Root Fumigation

carrot and beet roots used in tests for nematode control

J. F. Harrington and H. K. Pratt

Seedsmen should never use carrot and beet roots infested with root knot nematode for transplanting into uninfested soil.

In tests to find a means to sterilize the roots at the time of transplanting—without injury to the roots—both heat treatments and three fumigants were tried.

In a preliminary test, different lots of ten roots each of two varieties of carrot were immersed in water at 120° F for 15 minutes and 110° F for three hours. Additional lots were stored at 0° F for two hours. None of the roots survived these treatments. The treated roots rotted when placed in the soil, while the untreated roots all grew. Therefore, none of these treatments could be used for nematode control.

In a more extensive experiment, the tolerance of carrot and beet roots to fumigation and vapor heat treatments was tried with the view that later tests could be made on infected stock if any tolerance level appeared promising. Three fumigants—methyl bromide, ethylene dibromide, and ethylene chlorobromide—were each tested at five different combinations of rate and time. The roots were treated in a fumigation chamber at 68° F. The rates given in the larger table on this page are in pounds of fumigant per 1,000 cubic feet of chamber volume. The five vapor heat treatments were done with steam in modified mattress sterilizers.

For each treatment, two matched lots of 20 carrot roots per lot and two matched lots of 25 beet roots per lot were used. After treatment one lot was planted in a Yolo heavy clay loam, and the second in a Yolo fine sandy loam. The table lists the treatments and contains the data obtained on survival in the field. The data from the two field lots for each treatment were combined since there was almost no difference in results between the two fields. The relatively poor survival of the carrot check plots was due to root decay which started in the period between digging and the experimental treatments and which affected all treatments equally. The survival results indicate that the following treatments would be the maximum that might be safe:

	Carrots	Beets
Vapor heat ...	none	none
Ethylene dibromide	1 lb. for 2 hrs.	2 lbs. for 2 hrs.
Methyl bromide	2 lbs. for 2 hrs.	4 lbs. for 2 hrs.
Ethylene chlorobromide .	2 lbs. for 2 hrs.	1 lb. for 2 hrs.

Of the beet roots that survived any of the treatments, only 74.7% produced seed stalks compared to 90% of the beets in the check plots. Thus the treatments converted some beet roots back to a vegetative state. All carrot roots produced seed stalks.

It is not known whether these maximum safe fumigation treatments would control nematode in the roots of carrots and beets. So far, no treatment can be recommended that will control nematodes in beet or carrot roots without seriously injuring or killing the roots.

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The test roots were obtained through the cooperation of B. H. LaZansky, Ferry-Morse Seed Company.

The Effect of Treatment on Survival of Roots Planted in Test Plots

Treatment	Rate	Plants Which Survived Carrots	Plants Which Survived Beets
Vapor heat	110°F, 0 hr.*	0%	52.5
	110°F, 2 hr.	0	35.0
	110°F, 4 hr.	0	20.0
	120°F, 0 hr.*	0	0
	130°F, 0 hr.*	0	0
Ethylene dibromide	1 lb., 2 hr.	40.0	95.0
	2 lbs., 2 hr.	7.5	72.5
	2 lbs., 4 hr.	0	0
	4 lbs., 2 hr.	0	0
	4 lbs., 4 hr.	0	0
Methyl bromide	2 lbs., 2 hr.	35.0	92.5
	4 lbs., 2 hr.	22.5	75.0
	4 lbs., 4 hr.	0	0
	8 lbs., 2 hr.	20.0	2.5
	8 lbs., 4 hr.	0	0
Ethylene chloro-bromide	1 lb., 2 hr.	42.5	82.5
	2 lbs., 2 hr.	42.5	57.5
	2 lbs., 4 hr.	17.5	35.0
	4 lbs., 2 hr.	17.5	32.5
	4 lbs., 6 hr.	0	0
Average of four check plots		40.6	92.5

* Roots were brought to this temperature and immediately cooled.

PARASITES

Continued from preceding page

Lambs raised under worm-free conditions were successfully infected with six species of stomach and intestinal worms cultured from deer feces.

To some extent, parasites appear to exhibit a correlation both in their numbers and in their effects with the physical condition of the host. This effect is most likely to be influenced by nutrition of the host. Nutritional status in turn is largely determined by the availability of food and bodily demands for maintenance, growth, and reproduction. Young animals—because of the demand on their nutritive intake for growth—are in a relatively poor position to withstand attacks by parasites. Both sheep and deer were found to build up resistance to worms after exposure so that animals past their first year generally carried only a small worm burden.

Parasitism under these range conditions can probably be best attacked by improving range management practices, with stocking rates being one of foremost importance.

Chemical control of nematodes in sheep can be effective, however. Successful control with phenothiazine—the most effective agent—includes therapeutic doses given as a drench or pellet according to body weight, as well as prophylactic doses in a salt mixture. Obviously such a program is not practical for deer. On the other hand, it is probable that a reduction of nematodes in the sheep flock would be of indirect benefit to deer in that the rate of infection would be lowered. By the same token, reducing the incidence of roundworms in deer would benefit the sheep.

Nematode transference between sheep and deer is primarily a problem of the north coastal section of the State. There large numbers of both of these animals share common range, and conditions of moisture, temperature, and vegetation make it possible for the worms to complete their life cycle.

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