THE OCCURRENCE AND CONTROL OF THE ROOT-LESION EELWORM (*PRATYLENCHUS LOOSI*) IN NURSERIES

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During 1965 and 1966, 60 nurseries on 52 estates in most of the up-country planting districts of Ceylon, were sampled and the level of eelworm infestation determined. *Pratylenchus loosi* was not detected in 24 nurseries, infestation was very light in 16, light in 13, moderate in five and two nurseries were heavily infested.

Results of a nursery soil fumigation experiment have shown that methyl bromide is better than DD for controlling *P. loosi*, and has several other advantages, but at the present recommended rate of application, it is more expensive.

There is still no direct evidence that nurseries can become re-infested by eelworms carried in water.

There is little doubt that the most important mode of spread of the root lesion eelworm, *Pratylenchus loosi*, from estate to estate and even from district to district, has been by transporting rooted cuttings. There is also strong circumstantial evidence that heavy eelworm infestation of new clearings usually originates in the nursery. For these reasons it is very important to know the extent and level of eelworm infestation in estate nurseries and whether the control measures practised are adequate. This paper presents results of an eelworm survey of estate nurseries and also gives details of a soil fumigation experiment in which methyl bromide was compared with DD ; water as a possible source of re-infestation was also investigated.

Nursery survey

All estates above 3000 ft in elevation from which *P. loosi* has been recorded, were listed and 52 estates chosen at random, but ensuring proportional representation of the different planting districts. The nurseries on these estates were sampled by taking between 100 and 200 well-grown plants from each nursery, the number depending on the size of the nursery. Plants were taken in groups of ten from several sites, the sites being selected at random. Roots of the selected plants were freed from soil and brought back to the TRI for eelworm extraction by the method prescribed by Hutchinson (1962). Soil from around the roots was thoroughly mixed, ten soil samples taken and eelworms extracted from each sample by a modification of the Baermann funnel technique. The level of infestation was given an arbitrary rating, details of which are given in Table 1.

TABLE 1—*Arbitrary rating of level of eelworm infestation*

Roots (No. of *P. loosi* per g root)	Soil (No. of *P. loosi* per 100 g soil)	Rating
Less than 5	Less than 1	Very light
6–40	1–5	Light
41–100	6–25	Moderate
101–250	26–70	Heavy
More than 250	More than 70	Very heavy

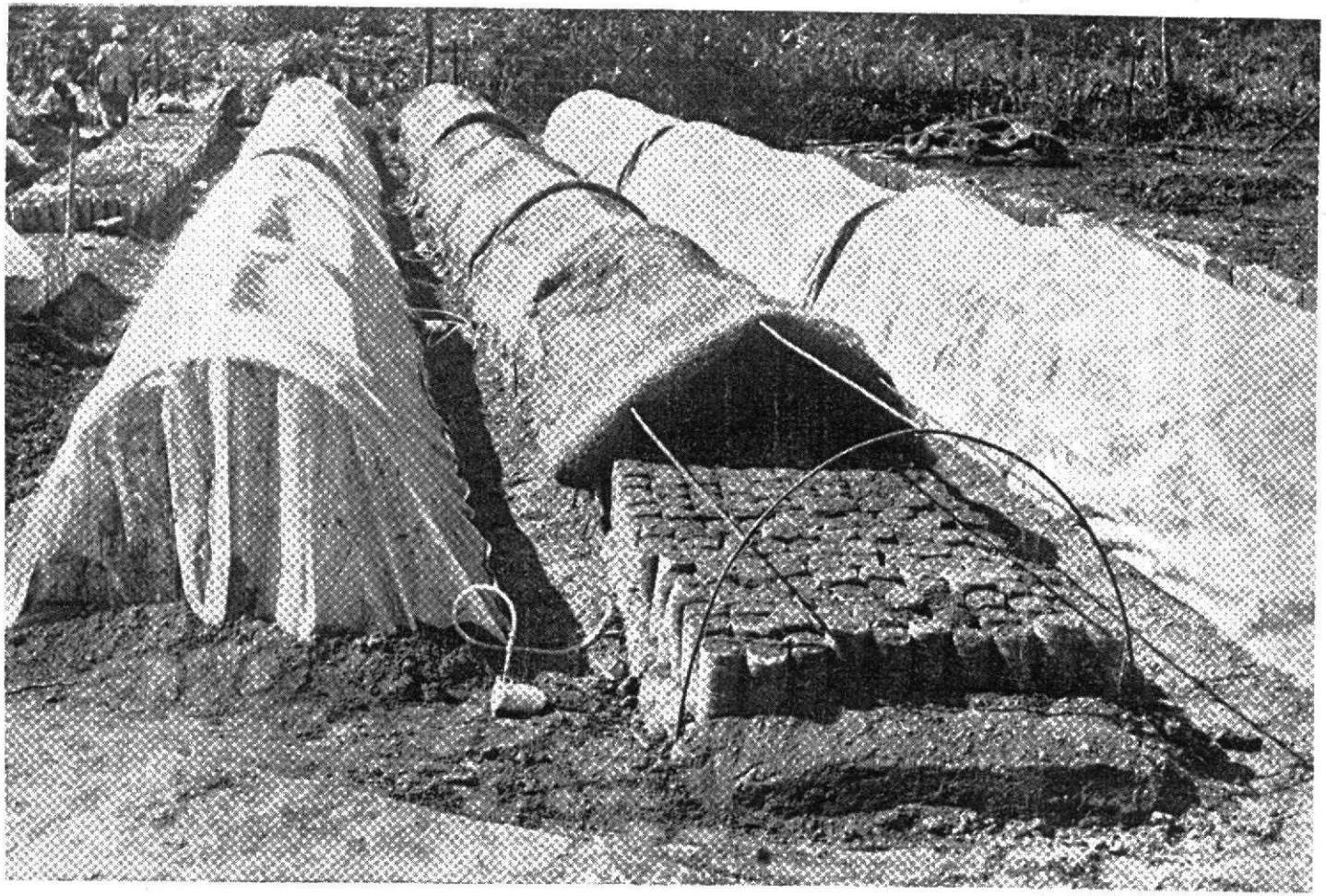

FIGURE 1—*Fumigation of nursery beds and bags with methyl bromide — It is more convenient to fumigate alternate beds and after 48 hours transfer the polythene sheets to adjacent beds*

As might be expected, there was a very close correlation between the results of the root and soil extractions. Where the ratings for the two methods of extraction differed, the higher rating was given. *P. loosi* was detected in 60 per cent of the nurseries sampled. Details are given in Table 2.

TABLE 2—*Eelworm infestation of estate nurseries*

District	No. of estates visited	No. of Nurseries sampled	Level of Infestation (No. of nurseries)				
			None	Very light	Light	Moderate	Heavy
Badulla ...	5	7	2	5	–	–	–
Dickoya ...	5	5	2	1	1	–	1
Dimbula ...	15	18	5	2	7	3	1
Haputale ...	4	5	2	–	2	1	–
Hewaheta ...	3	4	2	1	–	1	–
Madulsima ...	1	1	1	–	–	–	–
Maskeliya ...	4	4	1	1	2	–	–
Maturata ...	3	3	1	1	1	–	–
Nuwara Eliya ...	2	2	1	1	–	–	–
Passara ...	2	3	2	1	–	–	–
Ramboda ...	2	2	2	–	–	–	–
Rangalla ...	2	2	2	–	–	–	–
Uda Pussellawa ...	4	4	1	3	–	–	–
TOTAL ...	52	60	24	16	13	5	2

During the survey, details were obtained of the method of soil fumigation, if any, on all estates visited, and are given in Table 3 along with the corresponding levels of infestation. Where soil was fumigated, DD was the fumigant used on all estates except one, where Nemagon was used.

TABLE 3—*Methods of soil fumigation and level of infestation*

Method of fumigation	No. of estates	Level of infestation (No. of estates)				
		None	Very light	Light	Moderate	Heavy
No fumigation	22	10	6	4	2	–
Only bag soil fumigated ...	28	9	8	6	3	2
Bag soil & beds fumigated* ...	10	5	2	3	–	–
	60	24	16	13	5	2

* This category includes only those estates that fumigate the nursery beds every year.

The results presented in Table 3 must not be misinterpreted. On the surface, it looks as if no fumigation is as good as, if not better than, the other treatments. The most likely reason for this is that although *P. loosi* has been recorded on these estates, nearly half the nurseries are on eelworm-free sites and have an eelworm-free source of soil. To put it bluntly, these estates are lucky. Two main conclusions can be drawn from the data in Table 3. First, **fumigating only the bag soil is quite unsatisfactory for the control of** *P. loosi*; secondly, even when both the bag soil and the nursery beds are fumigated, 100 per cent control is not always achieved. The first conclusion is what one would expect. If the beds are infested, there is nothing to prevent *P. loosi* moving from the beds into the bags. The second conclusion is more difficult to explain. Assuming that the fumigation was carried out according to the recommendations given by Kerr (1963), there seem to be two possible reasons; either fumigation with DD is not 100 per cent effective, or nurseries become reinfested, the most likely source of reinfestation being the water used in nurseries. Experiments were designed to investigate these possibilities.

Soil fumigation with methyl bromide and DD

An experiment was designed to compare methyl bromide and DD as fumigants for nursery soil. There were three treatments in four randomized blocks, the first treatment being the normal DD fumigation which involves separate fumigation of the bag soil and of the nursery beds (Kerr 1963). The second treatment was the same as the first except that methyl bromide at the rate of two pounds per 100 sq ft was used instead of DD. In the third treatment, the bags were filled with soil and placed on the nursery beds and then the bags and beds were fumigated together with methyl bromide at the same dosage rate. The soil used in the experiment was topsoil from an infested field. Four weeks after fumigation, soil from the first two treatments was added to bags which were placed on the nursery beds. Cuttings of clone TRI 2024 were then planted in all the bags and the level of infection in the roots determined six months later. Percentage rooting and growth of rooted cuttings were also measured. Results are given in Table 4.

TABLE 4—*Fumigation of nursery soil with DD and methyl bromide (MB)*

	Fumigation of bag soil and bed soil		
	Separate		Combined
	DD	MB	MB
P. loosi/g root	11.1	1.1	0.0
% rooting	54.5	66.2	83.9
Mean weight of rooted plants (g) ..	39.9	50.8	58.3

Differences not significant at P = 0.05 are bracketed.

Not only did the combined methyl bromide fumigation (Treatment 3) give better control of *P. loosi* than did DD, but percentage rooting was higher and growth of rooted plants greater. Figure 1 shows a nursery bed being fumigated with methyl bromide.

In the experiment described above, planting of cuttings was delayed for four weeks following methyl bromide fumigation, but this was only to provide a strict comparison with DD. Further experiments have shown that cuttings can be safely planted 24 hours after the polythene sheet has been removed. **Tentative recommendations for fumigation of nurseries with methyl bromide have already been given** (Kerr & Vythilingam 1966) **and these are now confirmed.** A current experiment is designed to determine if the recommended dosage rate of 2 lb per 100 sq ft can be reduced. Results are not yet available.

Water as a source of re-infestation

It has been suggested by many Superintendents that nurseries become reinfested by eelworms carried in water. This is a very real possibility, but unfortunately there is no easy method of checking water for the presence of eelworms. Thousands of gallons of water are used on an estate nursery every day during dry weather and it is virtually impossible to check a sufficiently large volume of water to make the results worthwhile. Instead we have tried to infect a nursery by using water directly from an infested field. Two small nursery beds, each of 360 cuttings were used in this experiment. Water directly from an infested field was used to

water one bed, while for the other, water from the same source was held in sedimentation tanks for 24 hours before being used. Level of infestation was measured after 6 and 12 months, but no *P. loosi* was detected in either bed.

Discussion

The root lesson eelworm, *P. loosi*, was detected in 36 nurseries out of 60 sampled —60% infestation. As the estates were selected at random and the sampling was at random, there is every reason to believe that this represents an accurate picture of the level of infestation of nurseries on estates from which *P. loosi* has been recorded. The position is far from satisfactory and it is important to look at the possible reasons for it. In the first place, only ten of the estates visited practised the soil fumigation treatment recommended by the TRI (Kerr 1963). None of these estates had more than light infestation, but even this is not satisfactory and it would appear that DD does not give the best control of *P. loosi*. This was confirmed in the experiment in which DD was compared with methyl bromide. The experimental conditions were particularly severe, because topsoil with heavy eelworm infestation was used, a situation which would never apply in an estate nursery. In addition, there were many living tea feeder roots in the soil and it is possible that eelworms within the roots would be protected from DD, whereas methyl bromide might penetrate such roots. We still believe that under normal estate conditions DD, properly applied, gives good control of *P. loosi*, but there are many ways in which it can be misapplied and we consider that better results will be achieved by using methyl bromide. The most common way of misapplying DD is the failure to fumigate the nursery beds *every year*. If a nursery is infested, and it would appear that 60% of them are, the infestation will remain year after year in the beds if they are not fumigated, and there is nothing to prevent *P. loosi* moving from the beds into the bags and infecting the rooted cuttings. We have also noticed that soil is frequently stored more than one foot deep before injection. There are other disadvantages of using DD : the nozzle of the injector may become blocked and soil has to be stored for at least four weeks before cuttings can be planted. Apart from the inconvenience which this entails, it is possible for the fumigated soil to become contaminated with untreated soil during storage or while filling the bags. The use of methyl bromide eliminates all these possible sources of infestation—it gives better control of *P. loosi*, the nursery beds are treated at the same time as the filled bags, the soil is not stored after treatment and there are no nozzles to be blocked. It also promotes rooting and growth of cuttings.

Nine hundred bags, four inches in diameter, can be placed on a 100 sq ft nursery bed, which for fumigation, requires 2 lb of methyl bromide at approximately Rs 3.50 per lb. The cost of fumigation is, therefore, 0.78 cents a bag, appreciably more than the cost of DD fumigation.

Water used in the nursery must still be considered as a possible source of reinfestation but there is no direct evidence for this. We have been unable to infect nursery plants by watering them with water directly from an infested field, but further work on this aspect of nursery management is desirable, because it will operate irrespective of the method of soil fumigation.

Finally, it must be emphasized that there is little advantage in fumigating a nursery if it is not surrounded by drains to prevent reinfestation by eelworms carried in run-off water from adjacent fields.

Acknowledgements

We wish to thank the Superintendents of the 52 estates from which samples were taken for their help and co-operation. This work would not have been possible without the combined efforts of all members of the Nematology Division, TRI.

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(Accepted for publication — 14th October 1966)