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Cabbage Looper Important Cole Crop Pest

Horticultural Society to Meet In Salem on January 28-30

A horticultural equipment display will be one of the major features of the 84th annual meeting of the Oregon Horticultural Society at the State Fair Grounds in Salem. About 75 exhibits will be open from 9 a.m. to 5 p.m. on Wednesday, Thursday, and Friday in the Agricultural Exhibit Building.

The Vegetable Section of the meeting is scheduled for Thursday, January 29, in the 4-H Building Auditorium and will include talks on new developments in breeding, insect and disease control, fertilizers and spacing, harvesting and marketing. Dr. E. T. Haltvick, University of Wisconsin, will speak on "Growing Processing Vegetables in Wisconsin."

The general sessions on Wednesday afternoon and Friday morning will be devoted to product development and marketing, labor and transportation.

In This Issue . . .

The cabbage looper, *Trichoplusia ni*, is essentially a "warm weather" insect, but often appears in the Willamette Valley in late summer or early fall. Presently it is considered economically important only as a pest of broccoli and cauliflower. Loopers attacking peppermint, lettuce, peas, and other noncruciferous crops in Oregon are the closely related alfalfa looper, *Autographa californica*. As a pest of broccoli and cauliflower, the cabbage looper is not important for its leaf-feeding activities, but because of its presence as a contaminant in the heads at harvest. Attempts at mechanical removal of larvae and pupae from the edible portions in the processing plant have so far been unsuccessful.

Moth trapping studies

In the cole crop and cotton-growing areas of California and the Southwest, black light traps have been used successfully to indicate the seasonal activity and abundance of the cabbage looper. Attempts in Oregon to gather information by the use of traps has been very unfruitful. For example, personnel of Birds Eye Division, General Foods Corporation, operated a light trap at Woodburn in 1967 from July 22 to September 9 for a total catch of eight alfalfa looper moths and only one cabbage looper moth. This trap was relocated in the St. Paul area and operated until the middle of November 1967. During the period from September 9 to November 1 a total of 215 alfalfa loopers and 3 cabbage looper moths were caught. Both trap locations overlooked extensive cole crop plantings. Similar operations in southern California would have brought in hundreds of cabbage loopers in the same time span. However, the looper infestation of commercial broccoli in 1967 was not considered to be an economic problem.

(*Continued next page*)

Cabbage Looper . . .

In 1968 a trap was operated periodically at the Vegetable Research Farm near Corvallis from July 10 to October 4. In 25 trap-nights a total of seven alfalfa loopers and no cabbage looper moths were caught. Furthermore, from mid-August to October 3 the trap was baited with a preparation of synthetic female sex pheromone supplied by the USDA entomologists at Forest Grove, Oregon, and on one night (October 4), eight virgin cabbage looper females were caged on the light trap as an additional lure. Looper populations in commercial broccoli were above economic levels in many fields in the Woodburn area in 1968.

The 1969 trapping program again involved a single black light trap at the Vegetable Research Farm near Corvallis. The trap was operated nightly from May 15 to August 13 (90 nights) and periodically from August 15 to October 2 (30 nights). During the first period 24 alfalfa loopers and one cabbage looper moth were caught, and in the 30-night second period, 17 alfalfa loopers and again only one cabbage looper moth were caught. In late September it was discovered that moths often rested on the structure of the trap, without falling into the killing jar, until sun-up and then flew away. Eleven of the 17 alfalfa looper moths from the second time period were caught outside the killing jar on seven nights. This past season was the second year in a row for troublesome looper populations in commercial broccoli fields in the Willamette Valley.

Thus, the operation of light traps has not produced meaningful information on the seasonal activity or prevalence of the cabbage looper in Oregon. It has, however, raised the question of whether the larvae present on broccoli and other cole crops are 100 percent cabbage loopers, or if the alfalfa looper also is involved.

Rearing observations

Larvae of the cabbage and alfalfa loopers are extremely difficult to differentiate with assurance, whereas the adult moths are rather easily identified to species. Collections of larvae from the field have therefore been brought into the laboratory and reared to adults, either on broccoli leaves or semi-artificial media.

In 1968 three small larval collections were made and the results are summarized in Table 1.

These results implicated the alfalfa looper to some extent, at least at the Corvallis site.

Table 1. Results of rearing field-collected loopers, 1968

Date	Location	Crop	No. of larvae	Adults[1] identified as: Cab. loop.	Alf. loop.
Aug. 20	Corvallis	Br. sprouts	7	4	0
Sept. 6	Gresham	Broccoli	12	8	0
Sept. 17	Corvallis	Br. sprouts	4	2	2

[1] Some larvae died from parasitism or disease.

Larvae were collected again in 1969 and attempts were made to rear them. Information was also available from collections made by USDA entomologists from the Forest Grove laboratory. The results of these studies are summarized in Table 2. The larvae taken from mint and spinach in July are suspected of being alfalfa loopers, but the high rate of parasitism prevented positive identifications. It is evident that the species causing trouble in the broccoli fields of the northern Willamette Valley in 1969 was predominantly the cabbage looper.

Chemical control

One reason for the cabbage looper being a serious pest of broccoli and cauliflower is its natural tendency to migrate toward the center of the plant as the larva matures. There the larva seeks shelter during the day and even finds the edible heads to be suitable places in which to spin a cocoon and pupate. Also, this insect is inherently tolerant of most insecticides and, after reaching the third instar of the larval stage, is almost impossible to kill with any registered pesticide. Furthermore, the degree of looper control sought by the grower is essentially 100 percent—always a difficult goal to attain.

Small plot, field control trials were planned for 1968, but loopers failed to appear in the experimental broccoli plantings. Again in 1969 the looper populations did not build up in the special plantings at Woodburn, but one test was accomplished in a commercial field near Gresham in cooperation with the Birds Eye Division of General Foods Corporation.

Pre-counts of loopers were made on August 28 in a Gresham broccoli planting just starting to head. Indi-

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Cabbage Looper . . .

Table 2. Results from field-collected loopers reared in the laboratory on semi-artificial medium, 1969

Collection date	Location	Crop	No. of loopers		Identifications	
			Coll.	Parasit.	Cabbage looper	Alfalfa looper
July 15	Corvallis	Peppermint	31	31	....	....
July 20	Labish	Spinach	5	5	....	....
Aug. 26	Dayton and Woodburn	Broccoli	17	1	15	0
Aug. 30	Gresham	Broccoli	19	0	15	0
(The following data from USDA entomologists from Forest Grove)						
Various dates	Gresham	Broccoli	40	0	40	0
Various dates	Woodburn	Broccoli	150	0	150	0

Table 3. Results of small scale field trial for cabbage looper control with various spray materials

	Material and formulation		Rate ai per acre	Number of loopers			
				Dead	Moribund*	Missing	Alive*
			Pounds				
1.	Monitor	6 ec	1.0	4	1L	3	1S
2.	Monitor	6 ec	0.5	.....	.....	7	.....
3.	Galecron	4 ec	1.0	.....	.....	6	1S, 2M, 2L
4.	Galecron	4 ec	0.5	.....	1M, 1L	2	1M, 4L
5.	Herc 14503	4 ec	0.5	.....	.....	2	1S, 4M, 2L
6.	Azodrin	3.2 ec	0.5	.....	.....	1	5M, 5L
7.	VCS-506	3 ec	0.5	.....	.....	4	3M, 4L
8.	Methomyl	90 sp	0.5	2M	.....	4	2M, 2L
9.	Methomyl	90 sp	0.5	3	.....	6	1L
10.	Methomyl	90 sp	0.5	.....	.....	6	3M, 2L
11.	Methomyl	90 sp	1.0	.....	.....	8	1S, 1L
12.	SD-17250	2 ec	0.5	.....	.....	5	1M, 4L
13.	SD-17250	2 ec	1.0	.....	1L	2	2S, 2M, 6L
14.	Mevinphos	4 ec	1.0	.....	.....	4	2S, 1M, 3L
15.	(Mevinphos	4 ec	1.0	.....	1L	3	1S, 2M, 3L
	(Parathion	4 ec	0.5				
16.	Parathion	4 ec	0.5	.....	1L	2	1S, 1M, 4L
17.	(Parathion	4 ec	0.5	3	1L, 2M	3	4L
	(Endosulfan	2 ec	1.0				
18.	Endosulfan	2 ec	1.0	.....	2L	2	1S, 4L
19.	(Parathion	4 ec	0.5	.....	.....	10	.....
	(DDT	2 ec	4.0				
20.	N-2596	7.5 ec	0.5	.....	.....	5	1S, 2M, 4L
21.	R-15792	50 WP	0.5	.....	.....	3	6M
22.	(Diazinon	4 ec	0.5	.....	.....	7	3M
	(Carbaryl	50 WP	2.0				

* Size code—S = small, M = medium, L = large larvae; roughly equivalent to third, fourth, and fifth instars, respectively.

(Continued page 6)

Muskmelon Hybrids Show Promise

Because of current interest in new muskmelons to replace Fusarium wilt susceptible varieties, notes were taken on a number of varieties grown for classwork on the Vegetable Research Farm at Corvallis. In addition, four of the best F_1 hybrids tested in recent years and the open pollinated variety, Delicious, were grown in three replicated plots.

All of the varieties were planted May 15, in rows about 9 feet apart, in hills 24 inches apart in the row, through openings in a black plastic mulch. The replicated plots were 25 feet long, in a randomized block arrangement. The remainder of the varieties were planted in plots 10 feet long. About 500 pounds banded 8-24-8 fertilizer was used, and water was applied throughout the season as needed.

Results of the replicated trial are shown in Table 1. Harvests were made about every four days from August 25 to October 11. Individual fruits were weighed. Soluble solids were measured with a refractometer for usable sized melons. Because an unexpected infestation of symphylans affected the plots unevenly, with particular damage to replication 2, yield figures are not reliable and were not statistically analyzed. However, they should be of use in showing differences in average weight and the average percent soluble solids, which is largely a measure of sugars and an important measure of quality.

A summary of the descriptive notes taken, including those for the replicated varieties, is shown in Table 2. Only the varieties considered early enough for the Willamette Valley and of satisfactory quality are included. Of the other varieties grown, Maine Rock was early but very poor in quality as it also was in 1967; Gold Crown was early but weak in flavor and general appearance; Sweetheart was very poor in growth, though early and having good flavor; Melodew was very late; Milwaukee Market, Pride of Wisconsin, and New Yorker were late and/or low in production; and Lake Champlain was very poor in flavor, though early. Several Hales Best strains were grown but were not included in the table because they mostly tend to be of mediocre quality in this climate.

Of the newer melons, Harvest King was of excellent eating quality and good production and would be a good

Table 1. Results of a replicated trial of muskmelon varieties, Corvallis, Oregon, 1969

Variety	Rep.	No. fruit	Total wt.	Average fruit wt.	Avg. percent S.S.[1]	No. fruit 2 lbs. or over
			Lbs.	*Lbs.*		
Delicious	1	42	90.3	2.2	14.1	29
	2	33	58.3	1.8	12.5	8
	3	73	130.3	1.8	12.5	23
	Average	49.3	93.9	1.9	13.6	20
Harper Hybrid	1	53	107.6	2.0	14.1	26
	2	27	56.3	2.1	15.4	15
	3	62	133.7	2.2	14.6	38
	Average	47.3	99.2	2.1	14.6	26
Gold Star	1	36	91.5	2.5	14.3	29
	2	19	48.2	2.5	13.2	17
	3	33	92.0	2.8	13.8	31
	Average	29.3	77.2	2.6	13.9	26
Super Market..	1	40	76.4	1.9	14.1	16
	2	27	61.4	2.3	14.7	19
	3	54	125.4	2.3	14.4	42
	Average	121	87.7	2.2	14.4	26
Burpee Hybrid	1	51	108.4	2.2	13.5	29
	2	24	65.8	2.7	14.4	22
	3	45	121.3	2.7	13.5	40
	Average	40.3	98.5	2.5	13.7	30

[1] Average percent soluble solids, measured by refractometer.

Table 2. Descriptive Notes of Acceptable Early Muskmelon Varieties Observed at Corvallis, 1969

Variety	Source[1]	Days to 1st ripe[2]	Diameter	Texture	Net[3]	Cavity[3]	Flesh color	Flavor	Avg. percent soluble solids	General evaluation[3]	Notes
			Inches								
Iroquois	1	112	5½	Sl. coarse	H	S	Good, deep	Strong, musky	13.6	F	Heavy ribbing.
Samson	2	120	5	Fine, med. firm	H	VS	Med. deep	Strong, musky	13.3	F	Cavity unusually small.
Early Crenshaw	3	118	7	Fine	N	M	Light orange	Mild, sweet	13.5	F-G	Tends to crack; not very firm. For garden use.
Saticoy Hybrid	4	117	5½	Firm, sl. tough	H	MS	Good, bright	Good, med. musky	13.6	G	Shape oblong, good size and quality. Sl. late.
Fordhook Gem	3	110	4	Firm, sl. tough	H	ML	Green	Good, mild	14.4	F-G	Home garden type, attractive green flesh.
Harvest King	5	118	5	Fine	M	S	Light	Good, mild	15.1	VG	Light green inner rind, yield fair to good, smooth.
Spartan Rock	1	118	4	Firm, sl. tough	VH	L	Good, rich	Good, med. musky	15.0	G	Small but many fruit; good for home garden.
Hearts of Gold	1, 2	122	5	Fine, med. firm	MH	M	Med.	Mild	14.0	F-G	Somewhat late. Med. Oblong and ribbed.
King Henry	1	118	4½	Firm, tough	MH	MS	Light, poor	Fair, str. musky	14.0	F	General appearance fair to poor.
Delicious	6	110	4¾	Sl. soft	M	VL	Light	Mild, sl. musk	13.6	F-G	Shape variable during season.
Harper Hybrid	6	103	4¾	Fine, not very firm	M	VS	Good, rich	Good, med. musk	14.6	VG	May not hold after maturity as well as some. Very smooth.
Burpee Hybrid	3	103	5	M. firm, sl. coarse	H	M	Good, rich	Good, med. musk	13.7	VG	Good all-around melon; distinctly ribbed.
Super Market	4	105	4¾	Fine, firm	M	S	Good	Good, med. musk	14.4	G	Fair to good general appear. Sl. ribbed.
Gold Star	6	106	5	Firm, sl. tough	H	M	Fair, good	Strong musk	13.9	G	Good market appearance. Ribbed.

[1] Northrup King & Co., 2. Dessert Seed Co., 3. Burpee Seed Co., 4. Peto Seed Co., 5. T. Sakata & Co., and 6. Harris Seeds.
[2] The large number of plants of the last five varieties which were grown in the replicated plots increased the chances of a fruit ripening on an early date.
[3] H = heavy, N = none, M = medium, V = very, S = small, L = large, F = fair, and G = good.

Muskmelon Hybrids . . .

garden melon. It is somewhat light in flesh and rind color and mild in flavor to compete with the four F_1 hybrids included in the replicated test, as far as commercial market is concerned. It might be promoted for local markets, however. Of the replicated varieties, Burpee Hybrid and Harper Hybrid were rated very good, while Supermarket was nearly as good. Gold Star was scored good, though it appeared to be lowest in production and slightly low in soluble solids. Harper Hybrid seemed to be the best in quality, though it was down on average fruit weight and to some degree on total number of fruit weighing 2 pounds or more. The open pollinated variety, Delicious, was lowest in soluble solids, average fruit weight, and number of fruits of 2 pounds and over. It also had the largest cavity.

Generally, the four F_1 hybrids included in the replicated test appear to be the best current prospects for commercial use in western Oregon. Of the four, Burpee Hybrid is the only one not claimed to be resistant to Fusarium wilt. Harvest King should be tried further for local market.

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Cabbage Looper . . . (*Continued from page 3*)

vidual plants supporting a looper were marked with paint and a symbol indicating the relative size of the larva was placed on the leaf involved. On the same day a series of 22 different materials, combinations, or concentrations were applied to three-plant plots with a back-pack power mist sprayer delivering about 35 gallons per acre. Forty-eight hours later the marked plants were carefully examined and the previously located loopers recorded as dead, moribund, alive, or missing. Dead loopers usually were found on the ground under the plant. The results of the test are summarized in Table 3.

Only four treatments were found to have actually killed loopers: Monitor (an experimental organophosphate); methomyl (Lannate—just registered in 1969 for use on broccoli and certain other crops at the rate of 0.5 pounds active ingredient per acre); and the parathion-endosulfan (Thiodan) combination which is registered for use up to seven days before harvest.

As a result of the observations and chemical test summarized here, plus work reported by other entomologists from various parts of the country, it is evident that satisfactory control of the cabbage looper can be accomplished only through the use of a preventive spray program. This means that effective materials must be applied before the tiny larvae reach the third instar. The critical period appears to be from about mid-August through September. The choice of materials will be determined to a considerable extent by the restrictions regarding residues.

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Vegetable Notes . . .

Shifriss and Frankel in Israel reported genetic male sterility in the Bell type pepper variety 'All Big.' They suggest that utilization of this male sterility for hybrid seed production appears to have a number of advantages over the gene-cytoplasmic male sterility found in *C. annuum* by Petersen. These are high stability of the character, presence of fertility restoring genes in many, if not all, commercial pepper varieties, and its presence in a Bell type variety. (*J. Amer. Soc. Hort. Sci.*, 94:385-387, 1969).

Isenberg and Sayles in New York concluded that Danish cabbage has the biological capacity to respond favorably to modified atmosphere-low temperature environments. The best combinations of gas mixtures ranged between 2½ to 5% of oxygen and carbon dioxide, with nitrogen making up the remainder. These combinations reduced weight loss due to respiration and also trimming loss. Heads retained their green color, were succulent and firm, and remained dormant longer in atmospheres of low O_2 and CO_2 tension. (*J. Amer. Soc. Hort. Sci.*, 94:447-449, 1969).