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Effects of farmyard manures on root-knot nematode populations on carrot

Wirkung von Stalldünger auf Wurzelknollennematoden an Karotten

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1. Introduction

It has been suggested that artificial fertilizers do not seem to have notable direct influence on the nematode populations in the soil (Oostenbrink, 1960). Some workers have shown that organic manures such as stable dung, green manure, compost and other organic materials promote the population of sprozoic nematodes in the soil (Franz 1957; Kleyburg and Oostenbrink, 1959; Linford et al. 1938). Other workers have also found that organic matter added to soil decreases populations of plant-parasitic nematodes (Mankau 1968; Miller et al. 1968; Miller et al. 1973). Enzymes from plant tissue are known to decrease populations of certain plant-parasitic nematodes in vitro and in soil (Miller and Sands 1977). This paper examines the effects of farmyard manures on root-knot nematode population in soil, in relation to its pathogenicity on carrot.

2. Materials and Methods

2.1 Carrot (cv. Chantenay) were raised in a wooden box (45 × 30 × 12.5 cm) in the greenhouse for five weeks. An Nsukka population of the root-knot nematode, Meloidogyne incognita, was maintained and propagated on tomato (Lycopersicon esculentum 'Bonny Best'). Galled tomato roots from the population were excised and washed in tap water to obtain eggs. Galled roots were placed in a jar containing 200 ml of 10% clorox solution. The lid of the jar was closed tightly; the jar was shaken vigorously for 4 min, and the egg suspension was quickly passed through a 200-mesh sieve nested in a 500-mesh sieve (Int. Mel. Project 1978). The 500-mesh sieve contining eggs was held under a slow stream of cold tap water to remove residual clorox. The eggs were then rinsed into a 2-L flask. By repeating this pro-

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cedure eggs were concentrated in a flask, and the number of eggs was counted in 1 ml of the suspension.

2.2 Fresh stable cow dung and fresh chicken droppings from the pen were collected and air dried in a glasshouse for three weeks. Average day temperature recorded was 31.4 °C. The farmyard manures were ground to powder separately. A 2-litre volume of dry sterilized sandy loam soil (texture: 82% sand, 2% silt, 16% clay) was put each into four clay pots (15 cm diameter). Four other pots contained a thorough mixture of 2 litres by volume of sterilized soil and 0.2 litres by volume of powdered cow manure; a 10 : 1 ratio of soil/cow manure. The last four pots had 2 litres by volume of sterilized soil plus 0.4 litres of powdered cow manure thoroughly mixed (10 : 2 ratio). Similar soil/manure mixtures of 10 : 1 and 10 : 2 ratios were made with sterilized soil and poultry manure. Each mixture as well as sterilized soil alone were potted and replicated four times. Potted soils were moistened and a hole (4 cm deep) was made at the centre of each pot. Five week old carrot seedlings were carefully lifted and transplanted, one each into a pot and then inoculated with 2000 nematode eggs. Control plants in the unamended soil were not inoculated. Transplanting was done in the evening when it was cooler. The transplants were placed in the shadehouse under ambient temperature conditions. Plants were grown for nine weeks from transplanting dates. The number of leaves on each plant was counted and recorded. Plant heights were taken as the measurement from soil-plant base to the furthermost point of the foliar system. Shoot weights (fresh) were taken; fresh weights of the root systems were also recorded after roots had been assessed for galling. Larval extractions were made from 50 cc of soil from the rhizosphere and counted.

3. Results

Plant growth in the different treatments and the respective nematode pathogenicity on the inoculated plants are summarized in Table 1. Fig. 1 shows average number of nematode larvae recovered from 50 cc of soil in the rhizosphere after plants in the different treatments were removed for examination. No larvae were recovered from soil in which control plants were grown (Treatment 6). The best overall growth in terms of plant development was in treatments 3 and 4. Highest gall count was also in treatment 3, while the least was in treatment 4.

4. Discussion

Vegetative growth and development of carrot (cv. Chantenay) in treatment 6 (control) was not better than in the other treatments which had nematode inoculants. Ordinarily, the sandy loam soil used did not seem to be suitable for active growth of Chantenay carrot. The pattern of development in this experiment indicated that carrot grew better in soil treated with poultry manure than that treated with stable cow manure. Although in the soil/poultry manure ratio of 10 : 1, the highest gall count was recorded, this is attributed to the fact that addition of organic manure can improve root development of an infected host crop and thus promote the population of a plant-parasitic nematode indirectly. This has been

demonstrated for Heterodera species (Hesling, 1959). On the other hand, soil/poultry manure ratio of 10 : 2 yielded the least gall count on the carrot, thus making the carrot seemingly resistant to infection. The reason for this may relate to those earlier observations, that organic manuring added to soil suppresses the rate of infestation and reproduction of nematodes like Heterodera (Laan 1956), or Meloidogyne (Johnson, 1959; Linford et al. 1938). It could also be a simple change in the plant, resulting in a slight resistance (Laan 1956). Nevertheless, the indication in this experiment is that the amount of organic matter added to soil would be of relative proportion, to either enhance nematode population or to suppress it. These values did not show for the cow manure, but it did show for poultry manure in which the soil/manure ratio of 10 : 1 enhanced nematode population, possibly indirectly, but suppressed it at the 10 : 2 ratio. Nematodes may be exposed to different enzymes during the decomposition of different types of organic matter in the soil. The nature, amount and effect of these enzymes could vary from one organic matter to the other.

5. Summary

Meloidogyne incognita eggs were inoculated to carrot grown in sandy loam soil alone and in soil amended with dry stable cow manure and dry poultry manure. All inoculated plants in the different treatments were galled to varying degrees. The most severe galling occurred in plants grown in soil/poultry manure ratio of 10 : 1. The least galling occurred in plants grown in soil/poultry manure ratio of 10 : 2. Vegetative growth was, however, best in soils treated with poultry manure than those treated with cow manure. Carrot did not grow well in unamended sandy loam soil.

Zusammenfassung

Eier von Meloidogyne incognita wurden Karrotten eingeimpft, die nur im sandigen Lehmboden sowie im Boden, verbessert mit trockenem Kuhmist und im Boden verbessert mit trockenem Hühnermist angebaut wurden. Alle okulierten Pflanzen in den verschiedenen Versuchen waren unterschiedlich stark befallen. Die stärkste Mißbildung trat bei Planzen auf, die gepflanzt waren in Boden/Hühnermist im Verhältnis 10 : 1. Die geringste Mißbildung kam bei Pflanzen, die in Boden/Hühnermist im Verhältnis 10 : 2 wuchsen, vor. Das vegetative Wachstum jedoch war besser im Boden verbessert mit Hühnermist als in Böden behandelt mit Kuhmist. In dem unverbesserten sandigen Lehmboden wuchsen die Karotten nicht gut.

Table 1. Mean root galls, leaf number, plant height, shoot weight and root weight of carrot inoculated with Meloidogyne incognita eggs and grown in soils with or without organic amendments, as compared with growth of uninoculated controls

Treatments*	Leaf No	Plant Ht (cm)	Shoot Wt. (g)	Root Wt. (g)	Gall No
1	10	15.5	6.3	5.0	82.5
2	10	12.5	5.9	4.6	75.0
3	18.5	20.6	43.9	21.8	124.25
4	13.0	23.8	39.6	18.8	7.75
5	10.0	15.3	5.6	3.8	53.75
6	10.5	15.5	6.5	5.0	–
LSD_{05}	2.88	0.80	0.93	1.08	10.2

* 1 = 2 litres by volume of sterilized soil mixed with 0.2 litres of ground cow manure (10 : 1)
2 = 2 litres by volume of sterilized soil mixed with 0.4 litres of ground cow manure (10 : 2)
3 = 2 litres by volume of sterilized soil mixed with 0.2 litres of ground poultry manure (10 : 1)
4 = 2 litres by volume of sterilized soil mixed with 0.4 litres of ground poultry manure (10 : 2)
5 = 2 litres by volume of sterilized soil, unamended and inoculated
6 = 2 litres by volume of sterilized soil, unamended and uninoculated (control)

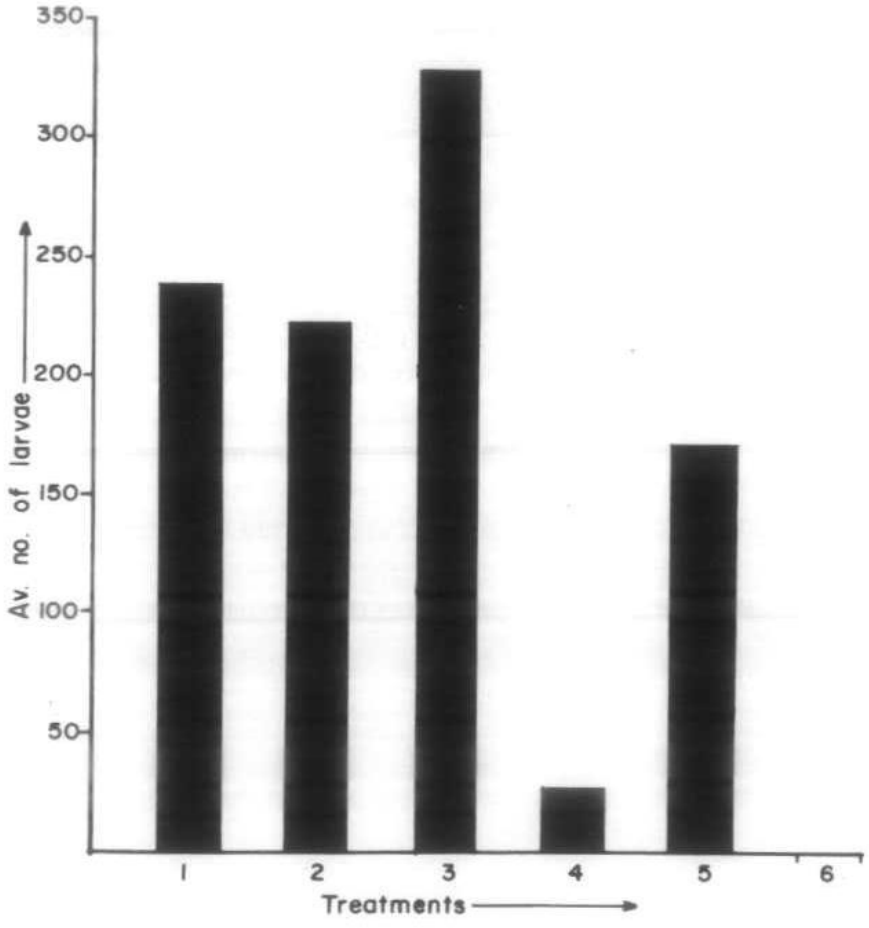

Fig. 1. Average number of Meloidogyne incognita larvae extracted from 50 cc of soil

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