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Seasonal Variation in Populations of the Principal Insects Causing Contamination in Processing Broccoli and Cauliflower in Central Mexico

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Abstract

The seasonal variation in populations of insects causing product contamination in broccoli and cauliflower was measured in the central plateau of Mexico using black-light traps, pheromone traps, and plant surveys. The major species that are found in heads of broccoli and cauliflower are diamondback moth *Plutella xylostella* (L.), and cabbage looper *Trichoplusia ni* (Hübner). Pheromone traps collected both species all year, whereas the black-light trap only collected diamondback moth during the spring. In pheromone traps and plant surveys, diamondback moth was found in significant numbers from April through October. Populations of cabbage looper showed extended peaks in spring and autumn when measured by pheromone traps. Plant surveys showed cabbage looper larvae to be highest from May through September. *Artogeia rapae* and *Leptophobia aripa* populations increased beginning in September. They laid more eggs and produced more larvae on broccoli than on cauliflower.

Introduction

For many agronomic and economic reasons the central plateau of Mexico has become a major center of broccoli and cauliflower production to supply the increasing demand for these products from the United States. The plateau area is located at a latitude of approximately 20°N and an altitude of 1700-2000 m. The climate is temperate and relatively free of seasonal variation.

Insect control was not considered a major problem until 1986-87. At that time, control of the diamondback moth (DBM) *Plutella xylostella* (L.) (Lepidoptera: Yponomeutidae) became the major preoccupation of the farmers and processors in the region. To effectively implement Integrated Pest Management (IPM) programs, it is first necessary to monitor the seasonal variations in pest populations. In this paper, we are reporting the activity of adult populations of the principal insect pests as monitored by black-light and pheromone traps and the corresponding egg, larval and pupal contaminants found in field surveys. Parasitism of the two major species is reported along with data on other important species encountered during the vegetative growth phase of the plant.

Procedure

The data reported here were collected on two separate ranches, El Copal near Irapuato and Villa Verde near Salamanca in the state of Guanajuato. The ranches are located about 30 km apart. El Copal is the research farm managed by the University of Guanjuato. On Villa Verde,

Gigante Verde maintains an experimental farm of 6 ha. Both farms are located in intensive agricultural areas where wheat, sorghum, garlic, sweet corn, broccoli, cauliflower and other vegetables are grown. Monthly plantings of broccoli (*Brassica oleracea* var. *italica* cv. Green Valliant) or cauliflower (*Brassica oleracea* var *botrytis* cv. Imperial 10-6) were made for the evaluation of pest populations. At Irapuato both crops were maintained to measure insect preferences. In Salamanca broccoli was planted in the winter and spring and cauliflower in the summer and fall (corresponding to normal cropping practices). These plantings were established using one application of malathion or endosulfan at transplanting. No other insecticides or fungicides were applied. Surveys were made in these plots for the principal insect pests. Normally 25 random plants were inspected for each sample. At Salamanca two dates of transplanting were surveyed each week, and the data presented are of the two oldest plantings.

Black-light trap data are recorded from a trap located at the El Copal ranch. The trap consists of two F15T8 General Electric fluorescent tubes and are mounted on a sheet metal frame with a container mounted below containing a dichlorvos strip for insect killing.

Pheromone data are from traps located on the Villa Verde ranch. Pheromones and Pherocon 1C sticky traps were purchased from the Trece Company, Salinas, California, USA. Two traps for each species were used for data collection. Pheromones for DBM were changed every 4 weeks, but on offsetting 2-week periods to reduce the problems of declining pheromone effectiveness. Trap height was adjusted to just above the height of the plants. Pheromones for cabbage looper (CL), *Trichoplusia ni* (Hübner) (Lepidoptera:Noctuidae), were changed every 2 weeks. New pheromones were placed in the traps on alternating weeks. Pherocon 1C cardboard sticky traps were used for DBM while large-mesh cone traps, usually used for *Heliothis*, are used for CL.

Results

Black-light trap — Irapuato

Black-light collections were started in April of 1989. Data from April 1989 to 15 October 1990 are presented in Fig. 1. The black-light collections of DBM show a very strong peak during May 1989. The black-light collections in 1990 showed a peak during the week of 25 March, and then substantial peaks in the last 2 weeks in May, similiar to the 1989 peaks. Essentially no DBM was collected in the black-light trap after 1 August in either year. More DBM males than females were collected in the black-light trap (357 to 165 in 1989, and 448 to 188 in 1990).

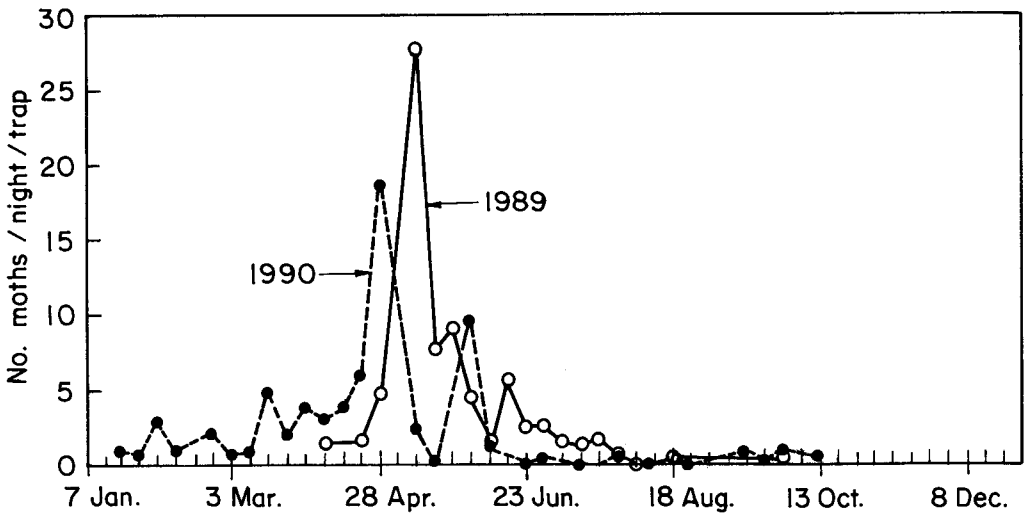

Fig. 1. Diamondback moth black-light trap collections, Irapuato, Mexico.

Of particular interest is the fact that this black light trap seldom collected CL, although CL eggs and larvae were found in the adjacent crucifer plantings. McCully (unpublished data) collected many CL moths in Maryland between 1965 and 1975 using a black-light trap. Chapman and Lienk (1981) reported collecting over 500 moths in July - November 1975 in western New York State. We have no explanation for the failure to collect CL adults.

The principal noctuid collected in the black-light trap was *Spodoptera frugiperda* (Hübner) (Lepidoptera: Noctuidae). From 1 April to 15 October 1989 and 1990, total collections of *S. frugiperda* were 3056 and 2870, respectively. This insect is seldom a pest or contaminant on broccoli or cauliflower.

Pheromone trap collections — Salamanca

Pheromone trap collections of DBM were started in October 1987. DBM moths have been collected every week, except one, since 1987. For discussion purposes, we will use an average of over 10 moths/night/trap as being a peak. Experience in production plantings would indicate that more than this number is likely to produce measurable field populations of DBM. The peaks are not definitive, lasting from 1 to 5 weeks as shown in Fig. 2. The data show six peaks in 1988, nine in 1989, and six in 1990. Data collected on other ranches showed peaks at times other than those shown here. This indicates that the DBM is responding to local conditions, most likely the crop stage. Therefore, to use pheromone traps to predict populations of DBM, the traps will have to be located on the grower's ranch.

CL trapping was started in January 1989 and the moths were found in the pheromone traps every week except one in 1989 (Fig. 3). In both years, two spring flights were recorded. In 1989, three peaks were noted in the fall. In both years, the lowest activity was reported in June.

Field collections

The major species recovered were DBM, CL, imported cabbage worm (ICW) *Artogeia rapae* (L.) (Lepidoptera:Pieridae), and *Leptophobia aripa* (Boisduval) (Lepidoptera:Pieridae). The strong preference of CL for laying eggs on cauliflower is shown in Table 1. ICW and especially *L. aripa* laid many more eggs on broccoli. Numbers of larvae and pupae recovered were different from the egg counts. CL and ICW were found in equal numbers on both broccoli and cauliflower. *L. aripa* eggs and larvae were found predominantly on broccoli (Table 2).

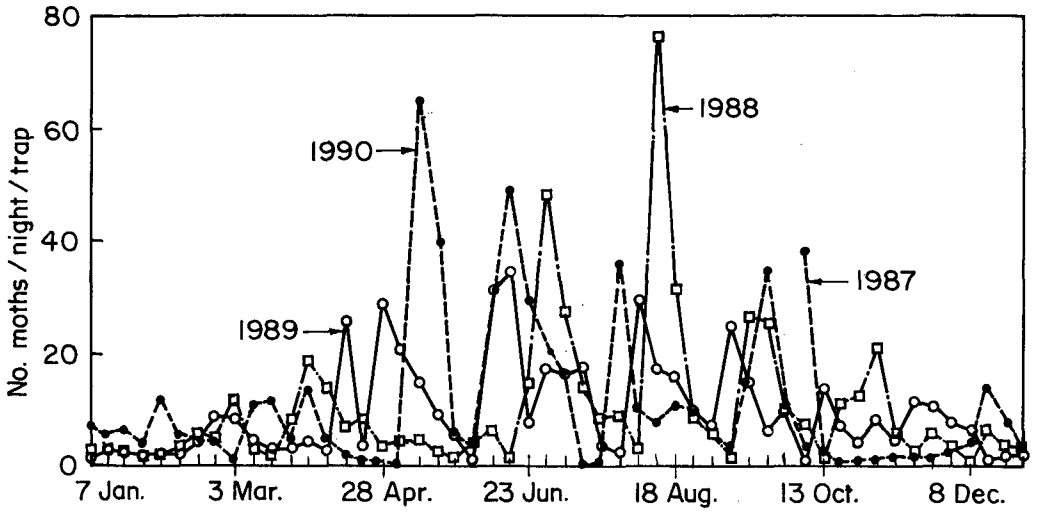

Fig. 2. Diamondback moth pheromone trap collections, Salamanca, Mexico.

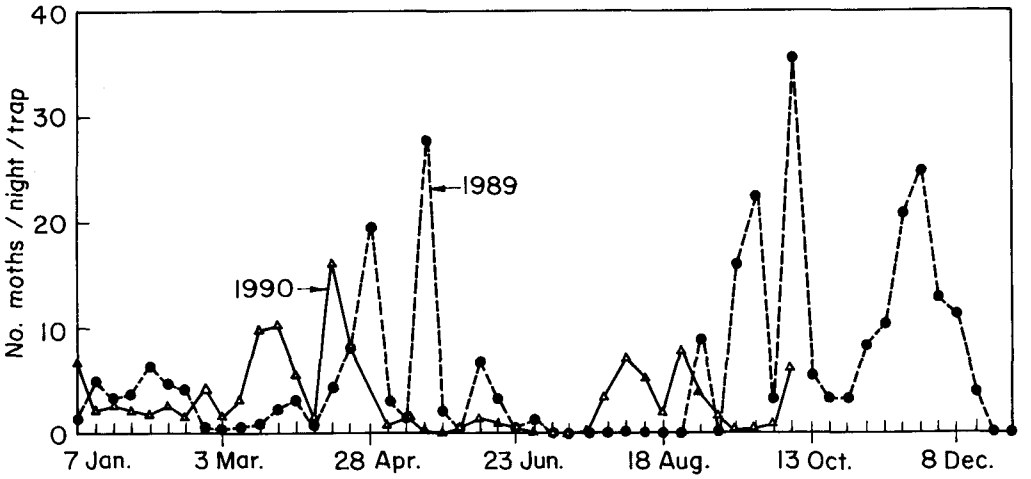

Fig. 3. *Trichoplusia ni* pheromone trapping results, Salamanca, Mexico.

Table 1. Influence of crop on the incidence of cruciferous pest eggs in 3 years, Irapuato, Mexico, 1990.

	Eggs/plant/sample					
	Broccoli			Cauliflower		
	1988	1989	1990	1988	1989	1990
T. ni	0.06	0.16	0.23	0.11	2.80	0.44
A. rapae	1.04	0.15	0.20	0.21	0.25	0.17
L. aripa	1.16	0.80	0.12	0.02	1.14	0.14

Table 2. Influence of crop on the incidence of cruciferous pest larvae and pupae in 3 years (larvae and pupae/plant/sample). Irapuato, Gto., Mexico. 1990.

	Broccoli			Cauliflower		
	1988	1989	1990	1988	1989	1990
DBM	0.07	0.17	0.31	0.08	0.41	0.54
CL	0.15	0.27	0.49	0.19	0.26	0.39
ICW	0.34	0.17	0.14	0.02	0.29	0.10
L. aripa	0.77	0.55	0.26	0.26	0.25	0.31

Monthly averages of larvae and pupae per plant, from Irapuato, are shown in Fig. 4, demonstrating the seasonality of the four most common species. DBM was found in significant numbers from April through September. At Salamanca we recorded over one larva per plant 10 weeks in 1988, 6 weeks in 1989 and 9 weeks in 1990. The concentrations were in September and October 1988, March-May 1989, and April-June and September 1990. CL lagged a month, being found mostly during May-August. In Salamanca, CL larvae were above one per plant in August and September 1988, May-June 1989, and June-July 1990.

In Irapuato, ICW larva showed two peak populations, June-September and November-December. In Salamanca, high larval populations were recorded only in 1988.

Leptophobia aripa larvae were found during September-December. In Salamanca, *L. aripa* were found rarely. Production experience indicates *L. aripa* is very easy to control in commercial plantings and is not considered a major pest. We encountered larvae in the heads of broccoli for the first time in an insecticide trial in October 1990. This contrasts with reports by Havranek (1981) in San Cristobal, Venezuela, where *L. aripa* was reported as the major pest in cabbage. Salinas and Briceno (1981) also report that *L. aripa* is a major pest of all cruciferous crops above 1,000 m in many countries of South America.

The most common parasites encountered were *Diadegma insulare* (Cresson) (Hymenoptera: Ichneumonidae), and *Voria ruralis* (Fallen) (Diptera: Tachinidae). Parasitism percentages are shown in Table 3. DBM parasitism by *D. insulare* was about equal in both broccoli and cauliflower. In contrast, CL parasitism by *V. ruralis* was higher in broccoli in 1988 and 1990, and higher in cauliflower in 1989. Except in the case of broccoli in 1990, *D. insulare* parasitized a higher percentage of DBM than *Voria ruralis* of CL.

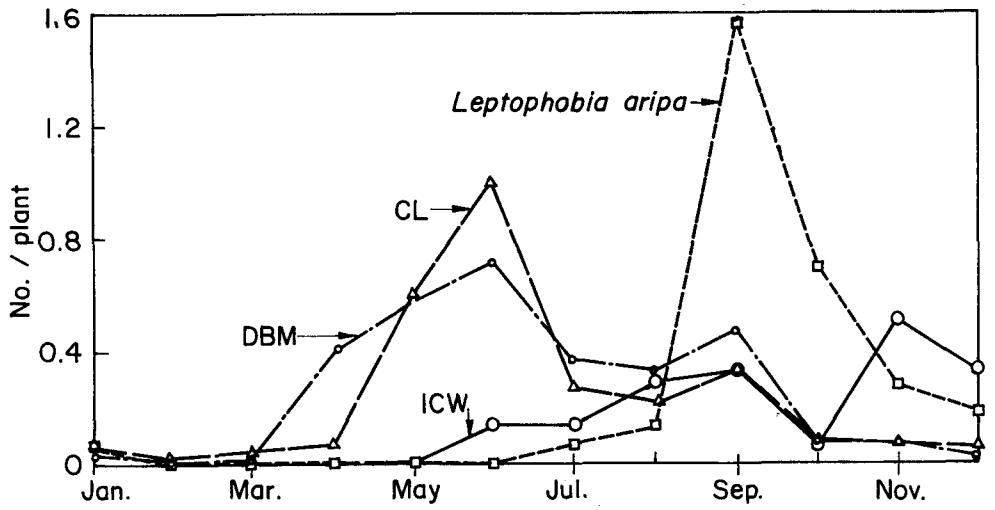

Fig. 4. Monthly averages of larvae and pupae/plant, Irapuato, Mexico (crops and years combined).

Table 3. Parasitism of DBM by *D. insulare* and CL by *V. ruralis*, Irapuato, Mexico, 1990.

	DBM			CL		
	1988	1989	1990	1988	1989	1990
Broccoli	62.5	36.0	30.2	14.7	6.7	38.8
Cauliflower	56.7	30.9	32.3	0.0	15.5	15.4

Various other insects have been collected from the heads of broccoli and cauliflower. To date, they have been serious only in isolated fields and for short periods of time. These include: *Copitarsia* sp. (Lepidoptera: Noctuidae), *Peridroma* sp. (Lepidoptera: Noctuidae), *S. frugiperda*, *S. ornithogalli*, and *S. exigua* (Lepidoptera: Noctuidae). The cabbage aphid *Brevicoryne rapae* (L.) (Homoptera: Aphidae) is a serious contaminant of broccoli heads. When the population of this aphid is high, larvae of *Allagrapta* sp. (Diptera: Syrphidae) are also found in the broccoli heads.

Lygus lineolaris (Palisot de Beauvois)(Hemiptera: Miridae) was found as an occasional pest of cauliflower. The nymphs are not found, but the adults feed on the cauliflower heads causing discoloration over large parts of the head, making these heads unusable.

Hernandez and Alvarado (unpublished data), of Campbells Soup Company in Villagran, Guanjuato, Mexico, reported on the aphid species attacking broccoli, their abundance, preference for leaf age, and parasitism. They report highest populations in winter plantings. This makes the cycle of pests complete. On a calendar year basis, the aphids appear first, followed by DBM in April, CL in May, and the Pieridae in August and September.

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