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Head: Prof. Dr. Henryk Sandner

Lucyna WASILEWSKA

THE EFFECT OF THE PRE-CROP ON SOIL NEMATODES  
IN A POTATO FIELD

The paper presents the results of a qualitative and quantitative analysis of soil nematofauna in a alfalfa crop (preceding crop) and potato crop (following crop) and also of investigation of the effect of alfalfa and cereal plants grown as preceding crops, on soil nematodes in a potato field.

The abundance and qualitative composition of nematofauna varies depending on the plant cultivated. The effect of the preceding crop is very distinct here, as shown by numerous data in world literature (Oostenbrink, s' Jacob, Kuiper 1956, Oostenbrink 1960, 1961a, b, c, 1965, Winslow 1964, Hijink 1967 and others).

The study presents the results of an analysis of soil nematofauna in an alfalfa crop (preceding crop) and potato crop (following crop) and also the results of investigations of the influence of alfalfa and cereal plants grown as preceding crops on soil nematodes in a potato field.

METHODS

The investigations were carried out in fields of individual farmers situated to the north of Warsaw, in the Nowy Dwór administrative district. The first

study area was formed by a potato field, planted in 1965 on the area in which alfalfa had been cultivated for 5 years. The second study area was formed by two potato fields planted in 1966 in succession to cereal plants (rye and a fodder mixture of rye with oats). Two fields were on brown soil, and one on brown alluvial soil.

Comparisons of the nematofauna of the fields were made on the basis of samples taken in the autumn, as the abundance of nematodes in the potato field is greatest at this time (Krylov 1962–1963). A sample consisted of soil from 20 semi-cylindrical corers (diameter of corer 1.5 cm and height 25 cm), taken at random in the area, and from it 8 subsamples, each 50 ml in volume, were taken for the purpose of extraction. Samples were taken twice during the autumn period. Nematodes were extracted by means of the modified Baerman method. The soil was not analysed for cyst contents. Data on the qualitative and quantitative composition of the nematodes in the alfalfa crop, which was the preceding crop on one of the potato fields, were obtained earlier (Wasilewska 1967a and b). Division of nematodes into ecological groups was made in the same way as in previous studies (Wasilewska 1967a and b) using, however, in this study the systematic names of the groups distinguished.

#### COMPARISON OF SOIL NEMATODES IN THE ALFALFA CROP (PRECEDING CROP) AND POTATO CROP

The proportions between the taxonomic – ecological groups of soil nematodes in the alfalfa crop and potato crop grown after alfalfa did not differ greatly (Fig. 1 A, B). The *Tylenchida* group formed more than half of all the nematodes. This group, together with the next most numerous group, *Panagrolaimidae* – *Cephalobidae* – *Plectus*, formed about 85% of the total number of nematodes. The *Rhabditidae* group, however, exhibited a greater percentage in the potato crop, and *Dorylaimida* in the alfalfa crop.

Total abundance of nematodes in the crops examined did not exhibit any important differences (Tab. I). When, however, we consider the absolute numbers of the most important genera of the *Tylenchida* group, certain characteristic differences can be observed, namely, the numbers of *Tylenchorhynchus* were almost three times smaller in the potato crop. Data given by other researchers also show that the potato is not a good host plant for species of the genus *Tylenchorhynchus* (Oostenbrink, s'Jacob, Kuiper 1956, Hijink 1967). The numbers of larvae of *Meloidogyne* sp. remained on a relatively high level (slight differences between the two crops examined). It must, however, be pointed out that these numbers were three times smaller than the numbers of *Meloidogyne* sp. in the soil under potato crops in Holland (Hijink 1967). It is now considered that the potato is a good host plant for *Meloidogyne hapla* (Oostenbrink 1961a, b, 1965, Hijink 1967). Numbers of *Pratylenchus* sp.,

*Helicotylenchus* sp. and *Ditylenchus* sp. remained on a fairly low level and did not exhibit any significant differences between the two crops. The genus *Tylenchus* sp. was numerously represented in both crops, while the numbers

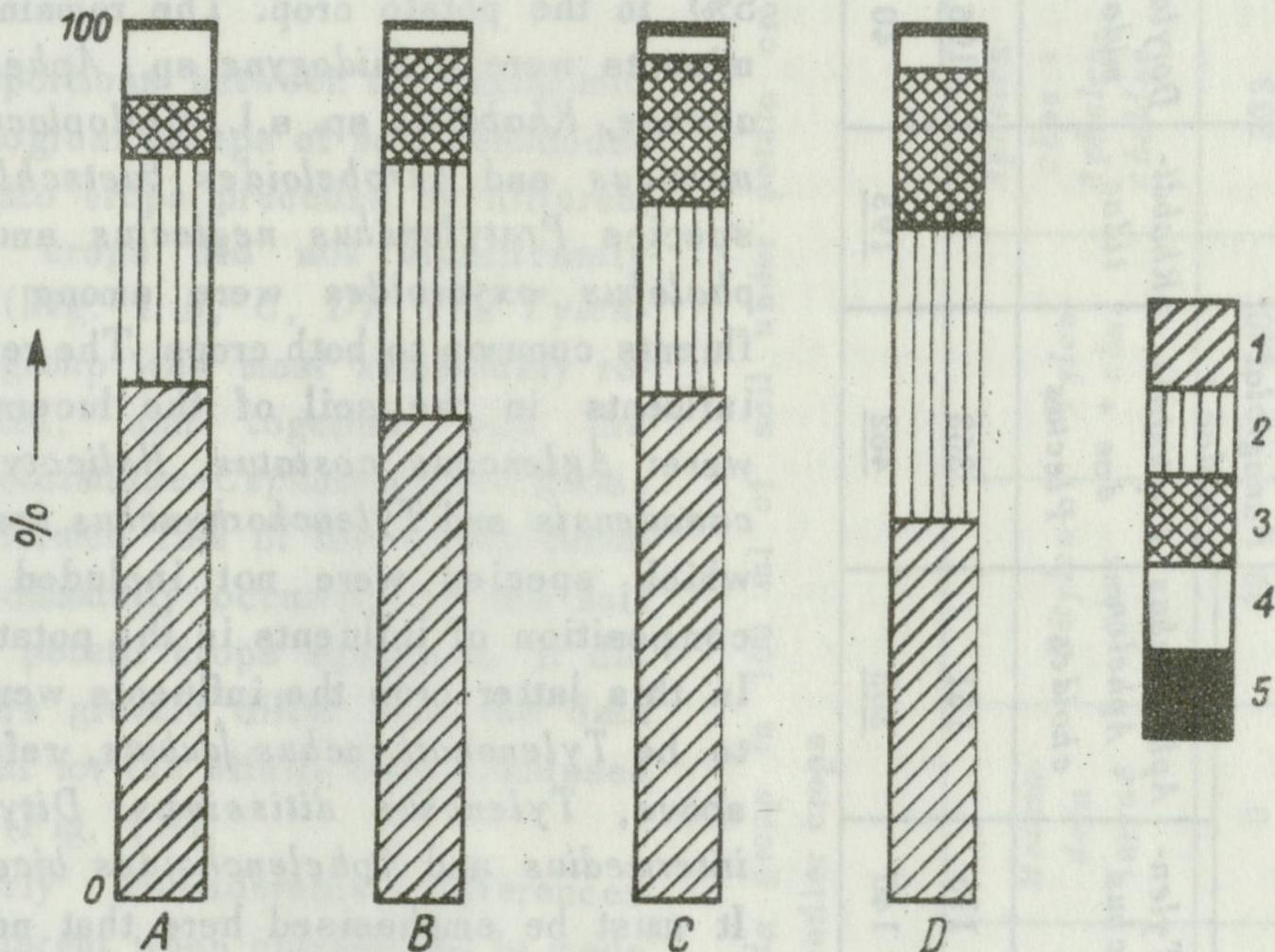


Fig. 1. Quantitative relations between taxonomic-ecological groups of soil nematodes in an alfalfa crop (A) and potato crops which were preceded respectively by alfalfa (B) and cereals (C and D)

1 - *Tylenchida*, 2 - *Panagrolaimidae, Cephalobidae, and Plectus*, 3 - *Rhabditidae*, 4 - *Dorylaimida*, 5 - *others*

of *Aphelenchus* sp. together with *Aphelenchoides* sp., and also the numbers of *Rhabditidae*, increased by twice as much in the potato field. This is evidence of the considerable organic residue content of the soil under the potato crop. The numbers of the *Panagrolaimidae - Cephalobidae - Plectus* group also increased in the potato field in comparison with the alfalfa field although not to the same extent as those discussed above. The numbers of the *Dorylaimida* group decreased by almost 2.5 times in the potato field in comparison with alfalfa.

The species composition of soil nematodes in the potato field did not differ from the composition of nematodes in the alfalfa field. All 60 species found in the potato field during the autumn had previously been found in the alfalfa field. The alfalfa field was examined over a period of 2 years, whereas the potato field was only examined once, in the autumn. The slight differences in the composition of the accessory species (percentage from 0-2%), of which there were more during the period of cultivation of alfalfa, must be attributed to this. The species composition of the group of dominants (percentage over 5%)

Numbers of nematodes in 100 ml of soil in a 5-year old alfalfa field (preceding crop) and potato field (following crop)

Tab. I

Crop	Tylenchida							Total numbers
	Pratylenchus	Helicotylenchus	Tylenchorhynchus	Meloidogyne larvae	Ditylenchus	Tylenchus	Aphelenchus + Aphelenchoides	
Alfalfa	65	45	180	240	18	115	151	363
Potatoes	38	21	56	210	39	140	303	462
								92
								106
								193
								1400
								1570

was identical in both crops, with the exception of *Tylenchorhynchus dubius*. This species was a dominant in the alfalfa crop and influent (percentage from 2.1 to 5%) in the potato crop. The remaining dominants were *Meloidogyne* sp., *Aphelenchus avenae*, *Rhabditis* sp. s.l., *Chiloplacus symmetricus* and *Acrobeloides buetschlii*. The species *Pratylenchus neglectus* and *Eucephalobus oxyuroides* were among the influents common to both crops. The remaining influents in the soil of the lucerne field were: *Aglenchus costatus*, *Helicotylenchus canadensis* and *Tylenchorhynchus brevidens*, which species were not included in the composition of influents in the potato field. In this latter crop the influents were found to be *Tylenchorhynchus dubius*, referred to above, *Tylenchus ditissimus*, *Ditylenchus intermedius* and *Aphelenchoides bicaudatus*. It must be emphasised here that no larvae of *Heterodera* were found in the soil of the potato field, but among the representatives of the genus *Ditylenchus* it was chiefly *D. intermedius* and *D. myceliophagus* which occurred.

To sum up it must therefore be said that potatoes grown after alfalfa retain a domination structure similar to the one which occurred in the alfalfa crop, with the exception of the character of domination of *Tylenchorhynchus dubius*. The differences applied mainly to the lower level of numbers of *Tylenchorhynchus* sp. and the *Dorylaimida* group during the time potatoes were cultivated, and the higher level of numbers of the group *Aphelenchus* sp. — *Aphelenchoides* sp., *Rhabditidae* and *Panagrolaimidae-Cephalobidae-Plectus*.

COMPARISON OF THE INFLUENCE  
OF ALFALFA AND CEREAL CROPS  
AS PRECEDING CROPS  
IN A POTATO FIELD  
ON SOIL NEMATODES

Proportions between the taxonomic – ecological groups of soil nematodes in potato crops preceded by different earlier crops did not significantly differ (Fig. 1 B, C, D). The *Tylenchida* group was most numerously represented, and together with the *Panagrolaimidae-Cephalobidae-Plectus* group formed 75% of the whole nematode community occurring in the soil of the potato crops examined. It did not thus greatly differ from the data obtained for the alfalfa crop discussed above (Fig. 1 A).

Fairly considerable differences are apparent when comparison is made of the total abundance and absolute numbers of the given groups of nematodes in the potato crops preceded by different pre-crops (Tab. II). In the first place the total abundance of nematodes in the soil under the potato crop preceded by alfalfa was over twice as great as in the potato crop preceded by cereal plants. This fact can not be attributed to differences in the soil, since one of the potato fields where the earlier crop had been cereal plants was located on brown soil, and the other on brown alluvial soil. It must therefore be assumed that the 5-year period of alfalfa cultivation as a crop preceding potatoes favours the maintenance of a relatively high level of abundance of nematodes in the soil in comparison with the field where the preceding crop had been cereal plants. In the

Total numbers, and numbers of nematodes of the *Tylenchida* group in 100 ml of soil under potato crops preceded by different earlier crops

Tab. II

Preceding crop	<i>Pratylenchus</i>	<i>Helicotylenchus</i>	<i>Tylenchorhynchus</i>	<i>Meloidogyne</i> larvae	Heterodera larvae	<i>Ditylenchus</i>	<i>Tylenchus</i>	<i>Aphelenchus</i> + <i>Aphelenchoides</i>	Total numbers
Alfalfa	38	21	56	210	0	39	140	303	1570
Cereals	64	15	9	40	4	31	53	200	740
	44	17	4	15	2	28	60	105	634

soils of north-west Europe the total abundance of nematodes, including the abundance of parasitic species, is higher in comparison with Polish soils. It is sufficient to cite here a few of the data given in Oostenbrink's study (1960, 1961c) which show that the abundance of active nematodes (*Tylenchida* together with the group of saprozoic nematodes) often exceeds 3.000 individuals per 100 ml of soil in potato crops. Other data from Poland, apart from those given in the present study, refer to soils in the Toruń district. The mean annual density of soil nematodes in a potato crop (following on sugar beet) was 587 individuals per 100 ml (Witkowski 1958), and after wheat 538 individuals per 100 ml of soil (Witkowska 1958).

Further differences between the potato crops examined apply to the numbers of nematodes belonging to different genera (Tab. II). In the first place the numbers of the larvae of *Meloidogyne* sp. were several times lower on one, and far lower on the second potato field following cereal plants, than on the soil under a potato crop following on alfalfa. As cereals are considered as plants resistant to *M. hapla* (Decker 1963), the influence of the preceding crop is particularly marked in this case. The numbers of *Tylenchorhynchus* sp. and the larvae of *Heterodera* sp. were low, only a few individuals per 100 ml of soil. The numbers of *Tylenchus* sp. and of *Aphelenchus* sp. and *Aphelenchoides* sp. proved to be lower in the potato crop grown after grain crops. The numbers of *Pratylenchus* sp., *Helicotylenchus* sp. and *Ditylenchus* sp. were over 50 individuals per 100 ml of soil in both crops.

### CONCLUSIONS

Analysis of soil nematodes in three crops of potatoes grown in the Warsaw province, differing as to the crop which preceded them, enabled the following conclusions to be drawn:

1. Neither the larva of *Heterodera* sp. nor *Ditylenchus destructor* were found to occur numerously in the soil of a potato crop. Among parasitic species the following were however found to occur: *Meloidogyne* sp., *Pratylenchus penetrans*, *Tylenchorhynchus dubius* and *T. brevidens*, and *Helicotylenchus canadensis* and *H. digonicus*.

2. Both alfalfa and cereal plants as preceding crops exert a characteristic influence on the soil nematofauna in a potato field.

3. A five-year period of cultivation of alfalfa as a crop preceding potatoes favours the maintenance of relatively large numbers of nematodes in the soil of potato crops.

4. The numbers of *Meloidogyna* sp. remain on a higher level in the potato crop following on alfalfa than in the potato crops following on cereal plants.

5. The potato is not a good host plant for *Tylenchorhynchus* sp. The numbers

of this species distinctly decrease in potato crops, regardless of whether the preceding crop was alfalfa or cereal plants.

6. It would appear that the numbers of *Pratylenchus* sp. and *Helicotylenchus* sp. did not distinctly depend on the preceding crop in the case examined.

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## WPLYW PRZEDPŁONU NA NICIENIE GLEBOWE W UPRAWIE ZIEMNIAKÓW

## Streszczenie

Zbadano wpływ lucerny i roślin zbożowych jako przedplonów na nicienie glebowe w uprawie ziemniaków. Badania przeprowadzono na trzech polach chłopskich położonych na północ od Warszawy w powiecie Nowy Dwór, w okresie od 1965 do 1967 roku. Porównano skład gatunkowy, liczebność ogólną oraz nasilenie występowania nicieni należących do poszczególnych grup systematyczno-ekologicznych oraz liczebność nicieni należących do określonych rodzajów zarówno w uprawie lucerny jak i w uprawie ziemniaków uprawianych w następnym roku po uprawie lucerny (fig. 1, tab. I).

Przeprowadzono również porównanie ugrupowań nicieni oraz porównanie liczebności ogólnej i liczebności nicieni należących do określonych rodzajów z grupy *Tylenchida* w uprawach ziemniaków, których przedplonem była lucerna a uprawami ziemniaków, których przedplonem były rośliny zbożowe (fig. 1, tab. II). Wnioski odnoszą się zarówno do występowania pasożytniczych gatunków nicieni w uprawie ziemniaków z tego terenu jak i wpływu przedplonu na nicienie glebowe w uprawie ziemniaków. Oto one:

1. Nie stwierdzono licznego występowania larw *Heterodera* sp. ani *Ditylenchus destructor* w glebie uprawy ziemniaka. Spośród gatunków pasożytniczych stwierdzono natomiast występowanie *Meloidogyne* sp., *Pratylenchus penetrans*, *Tylenchorhynchus dubius* i *T. brevidens* oraz *Helicotylenchus canadensis* i *H. digonicus*.

2. Zarówno lucerna jak i rośliny zbożowe jako przedplon wywierają charakterystyczny wpływ na faunę nicieni glebowych w uprawie ziemniaka.

3. Pięcioletnia uprawa lucerny jako przedplon ziemniaków sprzyja utrzymaniu stosunkowo wysokiej liczebności nicieni w glebie uprawy ziemniaków.

4. Liczebność *Meloidogyne* sp. utrzymuje się na wyższym poziomie w uprawie ziemniaków po lucernie w porównaniu z ziemniakami uprawianymi po roślinach zbożowych.

5. Ziemniak nie jest dobrym żywicielem dla *Tylenchorhynchus* sp. Liczebność *Tylenchorhynchus* sp. wyraźnie obniża się w uprawach ziemniaków, zarówno gdy przedplonem jest lucerna jak i rośliny zbożowe.

6. Wydaje się, że liczebność *Pratylenchus* sp. i *Helicotylenchus* sp. nie była wyraźnie uzależniona od przedplonu w analizowanym przypadku.

## AUTHOR'S ADDRESS:

Dr. Lucyna Wasilewska

Instytut Ekologii PAN

Warszawa, Nowy Świat 72,

Poland.