EXPERIMENTS IN BRITISH COLUMBIA WITH ACRICID, A NEW DINITRO MITICIDE[1]

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The control of phytophagous mites, especially the European red mite, *Panonychus ulmi* Koch, and the McDaniel spider mite, *Tetranychus mcdanieli* McG., is becoming an increasingly important and difficult problem, mainly because of the mites' ability to develop resistance to most acaricides in a relatively short time. In some areas of British Columbia, the European red mite has developed strains resistant to malathion, parathion, and other organic phosphates; to the sulpho-esters fenson, ovex, and Tedion; and in some instances to the chlorinated hydrocarbon Kelthane. The McDaniel spider mite poses a perplexing problem because malathion, parathion, and other phosphates, and in many cases, Kelthane, have been ineffective against it. There are few effective and safe miticides available, consequently, the search for new miticides of different molecular structure has special significance in the research work at Summerland and elsewhere.

Dinitrophenol derivatives have been used extensively for mite control in various areas of the world, especially in British Columbia (5) and, to the author's knowledge, these compounds have yet to induce resistance in insects or mites. Twelve to fifteen years ago dinitro-*o*-cyclohexylphenol (DNOCHP) was used quite extensively in British Columbia but was dropped in favor of newer and less phytotoxic miticides. The fungicide - acaricide Karathane (dinitro capryl phenyl crotonate) is fairly effective against mites (1) but because of its relatively high cost has had very limited use strictly as a miticide. A new dinitro compound, closely related to Karathane, became available for experimental purposes in 1959. This compound, described chemically as 1,1-dimethyl acrylic acid ester of 4,6-dinitro-2-*sec.* butylphenol and given the trade name Acricid, was developed by Farbwerke Hoechst A.G. in Germany. Emmel and Czech (2) state that the mammalian toxicity of Acricid is average, the acute LD50 to rats being 165 mg. per kg. When fed to rats at 200 p.p.m. for 90 days, it caused no harmful effects.

This is a report of laboratory and orchard experiments with Acricid in British Columbia.

Methods

Laboratory Experiments

Stringless green pod beans were grown in four-inch pots, three plants per pot, and only the two primary leaves were allowed to develop. The plants were infested with the McDaniel spider mite, *Tetranychus mcdanieli* McG., or the two-spotted spider mite, *Tetranychus telarius* (L.), by placing on the plants pieces of infested leaves from a stock culture of the mites. The infested plants were placed in a 70° F. greenhouse for four to five days. Then they were sprayed with a compressed air paint gun sprayer until thoroughly wetted. Living and dead mites were counted with a stereomicroscope at intervals after spraying.

Orchard Experiments

Sprays were applied either by a high-volume hand-gun sprayer, or by a concentrate sprayer. The former was operated at 425 p.s.i. and the trees were sprayed until dripping. The latter was a 1955 model "Turbo-Mist" concentrate machine. It applied 50 gallons of spray mixture per acre.

Estimates of mite populations were

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made by taking a 20-leaf sample from one quadrant of each of five trees per plot. The leaves were processed by the method of Henderson and McBurnie (3) as modified by Morgan *et al.* (4).

Results and Discussion

Laboratory Experiments

On June 4, 1959 Acricid was compared with DNOCHP (DN Dry Mix No. 1, Dow Chemical Company, Midland, Michigan) against the McDaniel spider mite. Three pots of bean plants were used per treatment; mite counts were made four, eight, and twelve days after spraying. Both preparations, at 0.0125, 0.025 or at 0.050 per cent concentration of active ingredient, caused 100 per cent mortality of mites but the Acricid seemed to be somewhat more rapid in its effect.

Lower concentrations were compared against the active stages of the McDaniel spider mite and the results are summarized in Table 1. Acricid at 0.0125 and 0.0062 and DNOCHP at 0.0125 per cent concentration were equal in effectiveness but the two lowest concentrations of DNOCHP gave practically no control of the mite.

TABLE 1.—Average Per Cent Mortality of the McDaniel Spider Mite at Various Periods after Spraying

Miticide	Per cent active ingredient	Average per cent mortality Days after spraying 3	7	12	16
Acricid	0.0125	88	64	78	53
Acricid	0.0062	52	75	73	48
Acricid	0.0031	62	40	29	31
DNOCHP	0.0125	73	70	74	33
DNOCHP	0.0062	38	42	32	30
DNOCHP	0.0031	36	33	28	25
Check—no treatment		12	21	11	16
S.S.R. @ 5% level		31.66	20.80	26.06	16.28
@ 1% level		43.38	28.50	35.71	22.31

Because of their close chemical relationship, Acricid was compared with Karathane (Rohm & Haas Company, Philadelphia, Pa.) in January 1961 against the two-spotted spider mite on bean plants. Table 2 shows that Acricid is considerably more effective than Karathane against the two-spotted spider mite.

TABLE 2.—Average Per Cent Mortality of the Two-Spotted Spider Mite at Various Periods after Spraying

Miticide	Per cent active ingredient	Average per cent mortality Days after spraying 4	9	14
Acricid	0.0125	100	100	100
Acricid	0.0062	100	100	98
Acricid	0.0031	82	100	100
Karathane	0.0125	31	74	82
Karathane	0.0062	22	50	82
Karathane	0.0031	17	8	27
Check—no treatment		16	33	15
S.S.R @ 5% level		21.27	11.93	9.75
@ 1% level		29.15	16.34	13.36

Orchard Experiments

In the first orchard experiment with Acricid, its toxicity to Anjou pear, a variety very sensitive to spray injury, was compared with that of DNOCHP. Acricid 25 per cent wettable powder was applied at two, four, and eight pounds per 100 gallons, and DNOCHP, 40 per cent wettable powder at one, two, and four pounds in the summer with a bucket-pump sprayer. Injury (yellow mottling and browning of the leaves) was evident with DNOCHP even at one pound concentration. On the other hand, Acricid at two pounds caused no injury. At four pounds it produced some yellow mottling and slight necrosis of the foliage. At eight pounds mottling was similar but the necrotic spotting was more obvious.

In the summer of 1959 two orchard experiments were carried out against the European red mite. The first was on mite-infested prune trees to which the spray chemicals were applied by hand-gun sprayer. Acricid, 25 per cent, one pound per 100 gallons gave good control; but one-half pound per 100 gallons was unsatisfactory (Table 3). DNOCHP appeared to be somewhat more effective.

TABLE 3.—Average Numbers of the European Red Mite per Leaf After Spraying Prune Trees by Hand-Gun Sprayer on August 17, 1959

Miticide	Amount per 100 gal.	Average number mites per leaf Before spraying Aug. 17	After spraying Aug. 24	After spraying Sept. 1
Acricid (25% w.p.)	1 lb.	31.5	0.2	0.2
Acricid (25% w.p.)	8 oz.	40.7	10.7	4.3
DNOCHP (40% w.p.)	5 oz.	34.9	0.3	0.3
Check—no treatment	—	54.1	28.0	0.6

For the second comparison, the two preparations were applied by concentrate sprayer to Newtown apple trees infested with the European red mite. One week after spraying, Acricid applied at eight pounds per acre had reduced the mites from 11.5 to 0.7 per leaf. DNOCHP at three pounds per acre had reduced them from 16.0 to 2.0 per leaf. DNOCHP caused slight injury to Newtown apple foliage.

In 1960 Acricid was applied against the European red mite infesting Jonathan apple trees in the pink bud stage. It was compared with Karathane, 25 per cent wettable powder, and fenson (50 per cent *p*-chlorophenyl benzene sulphonate, Murphy Chemical Company, Wheathampstead, England), a currently recommended "pink-bud" miticide. The preparations were applied with a concentrate sprayer. Seventy-nine days later the average numbers of mites per leaf were:

Miticide	Pounds per acre	Average numbers mites per leaf
Fenson 50%	4	0.1
Acricid 25%	8	1.5
Karathane 25%	6	16.4
Check—no treatment		10.5

Acricid was compared with Kelthane [18.5 per cent bis (*p*-chlorophenyl) trichloroethanol, Rohm & Haas Company, Philadelphia, Pa.] in June 1960 against the European red mite on seedling apple trees. The results of these hand-gun applications are given in Table 4. Acricid at three-quarters or one pound per 100 gallons gave good control as did Kelthane.

TABLE 4.—Average Numbers of the European Red Mite per Leaf after Spraying Apple Trees by Hand-Gun Sprayer on June 28, 1960

		Average number mites per leaf*				
	Amount	Before spraying	After spraying			
Miticide	per 100 gal.	June 27	July 5	July 12	July 20	July 26
Acricid (25% w.p.)	0.75 lb.	7.4	0.7	0.3	0.4	0.6
Kelthane (18.5% w.p.)	2.00 lb.	4.4	0.0	1.3	0.3	0.2
Check—no treatment		17.6	38.8	34.0**	0.2	2.8

* Based on 50 leaves per plot

** Sprayed with Acricid (25% w.p.) 1 lb. per 100 gal. on July 13, 1960

Kelthane and Acricid were compared again against the European red mite in July, application being by concentrate sprayer to Delicious, Winesap, Jonathan, Newtown, and Stayman apple trees. As indicated in Table 5 both miticides controlled the mite well. Neither preparation caused any foliage or fruit injury.

TABLE 5.—Average Numbers of the European Red Mite per Leaf after Spraying Apple Trees by Concentrate Sprayer on July 26, 1960

		Average number mites per leaf				
	Amount	Before spraying	After spraying			
Miticide	per acre	July 25	Aug. 2	Aug. 9	Aug. 16	Aug. 29
Acricid (25% w.p.)	8 lb.	17.2	0.6	5.2	1.7	2.3
Kelthane (18.5% w.p.)	10 lb.	13.3	0.4	4.6	1.8	0.6
Check—no treatment	—	6.6	3.9	9.8	11.0	3.8

Summary

Acricid, a new dinitro miticide of moderate toxicity to mammals, was less toxic to pear and apple trees than the older and more hazardous dinitro miticide, DNOCHP. In laboratory experiments against the McDaniel spider mite, Acricid was somewhat more effective than DNOCHP. Against the two-spotted spider mite, it was more effective than a third dinitro preparation, Karathane. In field experiments against the European red mite, Acricid was effective at one pound per 100 gallons in high-volume application and at eight pounds per acre in concentrate spraying, but was not quite as effective as DNOCHP.

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