CONTROL OF APHIDS AND CATERPILLARS ON BRUSSELS SPROUTS IN BRITISH COLUMBIA

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The cabbage aphid, *Brevicoryne brassicae* (L.), is a serious pest of brassica crops in British Columbia. The recommended control measures with malathion and TEPP have not always been satisfactory, especially on Brussels sprouts, broccoli, and cauliflower. With new and potentially useful systemic and contact insecticides available or about to become available it was necessary to work out new recommendations. This paper reports the results of exploratory field tests conducted at Vancouver in 1958.

Brassica crops are also attacked each season by other pests, which were considered when evaluating the insecticides against cabbage aphid; these were: imported cabbageworm, *Pieris rapae* (L.), diamond-back moth, *Plutella maculipennis* (Curt.), cabbage looper, *Trichoplusia ni* (Hb.), and green peach aphid, *Myzus persicae* (Sulz.).

Methods and Materials

Brussels sprouts was used as the test crop since it presented the most difficult problem in control under B.C. conditions. The aphids get into the sprouts where they are shielded from sprays and dusts. It lends itself well to continuing appraisal of leaves and of the harvested product. This crop also has a long growing period and must be protected until harvest is complete, which may be in November or even later.

Cultural procedures followed those of commercial growers as closely as possible. The variety of Brussels sprouts used was Long Island Improved, the one most commonly grown in the area. Plants were started in the seedbed May 8 and transplanted to the field June 12. The seedbed and the plants at transplanting were treated with heptachlor dust to control root maggots.

Eight treatments and the check were replicated 4 times in randomized blocks. Each plot consisted of two rows of 10 plants each. Table I shows the insecticides, formulations, rates per acre per application, and dates of application. Di-syston granules were applied to the soil around the base of the plants, but the other insecticides were applied as sprays at the field scale rate of 100 gallons per acre with a compressed air sprayer. The method of spraying gave results similar to those that would have been obtained in field applications: the spray nozzle was directed above and beside the plants but the rate did not permit individual spraying of each plant or thorough coverage of the lower leaves, especially the undersides. The surfactant Triton B 1956 (Rohm & Haas Co., Philadelphia 5, Pa.) was added to each spray at the rate of 4 ounces per 100 gallons. Portable barriers (figures 1 and 2) were placed around the plots during spraying. These were made of 1 x 4 inch cedar with corner braces, and covered with sign cotton cloth as used for advertising.

Di-syston was first applied when the aphids appeared in the field. The first application of all other materials was on July 30, when there were 194 colonies of *B. brassicae* on 60 leaves, i.e. when the infestation was well established.

Counts were made 14 times at weekly intervals from August 8 to November 14 from an upper, a middle, and a lower leaf from each of 5 plants at random per plot. Data recorded were: numbers of colonies of cabbage aphids, numbers of adult green peach aphids, numbers of each of the 3 species of caterpillars, and estimates of the percentage of leaf surface dam-

[1] Contribution No. 12.

TABLE 1.—Treaments against cabbage aphid on Brussels sprouts at Vancouver, B.C., 1958.

Insecticide	Toxicant per acre, per application lb.	Treated
None — check	—	—
TEPP[1] 20% emulsion	0.25	July 30, Aug. 12, 25, Sept. 5, 15, 22
malathion[2] 57% emulsion	1.25	July 30, Aug. 12, 25, Sept. 5, 22
Thimet[2] 47.5% emulsion	1.00	July 30, Aug. 18, Sept. 15
N.A. Cyanamid 12,880[2] 46% soluble conc. (Dimethoate)	1.00	July 30, Aug. 25
N.A. Cyanamid 18,706[2] 25% soluble conc.	1.00	July 30, Aug. 18, Sept. 15
Di-syston[3] 5% granules	1.00	July 7, 30, Sept. 2
Systox[3]	0.50	July 30, Aug. 25
Phosdrin[4] soln.	0.45	July 30, Aug. 12, 25, Sept. 8, 22

1 Later Chemical Co., Vancouver 14, B.C.
2 Cyanamid of Canada Ltd., Toronto 5, Ont.
3 Chemagro Corp., New York 16, N.Y.
4 Shell Oil Company of Canada, Toronto 1, Ont.; 12.3 lbs. of toxicant per gallon.

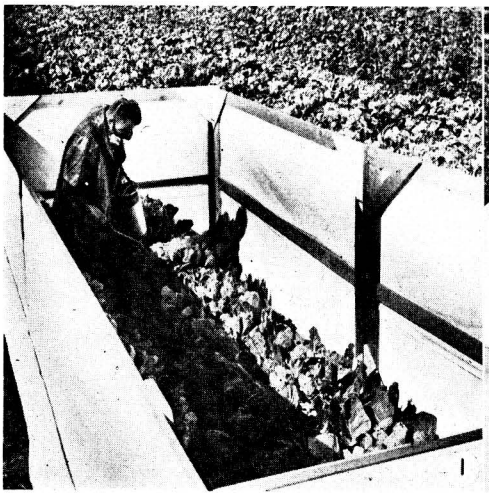

Fig. 1.—Portable barriers around plot during spraying.

Fig. 2.—Portable barriers being assembled around plot.

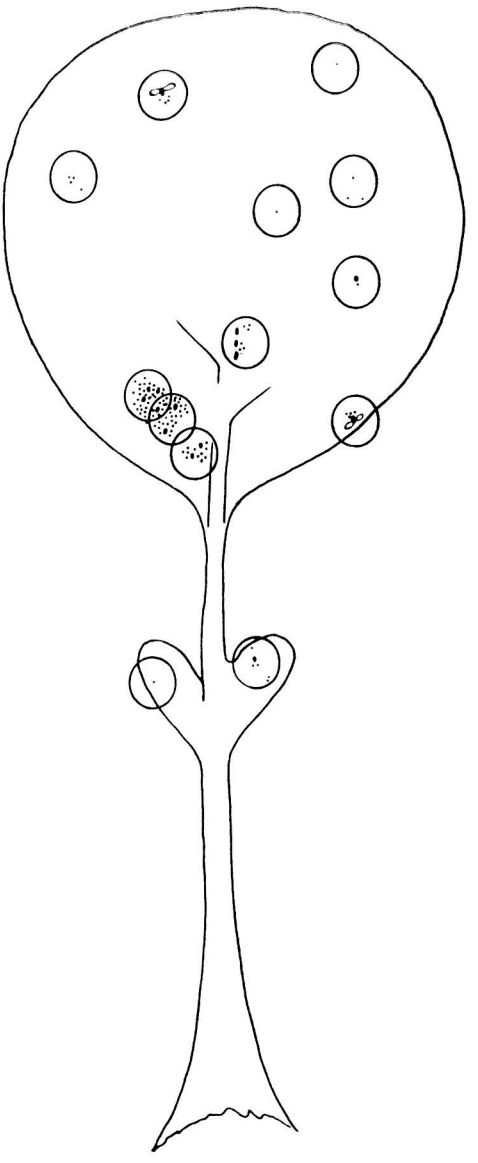

Fig. 3.—Diagram of mature leaf of Brussels sprouts with typical mid-season population of cabbage aphids. This leaf has 13 colonies.

aged by caterpillars. Where cabbage aphids covered large areas of the leaves, as in the checks, a circular area of covered leaf one half inch across, as estimated by inspection, was counted as one colony. A cabbage aphid in isolation, apterous or alate, settled on the leaf was also counted as one colony (figure 3).

At harvest 10 mature sprouts were taken, one from each of 10 plants per plot, every week for 7 weeks. These were weighed, inspected for caterpillar damage and examined by dissection for the presence of aphids. According to the absence or location of aphids they were categorized as clean, commercially acceptable, or rejected.

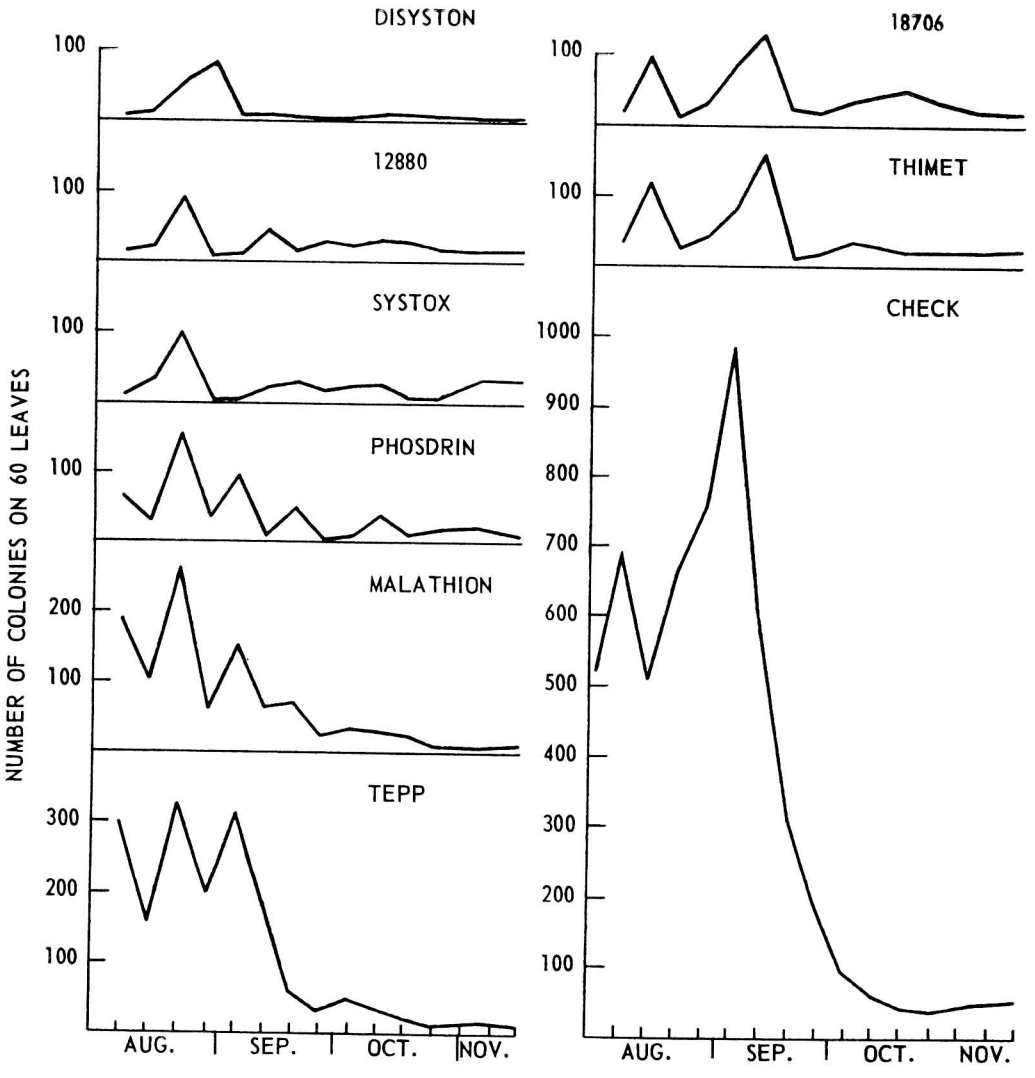

Fig. 4.—Populations of cabbage aphids on leaves of Brussels sprouts in all treatments at Vancouver, B.C., 1958.

Clean sprouts had no aphids in or on them; commercially acceptable sprouts had one or two aphids where they were easily washed off; rejected sprouts had aphids within the leaves where ordinary washing would not dislodge them. Differences between the treatments were assessed by analysis of variance.

Sprouts treated with Thimet, 12,880, 18,706, Di-syston, Systox, and Phosdrin were analyzed for residue by chemists of the British Columbia Research Council. Samples were taken from the field and immediately frozen on October 10 and 24. They were analyzed in February, 1959.

Results and Discussion

Aphids were first noted on the plants on July 7; by July 29 there were high populations of both cabbage and green peach aphids. The population of cabbage aphids in the check plots built up steadily until September 5 after which it declined (figure 4). A fungus infection, braconid parasites, syrphid larvae, chryso-

TABLE II—Aphid population totals from 14 weekly leaf counts[1], August 8 - November 14, 1958, on Brussels sprouts at Vancouver, B.C.

Treatment	***Brevicoryne brassicae*** colonies	Percentage control	***Myzus persicae*** adults	Percentage control
Di-syston	215	96	497	11
Systox	358	93	304	46
12,880	352	93	182	67
Thimet	538	89	283	49
Phosdrin	563	89	357	36
18,706	531	89	165	70
Malathion	1074	78	810	0
TEPP	1722	65	763	0
Check	4958	—	558	—

[1] Each weekly count from an upper, a middle, and a lower leaf from each of 5 plants per plot, 20 plants per treatment.

pid larvae, and cool damp weather contributed to the decline. The population of green peach aphids rose until August 15 but fell rapidly thereafter.

Populations of cabbage aphids in all treatments during the season are shown graphically in figure 4. Data on the effectiveness of the treatments against aphids are summarized in Tables II and III. The systemics gave markedly better control than malathion or TEPP. Di-syston was the outstanding material against cabbage aphids but had little effect on green peach aphids, probably because the latter were confined to the old leaves. Systox and 12,880 were promising against cabbage aphids. Phosdrin reduced the population of cabbage aphids each time it was applied but it required 5 applications. 12,880 and 18,706 were the best materials against green peach aphids.

TABLE III—Control of cabbage aphids and yield at harvest on Brussels sprouts at Vancouver, B.C., 1958.

	Clean Sprouts		Marketable Sprouts		Yield[2]
Treatment	Number[1]	Percentage	Number[1]	Percentage	gm.
Di-syston	59.0	84	68.0	97	1256
Systox	49.2	70	63.5	91	1236
12,880	48.7	70	61.5	88	1213
Thimet	45.2	65	60.5	86	1173
Phosdrin	43.7	62	58.5	84	1212
18,706	36.2	52	58.2	83	1146
Malathion	28.0	40	52.5	75	1233
TEPP	27.7	40	49.2	70	1121
Check	20.7	30	51.2	73	882
L.S.D. at					
5% level	7.9		6.8		138
1% level	10.8		9.2		188

[1] Maximum of 70.
[2] Average weight of 70 sprouts.

TABLE IV—Percentage control of caterpillars on Brussels sprouts at Vancouver, B.C., 1958.

Treatment	Percentage control based on:			
	Damaged sprouts[1]	Total caterpillars[2]	Leaves with more than 5% damage[2]	Undamaged leaves[2]
Phosdrin	76	87	44	24
Malathion	64	81	27	16
Thimet	34	61	22	6
12,880	21	56	25	11
TEPP	21	31	31	13
18,706	6	12	0	0
Systox	3	36	0	0
Di-syston	0	4	0	0

[1] Sample of 280 sprouts: 40 taken each week from October 2-November 14.
[2] Sample of 840 leaves: 60 taken each week from August 8-November 14.

All treatments greatly increased the yield of sprouts and there were no significant differences between treatments in this respect. The increases in weight ranged from 27 per cent for TEPP to 42 per cent for Di-syston. Thus controlling cabbage aphids increased both the yield and marketability of sprouts.

Against caterpillars, Phosdrin and malathion were the best materials (Table IV). Di-syston, 18,706, and Systox gave virtually no control.

TEPP and malathion were applied 6 and 5 times respectively, or every 7 to 13 days during the season, but never reduced the populations to acceptably low levels (figure 4). Other insecticides were reapplied each time the weekly counts of cabbage aphid colonies showed more than 50 per 60 leaves. Thus Phosdrin required 5 applications, Thimet, Di-syston, and 18,706 required 3, and 12,880 and Systox required only 2, to maintain the population levels shown (figure 4).

Green peach aphids occurred almost exclusively on the old, lower leaves. Over the 14 weeks, 0.5 per cent occurred on upper leaves, 3 per cent on middle leaves and 96 per cent on lower leaves. This and the fact systemics may not be effectively translocated to leaves that are not growing rapidly may account for their relatively poor performance. TEPP and malathion gave no control of green peach aphids because the method of spraying and rate of application did not permit coverage of the lower leaves.

The cabbage aphid occurred at all levels on the plant as follows: 19 per cent occurred on upper leaves, 37 per cent on middle leaves, and 44 per cent on lower leaves.

The method of counting aphids gave valid data on their relative numbers and their location. Results were consistent among different counters. For cabbage aphids, colonies were counted, since this is a gregarious species and the colonies provided discrete units that were counted easily and rapidly. For green peach aphids adults were counted, since this is a solitary species and the aphids are found dispersed over the leaf. Fortunately green peach aphid populations remained low so that counting the adults was not unduly time consuming.

The portable barriers used during spraying worked well in practice, so that buffer rows were not needed. They eliminated spray drift and permitted spraying even on windy days. The barriers were light and easily moved into position (figure 2).

No residue was detected in any of the sprouts except in those treated with Phosdrin and harvested on October 10. In these the inhibition of cholinesterase was 8.3 per cent greater than in the untreated check. The intervals in days, between last treatment and the October 10 harvest were: Thimet, 25; 12,880, 46; 18,706, 25; Di-syston, 38; Systox, 46; Phosdrin, 18.

PAINTED LADY, *Vanessa cardui*, on Vancouver Island

This cosmopolitan butterfly was common in Saanich, during 1958. Not since 1952 have I seen it in such numbers. As a matter of fact only a single specimen, in 1957, came to my notice between these dates. In 1958 I first noted it on May 18, and the last date recorded was October 1.

Soon after arriving in the district, from where I do not know, egg laying started on the two species of thistles abundant in the area, namely Canada thistle, *Cirsium canadensis*, and bull thistle, *C. lanceolata*. It seemed to prefer the latter. On June 18 I observed a female hovering about the head of a bull thistle where it was ovipositing so intently that it continued to lay even when I pulled the stem towards me for a closer look. In all, though not necessarily laid by this individual, 12 eggs were found, either on the involucre of the terminal flower head, or on the uppermost leaves just beneath the inflorescence. I snipped off the top of the plant containing the eggs and placed it under a muslin screen. The resulting caterpillars were reared to maturity. Adults emerged on July 17, one month after the eggs were laid.

During the course of the summer larvae in all stages of development were in evidence, varying from light yellowish green to almost completely black. Clumps of thistles soon assumed a bedraggled appearance, the bare leaf stalks festooned with the remnants of the silken cubicles in which the larvae lived or had lived. Pupae were rarely seen, however, as the caterpillars leave the food plant for less exposed quarters. Once in a while a chrysalis was found hanging within a very open-meshed tent along the leaf stalks of the host plant.

Fresh specimens of adults were common by July 18 and continued to be so well in September.

There is considerable overlapping of broods but with an average of one month for a complete life cycle and a constant succession of ova there could be two or more generations in one season, especially in a long, mild autumn as in 1958. From an economic point of view this is a useful insect, considering the ravages it commits among the thistles.

What becomes of the hosts of individuals seen up to October 1? They must do one of three things: Hibernate; but I have never come across them hereabouts, even early in the spring as in the case of the Mourning cloak and Angle Wing, both of which are known to hibernate. Emigrate; if so it is not noticeable. Or die before winter; here again I have no evidence in support of such a happening.

Most likely they are here in the first place as an overflow from Mexico or some other warm climate. They succeed well enough during the summer in their new haunt, but are unable to withstand the ensuing winter.

R. South in "The Butterflies of the British Isles" 1947 states that North Africa is thought to be the centre for this species, which periodically spreads all over the temperate world, where it thrives for a time but eventually disappears, until another wave of migrants from the original source re-populates its far flung range.

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