Table 1.—Effects of dipping broccoli transplants in Bay 37289 on symphylan numbers and plant vigor.

Replicate	Treatment	Total no. samples	Mean no. symphylans/ sample	Mean stem diameter (cm)
I	Bay 37289	6	2.16[a]	1.60
	Check	3[b]	10.00	1.34
II	Bay 37289	6	2.16[a]	2.03
	Check	6	13.16	0.99
III	Bay 37289	6	8.83	1.90
	Check	5[b]	16.80	1.70
IV	Bay 37289	6	4.83[a]	2.31
	Check	5[b]	87.40	.88
Total	Bay 37289	24	4.50[a]	1.95
	Check	19[b]	33.15	1.21

[a] $\chi^2 = (P < 0.5)$.
[b] No root-core samples taken where plants were missing.

Oregon.[4] Since Bay 37289 reportedly controls the garden symphylan, we used this opportunity to evaluate its effectiveness against symphylans when applied as a transplant dip.

The bare roots and stems of broccoli sets were dipped in an 8-oz AI/100 gal emulsion of Bay 37289 (1.66 g/liter) and immediately transplanted in moist soil on 11 June. Untreated broccoli sets were transplanted the same day. Twelve broccoli plants were transplanted 9 in. apart in single-row plots replicated 4 times in a randomized block. Plots were sprinkler irrigated ca. every 10 days during the summer.

At midseason, when alternate plants were pulled for cabbage maggot damage evaluation, it was apparent that the stunting or death of plants in the untreated plots was the result of symphylan damage. The cabbage maggot infestation was light. Root or stem damage by maggots does not cause stunting, and plant mortality occurs only with heavy infestations.

[4] Unpublished data. H. H. Crowell, Department of Entomology, Oregon State University, Corvallis.

Root-core samples (ca. 10 in.) were taken 10 in. deep with a small spade to estimate the symphylan population at harvest (12 Aug.). All samples were evaluated in the field. The stem diameter of each plant was measured with graduated calipers as an indication of plant vigor.

Our results (Table 1) show that the total number of symphylans/soil sample was significantly lower (χ^2 test) in 3 of 4 plots treated with Bay 37289 compared with the check plots. The average stem diameter was greater in all plots treated with Bay 37289, indicating a reduction in plant vigor resulting from high symphylan populations in untreated plots. There was no apparent phytotoxicity to plants dipped in Bay 37289.

Broccoli transplants dipped in Bay 37289 were protected from severe symphylan damage until harvest (62 days after transplanting). Bay 37289 could provide the seasonal protection required by many crops which are attacked by symphylans.

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Transmission of Cowpea Mosaic Virus by the Mexican Bean Beetle[1,2]

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There have been several reports of species of *Cerotoma* acting as vectors of cowpea mosaic virus isolates (Dale 1949, 1953; Smith 1924; Van Hoof 1962; Walters and Barnett 1964) and 2 reports of transmission by other beetles in the subfamily Galerucinae, family Chrysomelidae. Van Hoof (1962) named a *Diabrotica* species, probably *D. laeta* F., as a vector of a cowpea mosaic virus isolate in Surinam, and Chant (1959) incriminated *Ootheca mutabilis* (Sahlbergi) as the vector of the yellow or Nigerian strain of cowpea mosaic virus in Nigeria. To investigate the possibility that chewing insects other than galerucinid beetles might transmit cowpea mosaic virus, adults and larvae of the Mexican bean beetle, *Epilachna varivestis* Mulsant, were tested as potential vectors of the severe strain.

The severe strain of cowpea mosaic virus was obtained from Dr. J. P. Bancroft, Department of Plant Pathology, Purdue University, Lafayette, Ind. Agrawal (1964) by means of serology, differences in reaction of certain hosts, and physicochemical properties, found the severe strain to include the Vu and Vs isolates of Van Hoof and Trinidad cowpea mosaic virus. Cowpeas, *Vigna sinensis* var. 'Blackeye,' were utilized as virus source plants and test plants. Mexican bean beetles were reared from eggs in the greenhouse. Adults and 2nd- to 3rd-stage larvae were caged on infected cowpeas and allowed a 2-day acquisition feeding. Following the acquisition feeding, 5 adults were caged on each of 20 healthy cowpea plants with fully developed 1st true leaves. The larvae were treated similarly. Each group of insects was transferred daily to another test plant for 5 days. The test plants retained in the greenhouse at 27–32°C were read for symptoms and discarded 2 weeks after the last transfer.

Twelve groups of adults and 16 groups of larvae transmitted the severe strain of cowpea mosaic virus. Chi-square analysis showed that the difference in the rates of transmission was not significant; the vector efficiencies of both stages were equal. The numbers of infected plants after daily serial transfer of the groups of adults were

[1] Coleoptera: Coccinellidae

[2] Published with the approval of the Director as Paper no. 2796, Journal Series, Nebraska Agricultural Experiment Station, and Contribution no. 332 of the Department of Entomology, University of Nebraska, Lincoln. Received for publication Mar. 3, 1970.

11/18, 4/20, 0/19, 0/20, and 0/20 (the numerator is the number of infected plants and the denominator is the number of plants surviving the insect feeding). The corresponding results obtained with the groups of larvae were 16/20, 5/20, 0/20, 1/17, and 0/16. Except for 1 group of larvae which remained infective for 4 days, larvae and adults did not remain infective beyond 2 days. This phenomenon does not necessarily mean that every individual infective Mexican bean beetle must soon become noninfective. Freitag (1956) determined the retention period of squash mosaic virus in the western striped cucumber beetle, *Acalymma trivittata* (Mannerheim), and the western spotted cucumber beetle, *Diabrotica u. undecimpunctata* Mannerheim, and obtained very erratic infection patterns when groups of 5 beetles were transferred daily to healthy test plants. The greatest number of transfers between successive infections was 13; the greatest number of transfers before initial infection occurred was 10. Because squash mosaic virus is serologically related to cowpea mosaic virus (Gibbs and Giussani 1965), the same transmission phenomenon might occur with the Mexican bean beetle and cowpea mosaic virus.

The distribution of the severe strain of cowpea mosaic virus is not well known. Cowpea plants infected with this strain have been found in Surinam (Van Hoof 1962) and Trinidad (Dale 1949). The common beetle-transmitted cowpea mosaic virus of the southern United States is the Arkansas cowpea mosaic virus. According to Shepherd (1963) the Arkansas and the severe-strain cowpea mosaic viruses are closely related but not identical serologically. Furthermore, both viruses are transmitted by species of *Cerotoma*: the Arkansas cowpea mosaic virus by the bean leaf beetle, *Cerotoma trifurcata* (Forster) (Smith 1924), and the severe strain by *C. variegata* F. (Van Hoof 1962) and *C. ruficornis* (Oliver) (Dale 1949). The similarity in structure between these 2 viruses and in the vector species capable of transmitting them suggests that any insect species able to transmit 1 should also transmit the other. The Mexican bean beetle is present throughout the United States except in the Pacific Coast States and is occasionally injurious to cowpeas (Metcalf et al. 1962). The Mexican bean beetle is probably a natural vector of the Arkansas cowpea mosaic virus in the southern United States.

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