Neth. J. Pl. Path . 75 (1969) 40–44

Influence of repeated applications of nematicides on the soil fauna in begonia culture[1]

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Accepted 25 July, 1968

Abstract

At present most of the begonia growers around Ghent disinfect their fields annually or biennially to control nematodes, weeds, and also fungi. Investigations therefore were carried out on the influence of this annual application of nematicides on the soil fauna. Samples were taken in September from two adjacent experimental plots; one plot was disinfected for five consecutive years with 6 ml of DD per m^2, the other was used as a control. It was found that the annual disinfection of begonia fields with DD did not depress the saprophagic fauna and that earthworms, enchytraeids, mites and collembola were mainly in the upper 5 cm of the soil.

Introduction

Since infections of *Pratylenchus penetrans* have been established (Allen and Raski, 1952; D'Herde et al., 1961) in begonia crops, the use of soil fumigants has greatly increased in the Ghent area. At present most begonia growers disinfect their fields annually or biennially to control nematodes, weeds, and also fungi.
In this paper the results of yearly applications of nematicides on the soil fauna in begonia crops are reported.

Materials and methods

Sampling was done on two experimental plots of the State Research Station for Entomology of the Agricultural Research Centre at Ghent. Two adjacent plots of approximately 100 m^2 were compared. One plot was disinfected in 1962 with DD and has since been kept as a control; the other one has been disinfected annually in November with DD at the rate of 60 ml per m^2 up to and including 1967. Both have been planted with *Begonia tuberosa* as monoculture for all these years. Both plots had a soil with a texture of fine sand (covering sands). Stable manure was used as fertilizer, sometimes with cotton wastage and supplementary fertilization according to the results of chemical analyses.
Sampling was carried out mid-September 1967, by means of three rings placed on top of one another, each 4 cm high and having an internal diameter of 77 mm. For earthworms the volume was four times as large and sampling was done at the beginning of

[1] Research subsidized by the Institute for the Encouragement of Scientific Research in Industry and Agriculture (IWONL).

October. The rings were driven bij foot into the ground between the begonia tubers, so that only a few roots, or none at all, were taken in the soil to be examined. Lumbricidae Enchytraeidae, Nematoda, Collembola and Acari were collected from the samples.
The following methods were used:
(1) for mites and collembola: the Tullgren-funnel;
(2) for enchytraeids: a modified Baermann-funnel, similar to that described by O'Connor (1962);
(3) for nematodes: a modified Oostenbrink-method as described by De Maeseneer and D'Herde (1963);
(4) for earthworms: manual sorting.
A total of 192 ring samples were taken (4 methods × 2 plots × 3 depths × 8 replicates). Electric bulbs of 40 and 60 Watts respectively were used with the Tullgren- and Baermann-funnels. The sieves had a diameter of 12 cm and an edge of 7 cm; size of the mesh was 1 mm. The rings with the soil samples were placed directly on these sieves. For nematodes 100 ml samples of soil were taken from the rings, rinsed, collected in 50 ml, homogenized and finally two 1 ml samples were taken from this in a counting glass (model: Peters, 1955).

Results

The counts of the fauna in the disinfected and in the control plots are summarized in Table 1.
The quantitative comparison of the fauna according to depth (0–4 cm, 4–8 cm, 8–12 cm) also was carried out, without differentiating between the two plots. The results are summarized in Table 2.
The composition of the earthworm fauna was as follows: *Dendrobaena rubida* (50 %), *Lumbricus rubellus* (19 %), *Lumbricus castaneus* (10 %), *Allolobophora caliginosa* (12 %), *Allolobophora chlorotica* (7 %) and *Dendrobaena octaedra* (1 %). The mite population was divided into: 66 % Gamasides, 2 % Uropodina, 11 % Prostigmata, 7 % Oribatei, 1 % Acaridiae and 13 % juvenile mites (those which were not yet easily classified into

Table 1. Influence of repeated disinfection with DD on the soil fauna in a begonia plot; samples taken at a depth of 12 cm

	Sample size (ml)	*Samples mean*		*Transformation to*	*t'-test*
		control	*disinfected*		
Earthworms	2232	1.00	4.25	$\sqrt{(x+1)}$	0.01
Enchytraeids	558	146	75	log x	–
Mites	558	4.3	8.6	log (x + 1)	0.05
Collembola	558	5.5	13.5	log x	–
Saprophagic nematodes	100	2915	2952	log x	–
Tylenchus-Psilenchus	100	150	275	log (x + 10)	–
Phytophagic-nematodes	100	290	42	log (x + 10)	0.01

Tabel 1. Invloed van herhaalde desinfectie met DD op de bodemfauna in een begonia veldje; monsters genomen op 12 cm diepte

Table 2. Soil fauna in a begonia plot at various depths

	Sample size (ml)	Sample mean			Transformation to	t'-test between		
		0–4 cm	4–8 cm	8–12 cm		0–4 / 4–8	0–4 / 8–12	4–8 cm / 8–12 cm
Earthworms	744	3.63	0.87	0.75	$\sqrt{(x+1)}$	0.01	0.01	–
Enchytraeids	186	80	17	14	log x	0.01	0.01	–
Mites	186	4.1	1.1	1.3	log (x + 1)	0.05	0.05	–
Collembola	186	6.8	0.9	0.9	log (x + 1)	0.01	0.01	–
Saprophagic nematodes	100	3234	2928	2638	log x	–	–	–
Tylenchus-Psilenchus	100	184	184	269	log (x + 10)	–	–	–
Phytophagic-nematodes	100	228	156	112	log (x + 10)	–	–	–

Tabel 2. Bodemfauna in een begoniaveldje op verschillende diepte

the above-mentioned groups). The "phytophagic nematodes" consisted of 90.7% *Tylenchorhynchus*, 8.6% *Rotylenchus* and 0.7% *Pratylenchus*.

Discussion

Table 1 shows that repeated disinfection did not exterminate the soil fauna, but increased the number of individuals within most of the saprophagic groups. Only the phytophagic nematode group was depressed markedly by the DD-treatments. The small number (0.7%) of *Pratylenchus penetrans* found at first seems remarkable. Coolen and D'Herde (1968) found more than 2000 individuals per 100 ml of soil in the control plot before the planting of the begonias in May 1967. In this case, however, the organic fraction of the soil was separated from the mineral one and both examined separately. Andrassy (1953), Kühn (1959), Lownsberry and Viglierchio (1958, 1960), Peacock (1959, 1961), Wallace (1960), Henderson and Katznelson (1961), suspected or established that parasitic nematodes are attracted by root exudates. In September *Pratylenchus* occurs mainly in and around the roots, while in fallow in May the parasite has become dispersed due to various types of soil-tillage. That so few *Pratylenchus* were found in the DD-treated soil must be due to sampling technique and rinsing method, the time differences and the fact that the samples were taken between the plants and that there were no living roots in the soil examined.

The number of earthworms had increased greatly in the DD-treated soil (Table 1), but it is easy to see that this fauna is not the original arable-land population. Humus-loving, straw-decomposing, surface fauna predominated here. The mites also increased, but since the increase was mainly in predator mites, this is probably due to the increase of collembola (Karg, 1961; Sharma and Kevan, 1963; Heungens, 1968). The surface fauna on this begonia field does indeed consist of masses of collembola. They are, however, difficult to sample by drilling because of their jumping ability.

Table 2 shows that the earthworms, enchytraeids, mites and collembola mainly appear in the upper 4 cm. This finding simplified later sampling and also explains why DD-disinfection, due to its insufficient action in the surface layers, is so slightly destructive to these populations.

The nematodes, however, were found in equal distribution in the first 12 cm of the soil.

Although this distribution seems different from the rest of the fauna, it is explained by the fact that the pore spaces decrease with depth, which has greater consequences for micro-arthropods than for nematodes. It can not be excluded, however, that a large proportion of their parasites such as enchytraeids (Jegen, 1920; Schaerffenberg, 1950; Schaerffenberg and Tendl, 1951) and some mites and collembola (Brown, 1954; Karg, 1962; Rodriguez et al., 1962; Rockett and Woodring, 1966) are only present to a small extent or not at all in begonia fields at depths of more than 5 cm.

Conclusions

(1) Annual disinfection of begonia fields with nematicides did not exterminate the saprophagic fauna, generally considered as useful; it appears to have depressed the phytophagic nematode population only.
(2) The earthworms, enchytraeids, mites and collembola were mainly found in the upper 5 cm. As far as the nematodes were concerned, no difference was established in the first 12 cm.

Samenvatting

Het effect van het herhaaldelijk toepassen van nematiciden op de bodem-fauna in de begoniateelt

We constateren dat tegenwoordig de meeste begoniakwekers jaarlijks of tweejaarlijks hun cultuurgrond ontsmetten met het doel aaltjes, onkruiden en ook wel schimmels te bestrijden.
We hebben een aanvang gemaakt met de invloed van dit jaarlijks toedienen van nematiciden op de bodemfauna na te gaan. Hiervoor werden bemonsteringen in september uitgevoerd op twee naast elkaar gelegen proefpercelen: het ene vijf opeenvolgende jaren met DD aan 6 liter per are ontsmet, het andere als getuige gehouden.
We hebben vastgesteld dat het jaarlijks ontsmetten van begoniavelden met DD de saprofage fauna niet heeft gedrukt en dat de regenwormen, enchytraeiden, mijten en collembolen zich hoofdzakelijk in de bovenste 5 cm van de bodem bevinden.

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