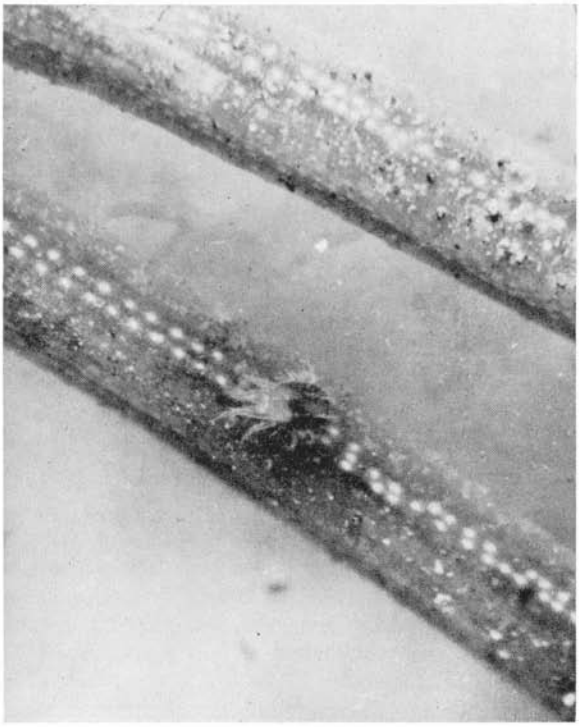
SPRUCE MITE CONTROL

by John C. Schread



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Cover illustration shows spruce mite adult on spruce needle.

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Evergreens, such as hemlock, arborvitae and spruce, as well as other types of vegetation, are frequently infested by mites. A severe infestation on the leaves causes the foliage to lose its green color and turn gray, various shades of brown, yellow or russet. When injury continues for several years, death of the plant may follow. A heavily infested plant may be more or less webbed by silk spun by the adults.

Some of the increase in mite populations on vegetation in recent years may be attributed to the use of comparatively recently developed insecticides, such as DDT. These are remarkable in their control of insects, but their use results in an increase in mites by destroying the natural enemies of the latter. Timely treatments with miticides will kill the mites, and the foliage of the treated plants will regain its normal green color if not too badly injured.

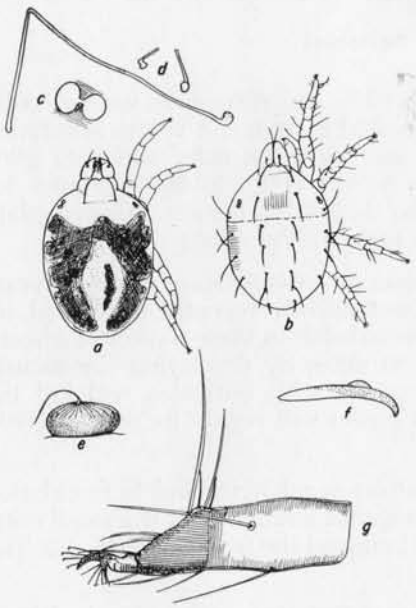
The principal mite offender on conifers in nurseries and in foundation plantings is the spruce mite, *Paratetranychus ununguis*. It is a small mite, the males being .29 to .35 millimeters long and the females .38 to .42. The eggs are .15 millimeters in diameter.

The young resemble the adults except that those newly hatched have three pairs of legs instead of four. The species overwinters in the egg stage. In most years eggs begin to hatch during late April and early May. A generation may be completed in four to five weeks in warm weather. As the growing season advances, much overlapping of generations occurs, so that all stages of the mites may be found at any one time during the late spring and summer months.

MATERIALS USED IN THE PAST TO CONTROL MITES

Miticides applied to spruce mite infestations in years past have often been of indifferent effectiveness, and considerable off-colored stock could be seen throughout the summer months in some nurseries. However, thorough spraying during the dormant season with a miscible oil, an oil emulsion or lime-sulfur has been shown to be reasonably successful in killing eggs. White summer oils, potassium sulfide and superfine dusting sulfur were used extensively until recently to destroy the young and adults during the growing season. Some success has been attained with dilute carpenter's glue at this time. Applications of dusting sulfur at 5 to 7 day intervals during the summer months have been necessary sometimes to cope with mite injury to nursery stock.

NEW MITICIDES



Spruce mite, Paratetranychus ununguis Jacobi. a. Adult female color pattern. b. Adult female, dorsal view showing spines. c. Eyes. d. Collar tracheae. e. Eggs in lateral view. f. Penis. g. Tarsus I, after German.

The recent development of new pesticides, notably the organic sulfite Aramite[1] and the organic phosphates EPN300,[2] parathion[3] and Bladex[4] (TEPP), has made available fast-acting and efficient chemicals, some of them good insecticides, which may be used for the control of mites. Tests of some of these new materials for the control of the spruce mite have been conducted, and our results are reported below.

Bladex and parathion are extremely injurious to mammals, including man, and therefore must be handled with the utmost caution. Although EPN300 is also an organic phosphate, preliminary laboratory tests reported by the manufacturer[5] indicate that it is four to eight times less toxic to humans than parathion, thus making it somewhat less hazardous to use. Aramite is relatively non-injurious to warm-blooded animals, human beings included. It may, therefore, be used with the usual precautions taken in handling insecticides. Furthermore, its toxicity to plants is extremely low. We have used all four materials in our experiments, emphasizing, however, Aramite and EPN300 for obvious reasons. Bladex and parathion, although good for the purpose of mite control, are much too hazardous for general use by inexperienced people.

Bladex and Parathion

Bladex was used at the rate of 1/2 pint and parathion 15 per cent wettable powder at the rate of 1.5 to 2 pounds per 100 gallons of water, respectively. The control of young and adult mites in each case was

1 U. S. Rubber Co., Chloroethyl butylphenoxy methyl ethyl sulfite.
2 E. I. duPont de Nemours & Co., 27% ethyl p-nitrophenyl thionobenzenephosphonate.
3 General Chemical Co., Genithion.
4 Shell Chemical Co., 20% tetraethyl pyrophosphate.
5 Haskell Laboratory of Industrial Toxicology, Service Department, Medical Div., E. I. duPont de Nemours and Co., Wilmington, Delaware.

excellent, but the eggs were not affected, and since these insecticides have little residual power, the effect was temporary. Both materials were applied by means of a "Bean Speed Sprayer" and a 3-gallon hand operated pressure sprayer.

EPN300

EPN300 27 per cent wettable powder was applied to three 30- to 35-foot Norway spruce trees in August at the rate of 1/2 pound in 5 gallons of water using a mist blower.[1] Three 5- to 6-foot evergreens (one each of hemlock, arborvitae and juniper) were sprayed at the rate of 2 level teaspoons or about 1/5 ounce per gallon of water, using a hand-operated pressure sprayer. Results of treatments appear in Table 1. Periodic sampling for mite infestation on the EPN300-treated trees was accomplished by taking a certain number of 10-inch twigs (Table 1) and counting all of the eggs and live mites present.

TABLE 1. EPN300 TREATMENTS, 27 PER CENT WETTABLE POWDER

Date Treated	Concentration	Date Examined	No. of Twigs Examined	Eggs		Young		Adults	
				Total	Per Twig	Total	Per Twig	Total	Per Twig
Aug. 8	8 oz. in 5 gals.	Aug. 14	30	137	4.5	0	0.0	0	0.0
Aug. 8	8 oz. in 5 gals.	Aug. 18	30	83	2.8	49	1.6	0	0.0
Aug. 8	Check	Aug. 18	10	97	9.7	73	7.3	31	3.1
Aug. 9	0.2 oz. in 1 gal.	Aug. 15	30	54	1.8	2	0.1	0	0.0
Aug. 9	0.2 oz. in 1 gal.	Aug. 19	30	17	0.6	19	0.6	1	0.03
Aug. 9	Check	Aug. 19	5	23	4.6	27	5.4	9	1.8

Aramite

Aramite has been used in most of our experimental work because of its comparatively long lasting qualities and low toxicity to mammals. In order to determine the comparative values of Aramite wettable powder, emulsion and dust, experiments were planned to use the three formulations on infested arborvitae.

On April 19 an examination of arborvitae nursery stock revealed the presence of many spruce mite eggs, none of which had hatched. By May 2, 25 per cent of the eggs had hatched and by May 9 about 40 per cent.

A block of trees 408 feet long and 90 feet wide was divided into six plots, five of which were 90 x 78 feet (approximately 1/6 acre) and one, a check plot, not sprayed, 90 x 18 feet. Each plot with the exception

1 "Homelite", having a No. 2 Whirljet nozzle made by the Spraying System Co. of Chicago.

of the check contained 26 rows of 3-foot, 6-year old trees planted 3 feet apart. The check contained 8 rows of trees.

TABLE 2. ARAMITE TREATMENTS FOR MITE CONTROL

Date	No. of Plot	Aramite Formulation	Amount Per Plot (1/6 Acre)	Actual Amount of Toxicant Per Acre
May 9	1	95% emulsion	2-2/3 ounces in 1 gallon water	1 pound
May 9	2	15% wettable powder	21 ounces in 1 gallon water	1.2 pounds
May 12	3	95% emulsion	2-2/3 ounces in 10 gallons water	1 pound
May 12	4	15% wettable powder	21 ounces in 5 gallons water	1.2 pounds
May 22	5	2% dust	8.5 pounds	1.02 pounds
July 14	5	2% dust	10.0 pounds	1.2 pounds

Note: Plots 1, 2, 3 and 4 were retreated July 28.

The plots were treated with Aramite emulsion (about 9.5 pounds of technical toxicant per gallon of 95 per cent concentrate), 15 per cent wettable powder and 2 per cent dust. The first two treatments (plots 1 and 2, Table 2) were made by means of a mist blower[1] mounted in a 1½-ton pick-up truck. Pressure was maintained at 30 pounds, delivering 0.35 gallons of spray per minute. Application of the miticide from two sides of both plots assured a good coverage of all of the trees. The time required to treat one plot was approximately three minutes.

On May 12 another mist blower[2] was used to replicate the May 9 treatments (plots 3 and 4, Table 2). The change in the type of apparatus employed to apply the miticide was made for the purpose of testing the efficiency of the two pieces of equipment for the purpose here considered. An increase in the amount of water used to make the mixtures (Table 2) applied to the plots May 12 over that used on May 9 assured more thorough coverage of all parts of the trees.

The May 22 dust treatment (Table 2) was applied from two sides of the plot.

Results of Aramite Treatments

Many dead and dying mites were present in plots 1 and 2 on May 16, 7 days after treatment. None was found that was not affected. On the same date, 4 days after treatment in this case, quite a number of live and apparently unaffected mites were seen in plots 3 and 4. This was to be expected since Aramite does not reveal its lethal action for perhaps five days or longer, especially when the weather is cool.

1 "Homelite", having a No. 2 Whirljet nozzle made by the Spraying System Co. of Chicago.
2 Modified "Niagara Duster".

An examination of plots 1, 2, 3 and 4 on June 5, 24 to 27 days after treatment, revealed no live mites in any of the four plots. There were a very few reddish mite eggs (old eggs, distinguished by their red color) but no fresh ones. In plot 5 (2 per cent dust treatment) and in the check plot there were numerous fresh, as well as old, eggs and countless numbers of newly hatched mites. No adult mites could be found.

On June 14 no young mites nor new eggs were found in plots 1, 2, 3 and 4. There were a few old eggs, most of which appeared to have collapsed. In plot 5 the young mite population, as well as the number of fresh eggs and older red eggs, was somewhat less than on June 5. The check plot revealed a heavy population of all stages of the mite, and some injury (discoloration of the foliage) had begun to show.

On June 26 no mites nor eggs could be found in any of the first four plots. Tremendous numbers of eggs and a light population of mites were seen in plot 5. A few trees in this plot displayed some mite injury. In the check plot there were innumerable eggs and mites and many of the trees showed light to heavy mite damage.

On July 7, one medium sized branch (6" long) was taken from each of 12 different trees in each of the first four plots and the number of mites determined (Table 3).

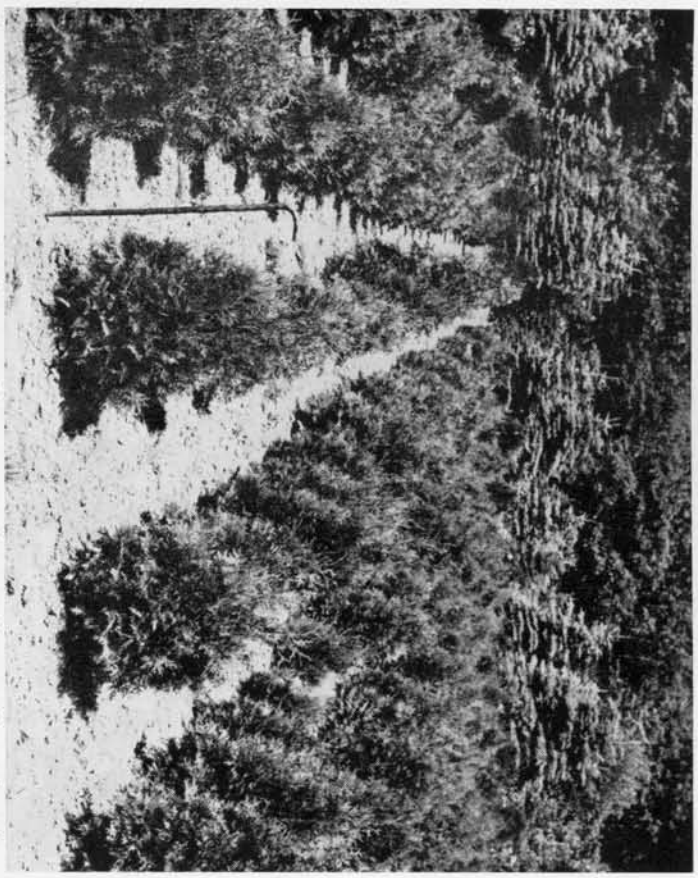
A week later (July 13) the infestation in plots 1, 2, 3 and 4 appeared to be as it was on July 7. Yellowing, graying and russeting of the foliage on many of the trees throughout plot 5 and the check plot, a result of spruce mite injury, provided a striking contrast to the normal, healthy, green foliage in all of the other treated plots.

Because of rapidly increasing injury to the many trees in plot 5, the plot was re-dusted July 14 with Aramite dust (Table 2), thus providing 1.2 pounds of technical Aramite per acre. The duster (Niagara) was drawn around the plot twice, applying the dust from all sides but the south.

July 24 examination of plots 1, 2, 3 and 4 showed a slight increase in the number of adults, young and eggs over those found on July 7. These four plots needed re-treatment. The dust treatment applied to plot 5 (July 14) was considerably more effective than the dust treatment applied to the same plot in the spring (May 22). This perhaps could be attributed to higher air temperatures in July than in May. At this time, July 24, no live adults nor young could be found. There was, however, a moderate population of eggs. Unfortunately, sufficient dust drifted into the check plot, when the treatment was applied to plot 5 on July 14, to kill all adults and young in the check area as well.

TABLE 3. RESULTS OF ARAMITE TREATMENTS

Date	No. of Plot	Aramite Formulation	Total No. Twigs Examined	Eggs	Young	Adults	Total Per Twig
1950							
July 7	1	95% emulsion	12	6	0	0	0.5
	2	15% wettable powder	12	3	1	0	0.3
	3	95% emulsion	12	4	2	0	0.5
	4	15% wettable powder	12	3	2	0	0.4
Aug. 4	1 & 3	95% emulsion	24	3	2	0	0.2
	2 & 4	15% wettable powder	24	0	1	0	0.04
	5	2% dust	24	numerous healthy eggs present	0	0	
	Check Plot		24	numerous healthy eggs present	0	0	
Aug. 29	1	95% emulsion	40	21	19	0	1.0
	2	15% wettable powder					
	3	95% emulsion					
	4	15% wettable powder					
	5	2% dust	10	23	0	0	2.3
	Check Plot		10	25	17	0	4.2



Control of spruce mite in nurseries assures clean and attractive arborvitae, spruce and other trees.

On July 28 plots 1, 2, 3 and 4 were re-treated following the pattern of procedure, materials used, etc., pursued on May 9 and 12. Mite counts made before the treatments were applied showed that there were one to five young and one to two eggs on the tree foliage per microscope field (ocular No. 5, objective 40 mm.).

An examination on August 4 of 24 branches (6" long) taken from the two Aramite emulsion plots re-treated July 28 provided data tabulated in Table 3. A comparable number of branches were taken from the Aramite 15 per cent wettable powder plots re-treated July 28 and plot 5 and the check plot (Table 3).

Results of August 29 examinations of 40 twigs (6" x 3") taken from plots 1, 2, 3 and 4 and 10 twigs taken from plot 5 and from the check plot are given in Table 3.

Examination of the plots during September and early October showed that no further treatments would be necessary (after the end of July) to protect all of the plots for the remainder of the growing season.

CONCLUSIONS

In our experiments the organic phosphate compounds, Bladex and parathion, showed themselves to be remarkably efficient for rapid control of both young and adult mites but exhibited little residual activity. Bladex remained active on foliage for several hours, but no longer, and parathion continued to be effective for only a few days. Eggs were not affected by the treatments. Because of this and the fact that the compounds are short-lived, mites hatching from the eggs will survive, requiring repeated treatments at 10-day to 2-week intervals during the growing season when the infestation is severe.

EPN300, when used at the stated levels, displays limited residual activity. It is less efficient than Aramite in this respect and, consequently, is less desirable where long residual toxicity is required.

Aramite appeared to be considerably slower-acting than the other chemicals discussed, notably Bladex and parathion. It will, however, following a period of several days (the delay is especially noticeable at lower temperatures during the spring) give good control of spruce mites. It also possesses prolonged residual activity, destroying mites hatching from eggs for 6 weeks or longer.

Experimental results would indicate that Aramite dust is not as efficient or lasting in its effect as the emulsion or wettable powder compositions. The latter two formulations appeared to be about equal in residual activity.

Nursery stock susceptible to mite injury should be examined frequently from the beginning to the close of the growing season. The necessity for a mite spray during the spring months may become obvious by mid- to late May. A treatment at this time, using Aramite 15 per cent wettable powder at the rate of 6 pounds per 100 gallons of water or an emulsifiable concentrate to make not more than 1 pound of technical toxicant per 100 gallons of water when an hydraulic sprayer is used, should protect nursery stock until July. A second treatment in July may protect the foliage for the remainder of the season. In the event warm weather persists from the end of August through October, a third spray in September will control spruce mite until the following year. Lower concentrations of Aramite provide immediate control comparable to that obtained at higher levels, but residual action appears to be somewhat reduced. Although more Aramite is used per treatment and it would appear to be more expensive per pound than some of the others, its effectiveness lasts longer, thus requiring fewer applications. Furthermore, the hazard in handling Aramite is less.

A mist blower may be substituted for hydraulic equipment using the same quantity of emulsion and wettable powder in 5 to 10 gallons of water per acre rather than 100 gallons.

Aramite is compatible with most insecticides and fungicides without altering their effectiveness and consequently may be included in a spray program. When insecticides such as DDT are used in nurseries during the growing season, Aramite should be included in the spray treatment. This assures protection from injury to vegetation by rapidly increasing mite populations.