CONTROL OF MITES AND APHIDS ON AND IN BULBS

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Tulip plants and flowers wilting from green aphid infestation.

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CONTROL OF MITES AND APHIDS ON AND IN BULBS

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Flowering bulbs are among the most sought after and useful plants in the home and for outdoor plantings. Many varieties are also forced in greenhouses during the winter and spring, with the peak occurring at Easter time. Most of the bulb crop is harvested free from disease, insects, and mites. Occasionally, bulbs reach the retail trade in a rotting condition. Examinations have revealed the presence of mites or aphids and sometimes both. Bacterial rot is usually found associated with the pests, resulting in partial or complete breakdown of the bulbs. Narcissus, hyacinth, scilla, crocus, tulip, amaryllis, and certain lily bulbs are among the most seriously affected by these troubles.

A considerable volume of the annual bulb crop is produced in the United States, notably in the Pacific Northwest. There is also a sizeable domestic trade in imported bulbs. Holland has always played an important role in the exportation of bulbs, and New Zealand, Japan, and Australia have now become increasingly important growing areas.

The problem of preventing injury to bulbs by disease, insects, and mites is important to growers and distributors. This bulletin reports on recent studies of chemical control measures that can be used to reduce mite and aphid infestation if required.

Previously suggested methods of control

Control methods used up to 1937 have been discussed in detail in an earlier bulletin of this Station (Garman, 1937). Techniques used included fumigants and dips. Potassium cyanide, carbon disulfide, paradichlorobenzene, and steam heat were the most commonly used fumigants. Dips included solutions of nicotine sulfate and soapy water, nicotine sulfate and formalin heated to 122°F, or heated water (Woods, 1897). The most satisfactory results were obtained with paradichlorobenzene, steam, and the heated nicotine sulfate-formalin solution. More recently, fumigation with BHC or lindane has controlled aphids in tulip bulbs (Marcussen, 1957).

Type of Damage

Mites and aphids may damage bulbs during feeding by removing nutrients and by causing wounds through which fungal and bacterial disease organisms may enter the bulb and cause decay. There is some confusion as to what comes first–the mites or the disease. Doucette (1941) believed that most of the breakdown occurring in affected bulbs was due to disease and not to the presence of mites. On the other hand, Biekart (1934) reported that the injury caused by mites created areas which were ideal for disease and that mites preferred sound rather than diseased bulbs. Hence, the movement of mites from diseased bulbs to healthy ones aids in transmitting bacteria and fungi. Bulbs lightly infested with mites may not reveal signs of infestation while growing unless accompanied by bacterial rot.

Badly infested bulbs produce weak growth. The leaves are stunted and yellowish with brown tips. Flowers may not mature. When they do, they are usually small, streaked, and off color, with short stalks. Bulbs stored or shipped at temperatures which permit mite activity may be completely ruined before planting time. Keeping bulbs at low temperatures which suppress mite feeding will reduce the severity of injury, but bulbs may still be seriously inhibited in their growth or completely ruined.

Bulbs damaged, bruised, or overheated during harvest and shipment are more susceptible to bacteria and mite troubles than uninjured ones. Bulbs kept in a warm atmosphere become more generally infested with mites and break down much faster than those held at lower temperatures. Seriously infested bulbs become soft and may be easily detected by applying a little pressure with the thumb or finger.

Biology of Bulb Mites

Although several species of mites attack bulbs, *Rhizoglyphus echinopus* (Fumouze and Robin) appears to be the most troublesome. It infests hyacinth, crocus, narcissus, tulip, Easter lily, Peruvian daffodil, amaryllis, gladiolus, and other bulbous plants. Bulbs with loose scales such as narcissus, hyacinth, and lilies are more seriously infested than those with tighter scales, such as crocus and tulips.

The minute, white, semi-transparent eggs of *R. echinopus* are laid on the surface of the bulb and also in injured and decaying tissue and between the bulb scales. They may occur singly or in groups of a few to a great many. Embryos hatch in about one week. Immature mites and adults are white in color with a faint yellowish tinge. Legs and mouth parts are brown with a pinkish hue. The mites chew their way into the bulb and roots, destroying the tissue as they advance. Brownish spots or streaks appear where injury has occurred. The time required to complete a generation from egg to adult varies from 9 days at 80°F to 27 at 60°. Female mites may live 1 to 2 months and lay as many as 100 eggs each (Garman 1937).

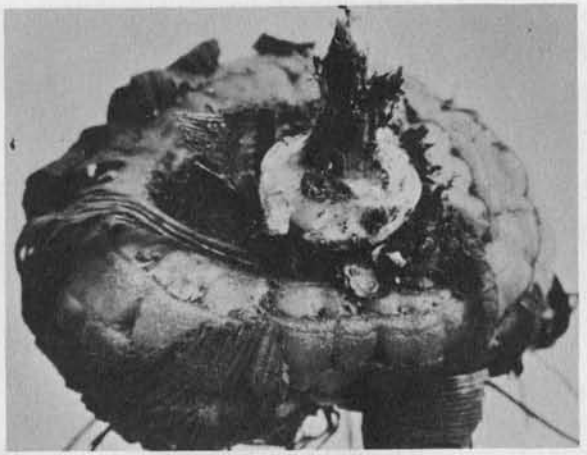

Fig. 1. Gladiolus corm infested with bulb mite.

Biology of Aphids Infesting Tulip Bulbs

Mites are not the only arthropods causing damage to bulbs. From time to time aphid infestation in domestic and foreign-grown tulip bulbs may pose a problem to distributors and customers. At least five species are known to be injurious to bulbs in Connecticut. The most common, *Dysaphis tulipal* (Fonsc.), has been collected from imported bulbs (about 1955).

The gravid wingless females of this species, present during the summer months, are fawn color to pinkish or greenish with dusky to blackish markings. The winged form has a black head and thorax with greenish or pale yellow abdomen and some blackish markings.

In addition, four species taken from tulip bulbs used in pesticide tests were identified[1] as follows: *Neomyzus circumflexus* (Buckton), the dominant species. It is yellow-green. Both the wingless and winged forms have a black spot in the middle of the upper surface of the abdomen. *N. persicae* (Sulzer) is green with only the winged form having a black spot on the upper surface of the abdomen. *Aphis fabae* Scop. is entirely black and *Acyrthosiphon solani* (Kalt.) is green. Both the wingless and winged forms have a black spot on the distal end of each antennal segment whereas only the winged form has black dashes on the dorsal area of the abdomen. The wingless form also has a dark spot at the base of each cornicle.

Material and Methods

The pesticides used in the experiments were malathion, dimefox, Dimite®, Systox®, ovex, chlorobenzilate, tetradifon (Tedion®) rotenone, schradan, and tetrasul (Aramite®).

[1] Dr. James B. Kring, Entomologist, The Conn. Agric. Expt. Sta.

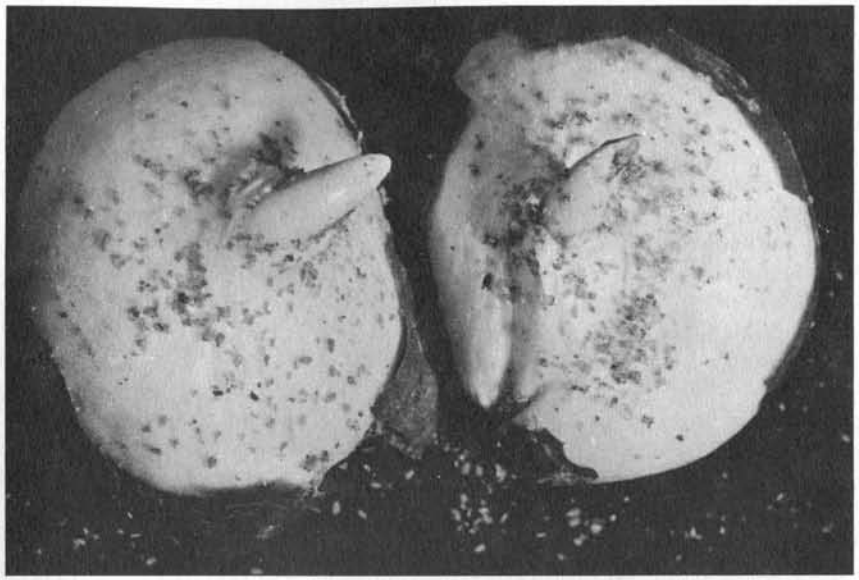

Fig. 2. Tulip bulbs infested with green aphids.

Bulbs used in the tests were of several kinds: Easter lily, narcissus including several varieties of daffodils and paper white narcissus, tulip, hyacinth, and scilla.

Treatments were applied as dips, drenches, and dusts at various stages of growth of the plants. Potted bulbs in various stages of growth were used in some of the tests. Many bulbs were soaked in or dusted with miticides before planting. Additional treatments were delayed until after the bulbs had been planted. A number of the bulbs (from soaking treatments) were planted immediately after treatment. Others were thoroughly dried beforehand. In addition, treated bulbs were planted in 4-inch clay pots and then pre-cooled at 36° to 46°F for 6 weeks to initiate root development before top growth was permitted at 75° to 85°F. Treated scilla bulbs were planted outdoors in late summer.

Mite Control in Easter Lily

The experiments discussed in this section were designed to determine (1) the effectiveness of various miticidal treatments on mite populations, and (2) the phytotoxic effects of miticides on the plants. Miticides were applied to dry and moist soil.

Moist soil treatments

The first experiment was undertaken when the lily plants were 8 to 12 inches high. Twenty bulbs growing in 5-inch pots were used in the tests. Systox® 26.2% emulsion was used as a soil drench at dilutions of

1, 2, 4, and 8 pints in 100 gallons of water. Each lily plant received 8 ounces of drench 12 hours following the last watering.

Bulbs examined 58 days later indicated no live mites in the ones treated with the three highest dilutions of Systox®. A few live ones were found in those treated with the 1-pint dilution. The level of mite infestation in the untreated checks ranged from 43 to 172 mites per bulb. The number of mites per bulb averaged 133.

Leaves on the lower one-quarter of the plants treated with Systox® at the 8-pint dilution died completely and the tips of the leaves in the center of the plants turned brown. The 4-pint treatment indicated irregular tip injury on a few of the leaves at the base of the plants. The 2-pint and 1-pint treatments caused no noticeable injury to the foliage. The leaves on the untreated checks were normal.

Dry soil treatments

A pretreatment count of mites was taken. Mites ranged from 75 to 185 with an average of 110 per bulb.

Aramite® 95%, Systox® 26.2%, schradan 40%, Dimite® 25%, ovex 25%, rotenone 80%, and chlorobenzilate 25%, emulsions were used at dilutions of 1, 2 and 4 pints in 100 gallons of water. Each dilution was applied as a soil drench at the rate of 1 ounce of solution per one inch of pot diameter. To assure rapid penetration of the treatments, soils were allowed to dry thoroughly beforehand. Watering was resumed 24 hours after treatments.

The results of the treatments appear in Table 1. Systox® was the most effective material used and gave excellent control at all concentrations tested. Most of the other materials gave good control at the two highest concentrations.

Plant injury by Systox®, schradan, and Aramite® at the 4-pint rate was noticeable 4 days after treatment. In addition varying degrees of injury appeared in most of the plants before full bloom was attained.

Table 1. Control of mites around Easter lily plants growing in dry soil[1]

Material	*Dilution in pt/100 gal*	*Live mites*	*Material*	*Dilution in pt/100 gal*	*Live mites*
Systox	1	0	Ovex	1	28
Systox	2	0	Ovex	2	8
Systox	4	0	Ovex	4	4
Schradan	1	5	Rotenone	1	36
Schradan	2	12	Rotenone	2	17
Schradan	4	0	Rotenone	4	3
Aramite	1	4	Chlorobenzilate	1	19
Aramite	2	11	Chlorobenzilate	2	2
Aramite	4	9	Chlorobenzilate	4	1
Dimite	1	33			
Dimite	2	0			
Dimite	4	0	Untreated checks		264

[1] Data obtained from 3 bulbs per rate of treatment and untreated checks.

With the exception of Dimite®, flower buds did not mature at the highest concentration of the materials. Flowers were produced by the plants at all other concentrations of the miticides. Injury may have been less serious if the soil in which the plants were growing had been thoroughly drenched with water several hours before treatment. This is borne out by the results of 1- and 2-pint treatments in the previous experiments in which Systox® was applied to moist soil.

Mite Control in Hyacinth

Many species and varieties of hyacinth bulbs are susceptible to mites. About 100 bulbs of several color varieties were sampled to determine the degree of mite infestation prior to conducting the experiments reported herein. Mites averaged 202 in a range of 72 to 552 per bulb.

The bulbs were divided into lots of 12 each and soaked in solutions of Systox® and malathion at the rate of 1 and 2 pints in 100 gallons of water. Half of the bulbs were soaked for 15 minutes and the remainder for 30 minutes. All were then allowed to dry in the sunlight for several hours before planting. Table 2 shows that Systox® was superior to malathion in controlling mites in hyacinth bulbs. The bulbs were planted outdoors in November. Most of them produced flowers the following spring, and none showed symptoms of phytotoxicity.

Mite Control in Tulip Bulbs

One hundred forty-four mite-infested Darwin tulip bulbs indicating an average of 1000 mites per bulb were soaked for 1 and 2 hours in Systox® and malathion solutions at the rate of 1 and 2 pints of material per 100 gallons of water. They were then dried for 2 weeks at 80° to 85°F. Seventy of the bulbs were dissected for control data. No live mites were found in those treated with Systox®. Malathion killed all mites at the 2-pint rate, but not at the lower one. Seriously infested and diseased bulbs rotted.

One hundred and forty-four of uninfested tulip bulbs treated with

Table 2. Control of mites in hyacinth bulbs

Material	*Dilution in pt/100 gal*	*Exposure time in minutes*	*Total number of live mites per 7 bulbs*
Systox	1	15	14
Systox	2	15	0
Systox	1	30	0
Systox	2	30	0
Malathion	1	15	50+
Malathion	2	15	75+
Malathion	1	30	50+
Malathion	2	30	75+
Untreated	....	....	861+

Systox® and malathion as stated in the preceding paragraph were planted outdoors in mid-November. All but 8 grew and flowered the following spring.

Mite Control in Daffodil

Precooled daffodil bulbs (7 weeks at 36°F) were planted in 4-inch clay pots. When 4 inches of growth had been attained at 75° to 85°F, Systox® and schradan solutions were applied as soil drenches for mite control at the rate of 5 ounces per pot. There were 12 plants per rate of treatment.

Table 3 indicates that mite control in daffodil bulbs was considerably better with a drench of Systox® than with that of schradan.

Controlling Mites in Daffodil with Dips and Dusts

Four varieties of infested daffodil bulbs were soaked in 25 W Tedion® at two concentrations for 24 and 48 hours and at several water and air temperatures. There was an average of 10 bulbs per rate of treatment. Bulbs were also treated with 25 W Tedion® used as a dust at the rate of 1 level tablespoon per 10 bulbs in 10-pound paper bags folded several times at the top and sealed with paper clips. Information relating to the treatments is given in Table 4. Four bulbs from each rate of treatment were dissected for control data, and three examined from the checks.

Table 4 shows that Tedion gave complete control of bulb mites at high temperatures. Good control was obtained at somewhat lower ones; however, mites did survive near the center of the bulbs. The time of exposure did not appear to influence control at the higher temperatures but may have been a factor at lower ones. Dusting bulbs with Tedion was ineffective.

Scilla

One hundred and sixty-eight scilla bulbs with mite infestations ranging from 74 to 1000 per bulb (352 av.) were soaked in Systox® and malathion in the same way as described under tulip. In addition to 1- and 2-hour exposure periods, 50 percent of the bulbs were soaked for 15 and 30 minutes. Half of each lot of bulbs were examined for control. The remainder were planted outdoors in November.

Table 3. Bulb mite control in daffodil

Material	*Dilution in pt/100 gal*	*Live mites per 12 bulbs*
Systox	1	143
Systox	2	105
Systox	4	7
Schradan	1	266
Schradan	2	418
Schradan	4	408
Untreated		1250

Table 4. Control of mites in daffodil bulbs with 25 W Tedion

Concentration of active Tedion in 12 gal water	Length of exposure	Temperature (°F)		Drying time	Mites		Percent kill
		Tedion solution	Air				
Lbs.	*Hours*			*Hours*	*Dead*	*Alive*	
Soaking							
⅛	24	50	90	48	609	94	86.6
⅛	48	92	112	72	1635	0	100
1/16	24	92	112	48	1286	0	100
1/16	48	92	112	72	4510	0	100
Checks						876	
Material							
Dusting							
Tedion used as dust	144		90		280	450	38.3

Good control of mites on or near the surface of the bulbs was obtained in the 15- to 30-minute tests, but almost no mites were killed in the center of the bulbs. Malathion was somewhat less effective than Systox®. Systox® killed all mites in the 1- and 2-hour tests whereas malathion was completely effective only in the 2-hour test (there were 100+ live mites per bulb in the 1-hour test). Many of the heavily infested and diseased bulbs rotted completely.

Control of Aphids Infesting Tulips

Infested bulbs of Darwin, Triumph, Crown Imperial, and La Tulipal were soaked in Systox® and malathion at dilutions of 1 and 2 pints in 100 gallons of water for 15, 30, and 60 minutes respectively. Each treatment was repeated nine times. Subsequently the bulbs were drained for 2 hours and then dried at 80° to 85°F for several weeks. A pre-treatment count of aphids on the exterior of the bulbs indicated an average of 164 in a range of 27 to 700. An average of 181 in a range of 150 to 250+ aphids was found in their interior.

Data obtained from dissected bulbs showed that with the exception of one bulb (1 pt malathion), Systox® and malathion caused complete mortality of the aphids.

Aphids and Mites in Tulip Bulbs

An additional experiment was conducted to investigate control of aphids and mites (both in the same bulbs) with 4% malathion and 3% nicotine dusts. The inside of 10-pound paper bags was dusted with 3 and 6 grams respectively of the pesticides. Twelve aphid-mite infested bulbs were put into each bag. The tops of the bags were folded three times and fastened with paper clips. The treatments were repeated several times. After 7 days exposure at 80° to 90°F the bulbs were examined for aphid and mite mortality. Data in Table 5 show that whereas good control of aphids was obtained with malathion and nicotine dusts, mites were unaffected.

Table 5. Control of aphids and mites on tulip bulbs with dusts

Treatment	Aphids		Mites	
	Dead	*Alive*	*Dead*	*Alive*
Malathion 3 gr.	231	0	4	16
Malathion 6 gr.	119	7	0	70+
Nicotine 3 gr.	93	6	75+	150+
Nicotine 6 gr.	139	0	0	4

Summary

Mites were controlled in Easter lily bulbs with Systox®. High concentrations of the material caused some injury when the soil was dry at the time of treatment. Aramite®, schradan, Dimite®, ovex, rotenone and chlorobenzilate controlled mites at the highest concentrations; however, variable foliage injury resulted.

Systox® controlled mites in tulip, daffodil, scilla, and hyacinth bulbs. Malathion was effective only at the strongest concentrations.

Good control of mites close to the surface of scilla bulbs was obtained with Systox® and malathion when the soaking period was 15 or 30 minutes. When soaking time was prolonged 1 or 2 hours all mites were killed in the center of the bulbs by Systox® but not by malathion.

Malathion and nicotine dusts gave good control of aphids on the exterior and interior of tulip bulbs. Mite control in the same bulbs was poor.

Tedion® provided complete control of mites only at the highest water and air temperatures used in the tests.

Literature Cited

Doucette, C. F. 1941. Control of insects and mites attacking narcissus bulbs. USDA Farmers Bull. 1890.

Biekart, H. M. 1934. Hyacinths for garden and home. Extension Bull. 118. N. J. Agric. Expt. Sta.

Garman, Philip. 1937. A study of the bulb mite. Conn. Agr. Expt. Sta. Bulletin 402.

Woods, A. F. 1897. USDA Div. Veg. Phy. & Path. Bull. 14.

Marcussen, K. H. 1957. Commercial tulip culture in New Zealand. New Zealand Journal of Agriculture 94 (1): 20-31.

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