 tbs.	94.6 cc. or 3.2 fl. oz. or 6.4 tbs.	47.3 cc. or 9.2 tsp. or 45.4 gm.	28.4 cc. or 5.6 tsp. or 27.2 gm.	9.5 cc. or 1.8 tsp. or 9.1 gm.	2.36 cc. 2.26 gm.

Note - 29.57 cc. = 1 fl. oz., 16 fl. oz. = 1 pt., 473 cc. = 1 pt., 2 pts. = 1 qt., 4 qts.= 1 gal. (U.S. Liquid Measure)
1 av. oz. = 28.34 gm., 16 av. oz. = 1 lb. (U. S. Avoirdupois Weight)
5 cc. = 1 tsp., 3 tsp. = 1 tbs., 2 tbs. = 1 fl. oz., 16 tbs. or 8 fl. oz. = ½ pt. or 1 cup.