EVALUATION OF SPRAYED AND GRANULAR APHICIDES AGAINST THE EUROPEAN ASPARAGUS APHID, *BRACHYCOLUS ASPARAGI* (HOMOPTERA:APHIDIDAE), IN BRITISH COLUMBIA

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ABSTRACT

A single spray of disulfoton and three of methamidophos (all at 1.12 kg ai/ha) suppressed populations of *Brachycolus asparagi* Mordvilko on immature asparagus for 90 days with light aphid damage. One application of oxydemeton-methyl (at 0.56 kg ai/ha) kept populations low as compared with the controls, but not low enough to prevent severe foliage damage. Two sprays of endosulfan (at 1.12 kg ai/ha) and three of malathion (at 2.24 kg ai/ha) during 90 days did not prevent moderate to heavy damage. The results indicated that the spray threshold of 0.5 *B. asparagi*/g of asparagus sprig used in this study was too high. No sprays controlled the other aphids present, which were mostly *Myzus persicae* (Sulzer). Granular formulations of disulfoton (at 0.5, 1.0, 2.0 and 4.0 kg ai/ha), carbofuran (at 2.0 kg ai/ha), and aldicarb (at 2.0 and 4.0 kg ai/ha) applied as side dressings alongside young asparagus, all gave excellent control for almost four months. CGA 73102 (at 1.0 and 2.0 kg ai/ha) and carbofuran (at 1.0 kg ai/ha) gave significant control for three months. Spray and granular treatments giving the best control also produced the thickest spears the following year.

INTRODUCTION

The European asparagus aphid, *Brachycolus asparagi* Mordvilko, is a newly-introduced and destructive pest of asparagus in the western U.S. and Canada. Feeding by this monophagous aphid stunts the cladophylls and shortens the internodes proximal and distal to the area of feeding, which gives a tufted, rosetted appearance to the tips of the branches. Prolonged feeding results in premature bolting of the dormant crown buds, producing stunted, bonsai-like ferns (Forbes 1981, Capinera 1974). Heavily infested plants are weak, give reduced yield, and may die. Forbes (1981) determined that the rosetting and subsequent symptoms were not caused by a pathogen, but by an unknown toxin injected when the aphids feed.

At present, there are no insecticides directly registered for controlling this pest in North America. In Canada, malathion, mevinphos and carbaryl are registered for control of the asparagus beetle, *Criocerus asparagi* (L.), and the spotted asparagus beetle, *C. duodecimpunctata* (L.). Malathion, an aphicide used on other vegetables, was recommended for control of asparagus aphids in British Columbia in 1981, but its contact action and short-term residual toxicity reduced its effectiveness. Complete coverage and repeated applications were needed for adequate control. In mature asparagus with dense fern growth above 2 m, complete coverage is difficult, and repeated applications by tractor-mounted sprayers are physically damaging to the plants. Ideally, an insecticide is needed that gives long-term control with one application. This study reports the efficacy of five aphicide sprays with various contact and systemic properties, and four granular systemics.

MATERIALS AND METHODS

Preparation of Experimental Field

In 1981, insecticide trials were conducted in a field of non-producing asparagus (cvs. Martha Washington and Mary Washington) at the Agriculture Canada Research Station in Summerland, B.C. The field consisted of 14 rows, 43 m long, precision seeded in May, 1980 in a sandy loam soil (pH 6.8, organic content 1.2%, sand 68.3%, silt 25.2% and clay 5.3%) with 15 cm between plants and 1 m between rows. The field was irrigated during the growing season every 2-3 weeks by overhead sprinklers. Weeding was by hand. To ensure the presence of asparagus aphids, populations were collected from nearby infested asparagus plantings and released evenly into the field on May 15, 21 and 27, June 2, and 8, and July 17, 1981. To facilitate the spraying and prevent sagging asparagus ferns from tangling between rows, the plants were held upright by a lattice of twine.

Liquid Aphicides

Spray trials were conducted on eight rows, divided into four blocks, each block containing two adjacent rows. The six treatment plots in each block were 6 m long and two rows wide with 1 m buffer strips of asparagus at both ends of the block and between consecutive plots. Commercial formulations were applied using a Solo manual backpack sprayer, at the rates shown in Table 1, on May 26, 1981 when *B. asparagi* populations had become established. The insecticides were applied to the foliage, then about 0.5 m high, in water at the rate of 3200 L/ha. The controls were sprayed with water only. The heavily populated buffer strips were left unsprayed to provide a source of reinfestation. Following the pre-spray aphid sample on May 25, post-treatment efficacy was determined by sampling every one or two weeks. Treatments were reapplied if the number of asparagus aphids increased to more than the chosen threshold of 0.5 aphids/g asparagus sprig (fresh weight).

Granular Aphicides

Granular formulations of commercial or experimental insecticides (Table 2) were applied as side dressings for systemic aphid control on the remaining six rows. These rows were divided into three blocks with each block consisting of two complete rows. Each of the 12 treatments in each block was a single, 6 m long strip. The strips were laid out in adjacent pairs in a randomized split plot design (see Fig. 3 for treatment pairs). The plots in each row were separated by 1 m buffer strips of untreated asparagus. On May 16, granular insecticides at the rates shown in Table 2 were sprinkled in 2 cm wide bands at the bottom of trenches dug 10 cm deep and 15 cm on both sides of the asparagus row. Efficacy was assessed by sampling the asparagus ferns weekly, beginning on May 24. Before this date, the aphid populations were low. Supplemental sprays to control asparagus aphid populations that later exceeded the threshold, were not applied as they were in the spray study.

Aphid Sampling

The efficacy of the aphicides was assessed by counting the aphids removed from 20 weighed asparagus sprigs in each plot. The sprigs, which consisted of complete lateral branches of about 1 g each, were taken consecutively from the bottom, middle and top regions of randomly selected plants in each plot. Only one sprig was taken from a plant on each sampling date.

The method for counting the aphids was modified from Gray and Schuh (1941). The sprigs were placed in the apparatus shown in Fig. 1, with 2 ml of methyl iso-butyl ketone added to make the aphids withdraw their stylets. After 15 minutes the assembled apparatus, with the collection chamber downward, was shaken 100 times, followed after 5 minutes by another 100 shakes. The aphids that fell through the screen onto the sticky grid were counted and identified. We determined this pro-

TABLE 1. Effect of sprayed insecticides for controlling aphid damage to asparagus foliage in 1981 and emergent spears in 1982 in British Columbia.

Treatments	Rate (kg ai/ha)	1981 foliage damage index[1] September 8	1982 spear yield (g/cm spear) April 27 - May 10
Endosulfan 4 EC	1.12	1.70 cd	0.19 ab
Methamidophos 4.8 L	1.12	0.75 d	0.24 a
Oxydemeton-methyl 2.4 SC	.56	3.35 ab	0.18 ab
Disulfoton 8 EC	1.12	0.75 d	0.22 ab
Malathion 50 EC	2.24	2.45 bc	0.20 ab
Check	--	3.80 a	0.15 b

[1]Values followed by the same letter are not significantly different at the 5% level (Duncan's multiple range test).

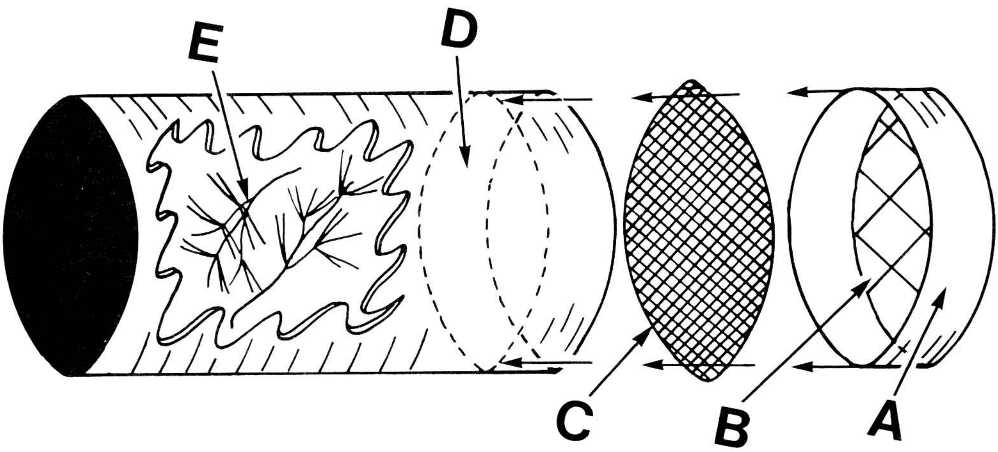

Fig. 1. Apparatus for extracting aphids from asparagus sprigs, consisting of a 1 L aluminum can (A) with a sticky collection grid (B) and a 1 mm mesh screen cover (C), which is inserted into a 7 L can (E) to the level shown (D).

cedure to be 94% efficient in removing intact aphids from the asparagus foliage (data on file).

Assessment of Plant Damage

The efficacy of the insecticides was also determined by examining foliage damaged by *B. asparagi* on 10 evenly spaced plants in each plot. In the spray trial, the damage was assessed on September 8, and in the granular trial on August 31, 1981. Damage symptoms were categorized as:

0 = no damage symptoms on a plant
1 = 1 - 3 rosetted sprigs/plant (light)
2 = 4 - 10 rosetted sprigs/plant (moderate)
3 = + 10 rosetted sprigs/plant (heavy)
4 = 1 or more bolted spears with bonsai appearance (advanced or very heavy)

The plants were ranked and averaged for each treatment and the control to derive an index of aphid damage.

We also determined the effect of the treatments on the harvest of asparagus spears in the following spring. On April 27, 1982, spears 13 cm or longer measured from ground level were cut, counted, weighed and measured. This procedure was repeated seven times for the spray trial and six times for the granular trial until May 10. At the end of the harvest period the yields per treatment were calculated and standardized into units of weight/cm of spear. The values from the aphid damage index and the following harvest were subjected to analysis of variance and ranked using Duncan's multiple range test.

RESULTS AND DISCUSSION

Evaluation of Spray Treatments

Efficacy data from the spray trials, and the aphid damage index for each treatment are shown, respectively, in Fig. 2 and Table 1. By June 12 the numbers of aphids in the control plots were well above the chosen threshold of 0.5 aphids/g asparagus, and by September 8 severe damage was obvious. All the aphicides gave excellent control of *B. asparagi* immediately after application, but they varied considerably in their residual effectiveness. The contact insecticides, malathion and endosulfan, needed repeated applications within one month of the first sprays. By the end of the season, three sprays of malathion and two of endosulfan had not prevented moderate damage.

Methamidophos, a local systemic insecticide, was applied three times to suppress asparagus aphids but the damage was light. One application of the systemic, oxydemeton-methyl, held the populations slightly below threshold for 90 days, but the damage was severe. This indicates that the spray threshold of 0.5 aphids/g asparagus may have been too high. In future trials a lower threshold will be set. A single application of the systemic, disulfoton, kept the numbers well below threshold for at least 90 days with only slight aphid damage.

None of the sprays (4 organophosphates and 1 organochlorine) appeared to affect the populations of other aphids, largely *Myzus persicae* (Sulzer) (Fig. 2). This supports the observations by Banham and Palmer (1979) that strains of *M. persicae* resistant to some organophosphate and organochlorine

TABLE 2. Effect of granular insecticides for controlling asparagus aphids and associated damage to asparagus foliage in 1981 and emergent spears in 1982 in British Columbia.

Treatments[1]		Rate (kg ai/ha)	1981 foliage damage index[2] August 31	1982 spear yield (g/cm spear)[2] April 27 - May 10
Disulfoton	15G b	0.5	0.10 cd	0.26 ab
Disulfoton	15G b	1.0	0.00 d	0.22 abc
Disulfoton	15G b	2.0	0.00 d	0.25 ab
Disulfoton	15G b	4.0	0.07 cd	0.29 a
CGA 73102	5G b	1.0	1.16 ab	0.20 abc
CGA 73102	5G b	2.0	0.90 abc	0.25 ab
Carbofuran	5G b	1.0	1.30 ab	0.21 abc
Carbofuran	5G b	2.0	0.23 bcd	0.22 abc
Aldicarb	10G b	2.0	0.07 cd	0.28 a
Aldicarb	10G b	4.0	0.00 d	0.27 a
Check 1	- a	-	2.90 ab	0.12 c
Check 2	- a	-	3.20 a	0.16 bc

[1]Treatments followed by the same letter did not have significantly different ($P < 0.05$) aphid populations between June 12 and August 28, 1981 (Duncan's multiple range test).

[2]Values followed by the same letter are not significantly different at the 5% level (Duncan's multiple range test).

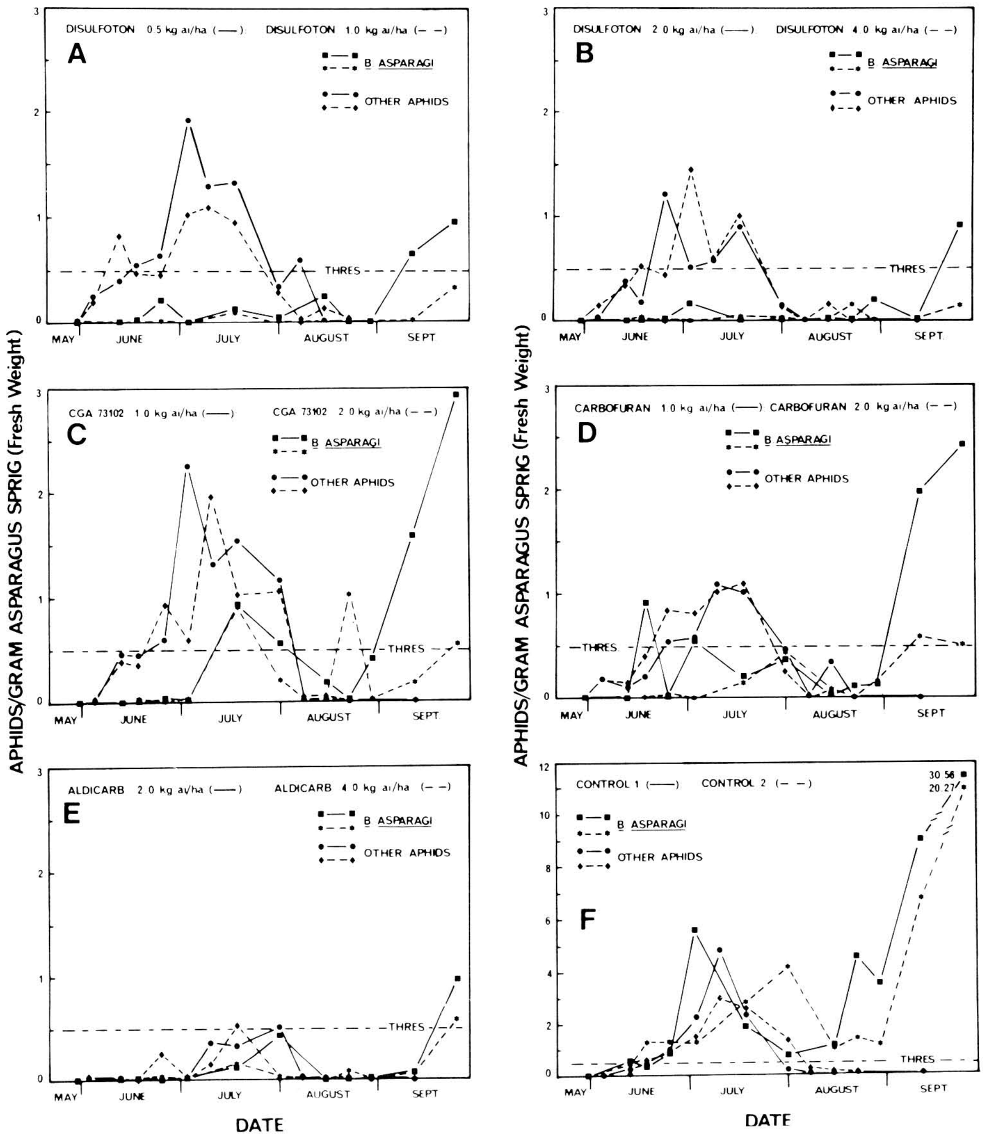

Fig. 2. Populations of **B. asparagi** and other aphids in asparagus foliage sprayed with five insecticides (Fig. 2A-E) or with water (Fig. 2F). Spray dates are indicated by arrows.

insecticides are widespread in the Okanagan Valley of B.C. The other aphid species encountered were: *Aphis helianthi* Monell, *Sitobion avenae* (Fabricus) and *Aulacorthum* sp.

The effects of the sprays in 1981 on yields of spears in the following spring are shown in Table 1. Plots treated once with disulfoton and three times with methamidophos in 1981 had the least damage in that year and yielded the thickest spears in 1982. Oxydemeton-methyl and the control plots, which had the most damage in 1981, yielded the thinnest spears. The yield from the control plots was 32% lower than that in the methamidophos-treated plots. Spears from the controls were longer, thinner, and of lower marketability than those from the treated plots.

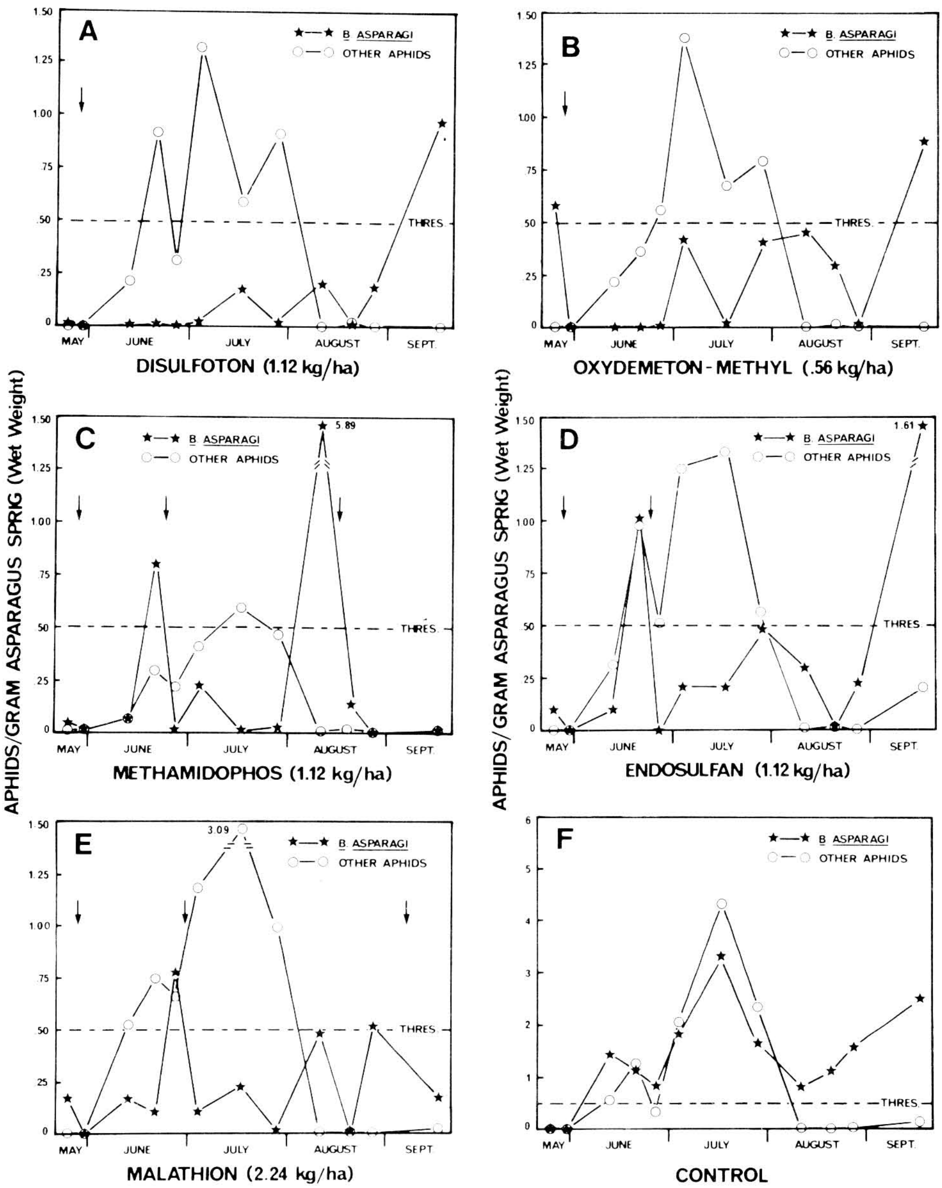

Fig. 3. Populations of **B. asparagi** and other aphids in asparagus foliage side-dressed with four granular insecticides at various rates and in 2 untreated controls.

Evaluation of Granular Treatments

Efficacy data from the granular trial, and the damage index for each treatment are shown, respectively, in Fig. 3 and Table 2. Between June 12 and August 28, 1981, the numbers of *B. asparagi* in the controls were significantly higher ($P < 0.05$) than those in the treated plots. During this period there were no significant differences between treated populations, even though some increased occasionaly to levels above the threshold. These increases may have caused the significant differences ($P < 0.05$) observed in foliage damage occurring between some treatments by August 31 (Table 2).

Disulfoton and aldicarb at all rates provided excellent control for almost 120 days. Foliage damage in these treatments was very light or absent, but by September 24, disulfoton at the lowest rate and aldicarb at both rates no longer provided acceptable control. Total residues of disulfoton in the above ground plant tissue at this time were still about 0.75 ppm (Szeto *et al.* 1982). Carbofuran at the high rate also provided good control for 120 days with light damage only. With carbofuran at the low rate, aphid populations were above threshold on two occasions before August 31, resulting in light to moderate damage. The experimental carbamate CGA 73102 5G at both rates did not keep populations below threshold after 62 days, resulting in light damage. In the controls, the aphid populations were usually well above threshold, and the damage was severe (Fig. 3 and Table 2).

Of the four granular insecticides tested, only aldicarb, at both rates suppressed populations of the other aphid species to levels below the threshold (Fig. 3). Even disulfoton at the high rate did not give good control. At this rate, the total disulfoton residues in green tissue were between 25 and 40 ppm (Szeto *et al.* 1982) at the time when the other aphids were at their peak (July 2-17). However, the numbers of other aphids in all the disulfoton and carbofuran treatments were significantly ($P<0.05$) lower than those in the checks, suggesting that some control was achieved.

The effects of the granular treatments in 1981 on yields of spears in the following spring are shown in Table 2. The untreated areas, with spear measurements averaging 0.14 and 0.16 g/cm had the poorest yields, which compared closely with the yield of 0.15 g/cm in the control for the spray trial. Aldicarb at both application rates, and disulfoton at the highest rate gave significantly higher ($P<0.05$) spear yields than the controls but they were not significantly different from those in the other treatments.

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