grow but suppressed other fungi. Foc colonies were sufficiently different in color and shape from other Fusaria to be easily counted after incubation for eight days at 78°F under diffuse light.

We also planted seeds of 'Rio Verde' cabbage in field soil taken from the same depths. After emergence, the seedlings were grown for five weeks at 75° (night) to 82°F (day) in a growth chamber. We rated disease severity by averaging the data from three replicates per treatment of 60 seedlings per sample.

In addition, the field plots were hand-seeded densely with the 'Rio Verde' cultivar in five rows per plot, approximately 6 inches apart. After emergence, seedlings were thinned to 2-inch intervals. Plants were observed frequently for yellows symptoms and, after 70 days, disease severity ratings were made from the three central rows. Disease incidence was indicated by 50 plants selected at random from each plot and rated for internal stem discoloration. Roots were excised, surface-sterilized, and plated on an agar medium to detect Foc.

Foc was practically eliminated and cabbage yellows was not detected in the field in the treatments combining solar heating of soils with cabbage amendments (1 percent by weight). Both solar heating alone and cabbage amendments plus cover under shade were effective, but not as effective as the combination of solar heating and cabbage amendments. In contrast, cabbage amendments without cover were ineffective, whether under shade or in direct sunlight.

Conclusions

In laboratory and field tests, solar heating of soil amended with cruciferous crop residues controlled cabbage yellows and practically eliminated the pathogen (Foc) from infested soil. The use of a tarp is necessary, not only to increase the temperature of the soil to critical levels under solar heating, but also to trap fungitoxic gases emanating from the amendments.

Polyethylene tarps are readily available and can be laid by hand over small areas or by machines over large acreages. Crop residues from a previous crop possibly may be used — certainly residues from cruciferous plants should be tried.

The concentration of cabbage used in our trials was high. Results from laboratory experiments suggest that lower concentrations are feasible and should be tried in future field trials. The technique, which is effective, safe, and easy to apply, may prove useful against other soil-borne diseases as well as cabbage yellows.

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Host range and life cycle of *L. africanus*

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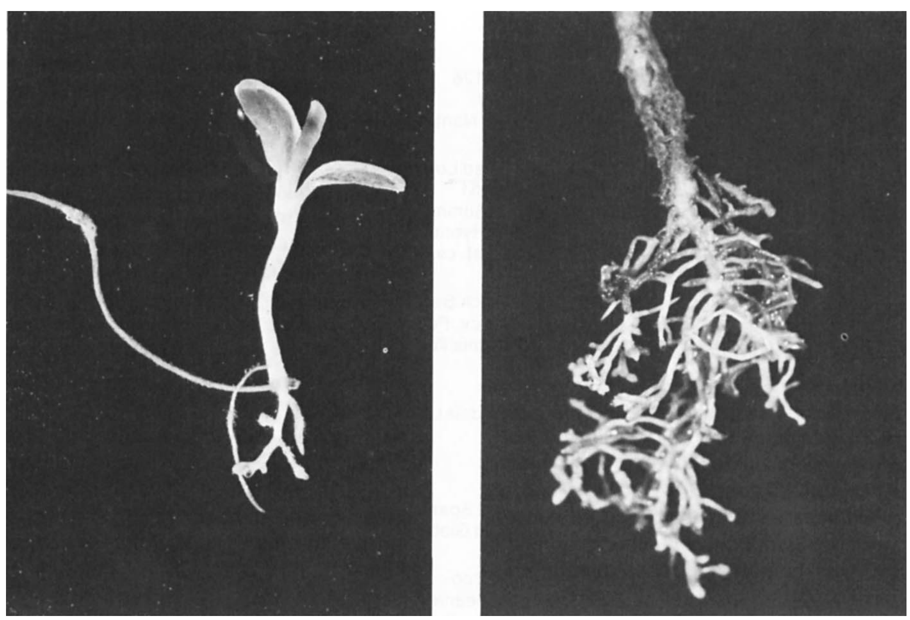
Widespread in the Imperial Valley, this needle nematode can cause severe seedling disease at relatively low populations

In 1969, a needle nematode was first reported to be causing a disease of head lettuce in the Imperial Valley of southern California. Root tips of lettuce seedlings attacked by this external parasite, *Longidorus africanus,* are swollen and usually have necrotic spots at the feeding sites. Seedlings are severely stunted when compared with nematode-free plants.

Because of the importance of this nematode in fall-planted lettuce, chemical control with preplant fumigants has proved to be profitable. Information has been lacking, however, on distribution of



Swelling and dead spots on root tips of a lettuce seedling and a six-week-old lettuce plant are symptoms of soil infestation by the needle nematode, *Longidorus africanus.* The nematode is widespread in a broad range of Imperial Valley crops.

this needle nematode in the Imperial Valley and on its host range and life cycle. Such information is needed for development of a rational pest management scheme.

Host range studies

Our study evaluated as potential *L. africanus* hosts 33 cultivars of crops that have been grown at one time or another in the Imperial Valley (table 1). Six pots for each cultivar were filled with air-steamed sandy loam soil, seeded, and maintained in the greenhouse at approximately 80°F. Plants, when two to three weeks old, were inoculated with 30 needle nematodes of mixed life stages. During the third month after inoculation, plants were washed free of soil, nematodes extracted (by the wet screening-cheesecloth technique) and counted, and any symptoms of root feeding by nematodes noted.

The host range data demonstrated that this nematode is capable of feeding and reproducing on a large number of crop plants grown in the Imperial Valley. Furthermore, the feeding process damaged the root tips of most host plants observed, and the severity of root damage was proportional to the extent of nematode buildup and host suitability (table 1).

TABLE 1. Plant cultivars tested for suitability as hosts for the needle nematode, *Longidorus africanus*, and effect of different plant cultivars on its reproduction under greenhouse conditions

Plant family and common name	Scientific and cultivar name	Final population*	Percent Change†	Host rating‡
Control	Moist fallow soil	11	− 19	
Poaceae				
Sorghum	*Sorghum bicolor* (L.) Moench, cv. G-499 GBR	487	+4,327	B
Barley	*Hordeum vulgare* L., cv. UC 566	300	+2,627	G
Bermudagrass	*Cynodon dactylon* (L.) Pers., cv. Common	270	+2,355	G
Corn	*Zea mays* L., cv. Gldn. Cross Bantam	234	+2,027	G
Wheat	*Triticum aestivum* L., cv. Ramona 70	196	+1,682	G
Oat	*Avena sativa* L., cv. Sierra	53	+ 382	FP
Malvaceae				
Cotton	*Gossypium hirsutum* L., cv. SJ-4	254	+2,209	G
Okra	*Hibiscus esculentus* L., cv. Clemson Spineless	154	+1,300	G
Asteraceae				
Lettuce	*Lactuca sativa* L., cv. Climas	254	+2,209	G
Sunflower	*Helianthus annuus* L., cv. Mammoth	38	+ 245	FP
Fabaceae				
Snap bean	*Phaseolus vulgaris* L., cv. Green Pod	649	+5,800	B
Lima bean	*Phaseolus lunatus* L., cv. Baby Fordhook	577	+5,146	B
Alfalfa	*Medicago sativa* L., cv. Moapa	88	+ 700	FP
Pea	*Pisum sativum* L., cv. Snowbird	63	+ 473	FP
Umbelliferae				
Carrot	*Daucus carota* L., cv. Danvers 126	85	+ 673	FP
Carrot	*Daucus carota* L., cv. Imperator	62	+ 464	FP
Carrot	*Daucus carota* L., cv. Half-long Nantes	48	+ 336	FP
Cucurbitaceae				
Cucumber	*Cucumis sativus* L., cv. Improved Long Green	282	+2,464	G
Cantaloup	*Cucumis melo* L., cv. Delicious 51	130	+1,082	FP
Squash	*Cucurbita pepo* L., cv. Golden Summer Crookneck	90	+ 718	FP
Zucchini	*Cucurbita pepo* L., cv. Burpee Hybrid	62	+ 464	FP
Watermelon	*Citrullus lunatus* (Thumb.) Mansf. cv. Crimson Swt.	55	+ 400	FP
Solanaceae				
Eggplant	*Solanum melongena* L., cv. Black Beauty	348	+3,064	G
Tomato	*Lycopersicon esculentum* Mill. cv. Pearson Imp.	193	+1,655	G
Pepper	*Capsicum annum* L., cv. California Wonder	109	+ 891	FP
Chenopodiaceae				
Sugarbeet	*Beta vulgaris* L., cv. USH 10	453	+4,018	B
Spinach	*Spinacia oleracea* L., cv. Blmngsdale Long Standing	92	+ 736	FP
Labiatae				
Spearmint	*Mentha spicata* L., cv. Burpee	52	+ 373	FP
Liliaceae				
Onion	*Allium cepa* L., cv. White Sweet Spanish	39	+ 255	FP
Radish	*Raphanus sativus* L. cv. Scarlet Globe	21	+ 91	FP
Cruciferae				
Broccoli	*Brassica oleracea* L., cv. De Cicco	30	+ 173	FP
Cauliflower	*Brassica oleracea* L., cv. Burpeeana	6	− 80	NH
Cabbage	*Brassica oleracea* L., cv. Yellows Resistant	2	− 93	NH

* Means of four replicates.

† Expressed as percentage increase or decrease in fallow soil population.

‡ Host rating scale: B = best host; G = good; FP = fair to poor; NH = nonhost.

Life cycle and distribution

We studied the length of the nematode's life cycle in three experiments using tomato, which we had found to be a good host in the host range test. With an optimum soil temperature under greenhouse growing conditions, the life cycle of *L. africanus* was completed in seven weeks. However, information from soil fumigation and population studies conducted in the Imperial Valley (not reported here) strongly indicates that the life cycle under field conditions in the valley can be less than seven weeks.

TABLE 2. Survey of 39 Imperial Valley fields for *Longidorus africanus*

Plants	Fields sampled*	Fields infested *L. africanus*†
Cotton	6	2 (16)
Cantaloup	7	1 (11)
Honeydew melon	1	0
Squash	2	0
Alfalfa	6	3 (5)
Sudangrass	4	1 (171)
Sorghum	4	1 (7)
Soybean	2	0
Asparagus	1	0
Bermudagrass	5	3 (36)
Portulaca	1	1 (8)
Total	39	12
Percent	100	31

* Soil samples consisted of four cores per sample with one sample per field.

† Numbers in parentheses indicate number of *L. africanus* per 644 cc of field soil.

During the summer, we sampled 39 fields in the Imperial Valley in which potential host crops were growing. The nematode was present in 12 of the fields, representing 31 percent of the total sampled (table 2). Soil type was seemingly not a limiting factor in the distribution of the pest, as is often the case with other nematodes such as the root-knot (*Meloidogyne*) species.

Conclusions

Our results demonstrate that the needle nematode, *L. africanus*, is widespread throughout the Imperial Valley. The nematode has a wide host range; most valley crops, with the exception of the crucifers, should be considered capable of supporting populations high enough to cause economic damage to fall-planted crops. Experimental work reported elsewhere confirms that this nematode is a relatively high-temperature organism and will probably be of greatest economic significance in fall crops, such as lettuce and tomatoes, where soil temperatures exceed 80°F at planting time.

This nematode can cause a serious seedling disease at relatively low population levels in soil. Because it feeds on root tips, plants are often severely stunted before the first true leaf develops. As infected plants mature, the stunting continues, and they may never reach harvest maturity. Root systems on older infected plants are greatly reduced in size, and root tips display the same symptoms as observed on seedlings. Preplant control by crop rotation, prolonged fallow, or chemicals is essential if susceptible crops are grown in land where economically significant levels of the nematode. exist.

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