treatment. The total yield of potatoes also varied inversely with the density of *C. onoense* (Fig. 2). Populations of *H. pseudorobustus* and *T. martini* steadily declined throughout the potato season.

From a uniformly low level at planting, *Meloidogyne* increased steadily as weed infestations developed so that at harvest high populations of the larvae of the species were recovered from plots mowed in July and September, and low populations were recovered from plots mowed in July and September and sprayed with paraquat in October. *C. onoense* was also reduced in numbers early in the potato season as a result of the paraquat spray, although final counts at harvest were no different from those counts following only the July and September mowings.

CONCLUSIONS

1. Discing and paraquat plus dalapon employed in off-season fallowing improved potato yields.
2. Heavy weed infestations reduced yields.
3. Sparse stands of hybrid sorghum permitted heavy weed infestations and contributed to high nematode populations and low potato yields.
4. Populations of *Criconemoides onoense* were directly related to weed infestations.
5. The total yield of potatoes was inversely related to the density of *C. onoense*. This relationship may be an indirect effect which was dependent on the influence of weed infestations on yield.
6. In Perrine marl soil Irish potato was not a favorite host to *Tylenchorhynchus martini* or *Helicotylenchus pseudorobustus*.
7. Under field conditions it was not possible to separate the effect of nematodes and weeds on potato yield. This work does serve, however, to define some of the biological processes which operate in a field over a period of time, processes which may not be limiting singly, but in aggregate may deter improvement of crop production.

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PATHOGENICITY AND CONTROL OF A FLORIDA POPULATION OF THE SUGARBEET NEMATODE, HETERODERA SCHACHTII, ON CABBAGE

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ABSTRACT

In a greenhouse trial, population levels of 100 and 1000 cysts of *Heterodera schachtii* in 3-gallon crocks of steamed fine sand soil failed to significantly reduce the growth of cabbage. However, a second planting in the same crocks was reduced 30 and 34% respectively in the infested crocks and a third planting was reduced approximately 72%. Infected plants were somewhat chlorotic and wilted severely on warm sunny days. Nematode populations reached approximately 20,000 larvae per 100 cc of soil by the end of the second planting.

In a soil fumigation test, 1, 3-dichloropropene, 1,2-dichloropropane and related compounds (D-D Mixture) applied at 25 gal/acre and 1, 2-dibromo-3-chloropropane (DBCP) at 25 lb/acre both reduced *H. schachtii* larvae populations by approxi-

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mately 87% and markedly improved the growth of cabbage.

Introduction

The sugarbeet nematode, *Heterodera schachtii*, was first found in Florida in 1969 near Sanford, parasitizing the roots of cabbage (12). From this original infestation, populations were reared on cabbage in the greenhouse for experimental purposes.

Cabbage and other *Brassica* crops have long been recognized as hosts of *H. schachtii* (7), but the importance of this parasite in cabbage production was not studied until more recent years. Researchers have disagreed about the pathogenicity of *H. schachtii* to cabbage with several (4, 10, 11) claiming that the nematode is not harmful whereas, in contrast, others (1, 2, 9) state that beet cyst nematodes significantly decrease yield of cabbage and other *Brassicas*.

Since the sugarbeet nematode and other cyst-forming species are difficult to kill because of the protective cyst wall, it is nearly impossible to eradicate them by use of chemicals. However, in other areas of the country standard applications of several soil fumigants have been effective in greatly reducing sugarbeet nematode populations and increasing yields (6, 8). Recent research has also shown that several experimental organophosphate and carbamate nematicides show considerable promise for controlling this nematode (5).

The objectives of the experiments reported here were to determine if the Florida population of *H. schachtii* is pathogenic to cabbage and the efficacy of certain standard soil fumigants for reducing field populations of the pest.

Materials and Methods

Pathogenicity.—Soil from pots heavily infested with *H. schachtii* was spread in a thin layer in the laboratory and allowed to dry for 72 hours. Cysts were then separated from the soil by flotation and collected on a 60-mesh screen. Large plump cysts were hand picked and added to 3-gallon crocks of steamed Leon fine sand. The cysts were mixed in the top 2 inches of soil near the center of the crocks and, on October 16, 1970, two-leaf-stage cabbage seedlings of the variety Rio Verde were transplanted into the crocks. The experiment consisted of 100 and 1000 cyst infestation levels and two types of checks, one with no additions and the other with the addition of 50 cc of the water used for floating the cysts. This was passed through filter paper to insure freedom from nematodes or their eggs. Presumably this water carried bacteria of kinds that were associated with the nematodes. The experiment was a randomized complete block design with five replications and was conducted in the greenhouse during the period of October 1970 to July 1971.

The cabbage plants were properly fertilized and watered for vigorous growth. On January 5, 1971, when heads were beginning to form the plants were cut and weighed. The soil in the crocks was immediately mixed and two-leaf-stage Rio Verde cabbage plants were again transplanted. These were allowed to grow until April 14, when they were cut and weighed. Soil samples were then removed from the crocks and processed by a centrifugal-flotation technique (3) for the determination of larval numbers. The soil in the crocks was then mixed again and transplanted with Rio Verde transplants on April 20. These were cut and weighed on July 19.

A gas heater was used to prevent greenhouse temperatures from dropping below 60F during the winter. Maximum temperatures varied between 75 and 85F on most days. During the spring and summer months an evapo-cooler was used to prevent daytime temperatures from rising above 95F whereas minimum night temperatures varied from 68-74 F.

Control.—A portion of the field in which the first infestation of *H. schachtii* was discovered was utilized for a soil fumigation experiment during the fall and winter of 1970-71. The experimental design was randomized complete block with three replicates. Plot size was 25 by 100 feet. Treatments consisted of preplanting applications of 25 gal/acre of 1,3-dichloropropene, 1,2-dichloropropane (D-D Soil Fumigant) and 25 lb/acre of 1,2-dibromo-3-chloropropane (DBCP). The fumigants were injected 6-8 inches deep with chisels spaced 10 inches apart on November 9, 1970. Rio Verde cabbage plants were transplanted into the field on December 15. On April 13, 1971, at the time of the first harvest, soil samples were taken for nematode population determination.

Results and Discussion

Pathogenicity.—During the growth of the first planting, no particular symptoms could be observed in plants in the infested crocks indicating that the level of infestation was too low to affect the plants seriously. When the plants were cut, the average weight of those originally infested with 100 cysts

Table 1. - Effect of Heterodera schachtii on the growth of cabbage.

Treatment	Plant Weight[b] First planting	Plant Weight[b] Second planting	Plant Weight[b] Third planting	Nematode population[c]
Check 1[a]	346	545	236	-----
Check 2	331	525	247	-----
100 Cysts	291	375	64	19300
1000 Cysts	276	354	69	22800
LSD .05	N.S.	108	70	
.01		152	100	

[a] Check 1 received no additions whereas check 2 received 50 ml of water taken from around floating cysts.

[b] Average fresh weight of plants in grams.

[c] Average number of larvae extracted from 100 cc of soil at harvest of second planting.

was approximately 14% less than that of the check plants and those originally infested with 1000 cysts was 19% less. However, these differences were not great enough to be statistically significant (Table 1).

During growth of the second planting, plants in infested crocks were considerably stunted with some chlorosis occurring. On warm sunny days severe wilting of infected plants occurred (Figure 1). Plant weight was reduced approximately 30 and 34% respectively for the 100 and 1000 cyst original infestation level (Table 1) and the nematode population had reached a very high level in all of the infested crocks. Since there was little difference between the populations of the two treatments, apparently a maximum population was approaching.

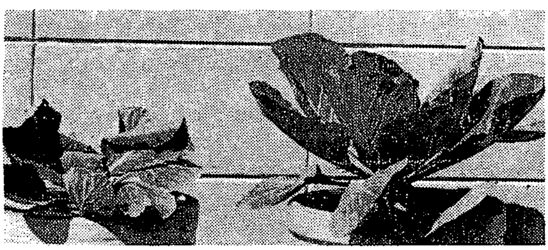

Figure 1.—Effect of Heterodera schachtii on the growth of cabbage. Left, heavily infested; right, uninfested.

Severe stunting and chlorosis occurred in all infested crocks during growth of the third planting. Average plant weight was reduced approximately 72% by the nematodes (Table 1).

Control. — Since relatively high populations of sting (*Belonolaimus longicaudatus*) and lance (*Hoplolaimus* spp.) nematodes were present in the area of the fumigation experiment, the effect of *H. schachtii* on yield could not be determined and yield data was not collected. However, a remarkable improvement in growth was observed in the fumigated plots and nematode counts showed that both D-D and DBCP greatly reduced the populations of all the nematodes (Table 2).

The results of these experiments show that under greenhouse conditions *H. schachtii* is capable of building up to extremely high populations in a Florida fine sand soil and seriously injuring cabbage. Also, that soil fumigation with standard D-D and DBCP type fumigants will greatly reduce populations of this nematode and will probably give protection for at least one crop as has been found for other soil types in other sections of the country.

Table 2. - Efficacy of D-D and DBCP soil fumigants for controlling sting, lance, and sugar beet nematodes.

Treatment	Nematode Populations a		
	Sting	Lance	Sugarbeet (larvae)
Check	41	213	238
D-D, 25 gal/acre	0	12	32
DBCP, 25 lb/acre	0	10	30

[a] Average number of nematodes extracted from 100 cc of soil.

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CABBAGE LOOPER INJURY TO DIFFERENT CABBAGE CULTIVARS

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Abstract

Thirty-eight cabbage cultivars grown during 1968-1971 without insecticide treatments showed differences in amounts of cabbage looper injury at harvest. None of the cultivars were commercially acceptable but those showing lesser damage would have been usable with light trimming. Differences between cabbage cultivar and season were not significant at the 5% level. Low cabbage looper injury appeared to be coupled with increased flaccidity, toughness, and pungency.

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Introduction

The cabbage looper, *Trichoplusia ni* (Hübner), is a serious pest of cruciferous crops in Florida. Objections and difficulties with chemical controls have led to studies of other methods of producing insect damage-free crops. Host resistance offers promise and some data are available. Pimentel (3) found that various *Brassica* crops exhibited resistance to 5 insect species but not to low densities of cabbage loopers. He found each variety to have its own pattern of insect resistance based on physiological and ecological factors and the interactions of both. Wolfenbarger (4) made ratings of cab-