

Olga POLESZCZUK¹, Elżbieta PEZOWICZ¹
and Dorota TUMIALIS¹

**RETRIEVAL IRRADIATED
ENTOMOPATHOGENIC NEMATODES
– *Steinernema feltiae* (Filipiev, 1934)
FROM THE SOIL**

**ODZYSKIWANIE NAPROMIENIOWANYCH
NICIENI ENTOMOPATOGENNYCH *Steinernema feltiae* (Filipiev, 1934)
ZE ŚRODOWISKA GLEBOWEGO**

Abstract: Infective juveniles *Steinernema feltiae* obtained in the field (Biała Podlaska) and from biopreparation Ovinema were used in the study. Gamma rays ie electromagnetic wave emitted by nuclei of excited radioactive atoms of ⁶⁰Co were used in experiments. The differences were revealed among applied doses and nematode strains response to irradiation. The same species may respond to a given factor in various ways. Confirmation of the phenomenon of radiation hormesis needs many repetitions and seems accidental. Changes in the nematode genotype under the effect of gamma radiation or of other mutagenic factors might be used in future production of biopreparations.

Keywords: ionizing radiation, entomopathogenic nematodes, *Steinernema feltiae*

In the age of organic agriculture and nature protection chemical means of plant protection are used less commonly. One of the alternative insect pest control measures are entomopathogenic nematodes. Nematodes of the families *Steinernematidae* and *Heterorhabditidae* play important role in controlling the so-called soil pests which develop, at least partly, in the soil [1, 2]. The nematodes possess many excellent attributes of biological control factor. They are safe for the environment, have broad range of natural hosts, and are able to actively search, infect and kill the host insect. They are characterised by a high reproductive potential and produce dormant growth stages – an infective *dormant juvenile* (DJ) – which allow them to persist longer in the soil. Moreover, it is possible to multiply them in artificial media. They are safe for mammals and other non-target organisms [3].

¹ Chair of Animals Environment, Animal Sciences Faculty, Warsaw University of Life Sciences – SGGW, ul. J. Ciszewskiego 8, 02–786 Warszawa, Poland, phone: +48 22 593 66 24, email: elzbieta_pezowicz@sggw.pl

Increasing economic importance of entomopathogenic nematodes for agricultural practise creates a constant demand for new strains of high reproductive potential, endurance to handling during storage and transport and competitive (with chemical plant protection measures) efficiency in controlling harmful insects. Unfortunately, under specific field conditions commercial biopreparations are not effective.

Therefore, it seems reasonable to search for fast and effective method which would introduce changes of possibly narrow and easily controllable range into population. Ionising radiation is an abiotic factor which affects cell processes in nematodes and brings biological and chemical alterations within nematodes' tissue [4–6] Low doses of ionising radiation are known to bring positive effect and be safe. It was demonstrated that physiological responses of plants and animals to low radiation doses (*radiation hormesis*) are similar to the effects of many natural elements and chemical compounds which are nutrients at low concentrations but become toxic at higher concentrations.

The experiment was performed to check whether low doses of ionising radiation may improve pathogenic properties of nematodes and thus be used in biological plant protection and commercial production of nematodes.

Material and methods

Infective juveniles *Steinernema feltiae* obtained in the field (Biala Podlaska) and from the Ovinema biopreparation were used in the experiment. Cobalt bomb (RChM- γ -20) emitting γ radiation from ^{60}Co was a source of radiation. Three doses of radiation: 0.1, 0.05 and 0.01 kGy were applied. Non-irradiated larvae of the nematode *S. feltiae* were used as a control. Experiment was carried out in 150 cm³ pots with sterilised soil and 1000 L3 larvae per pot. Then two caterpillars of the greater wax moth *Galleria mellonella* were placed in every pot. Pots were checked after 48 hours. Infected individuals of *Galleria mellonella* were incubated for 24 hours in a SANYO chamber at 25 °C. Afterwards, insects were dissected to check whether nematodes were the reason of their death. The intensity of infection (the number of nematodes that penetrated insect's body) was also analysed to estimate the number of nematodes retrieved from the soil. The procedure was replicated three times every two days. The experiment was performed in nine pots in three repetitions.

Results and discussion

The highest percent of retrieved nematodes from every analysed variant was observed in the first sample, definitely lower in the second. Dissections of the third sample revealed only single adult individuals. In total from 22 % (control) to 27 % (0.01 kGy) nematodes *S. feltiae* Ovinema were retrieved. *S. feltiae* from Biala Podlaska responded differently to gamma radiation. An increase in the applied dose negatively affected the percent of retrieved nematodes which varied from 38 % (0.05 and 0.1 kGy) to 56 % (control) (Fig. 2).

Experiments performed to test the effect of gamma radiation on active search for the host insect by nematode infective dormant juveniles not give obvious solution.

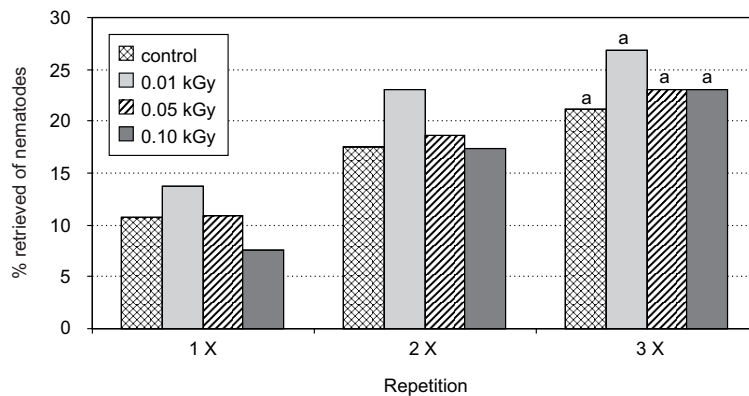


Fig. 1. Mean percent of *S. feltiae* Ovinema retrieved from the soil after preliminary irradiation with different doses of ionising radiation (different letters denote significant differences at $p < 0.05$)

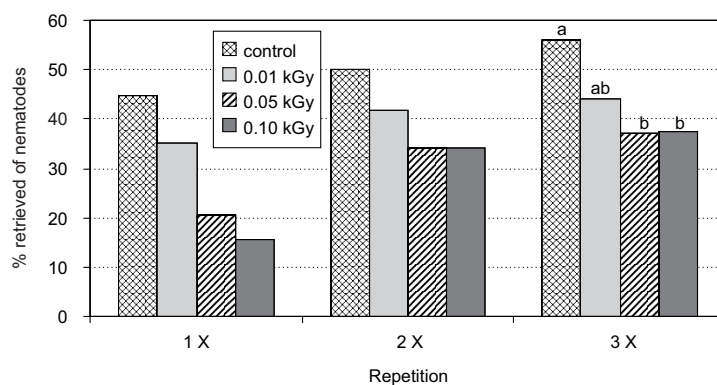


Fig. 2. Mean percent of *S. feltiae* Biala Podlaska retrieved from the soil after preliminary irradiation with different doses of ionising radiation (different letters denote significant differences at $p < 0.05$)

Strain-specific differences were found in the response of nematodes to ionising radiation. The larvae of *S. feltiae* obtained from the Ovinema biopreparation did not change their pathogenic properties. It even seems that the dose of 0.01 kGy exerted slightly positive effect. Resistance of this strain to abiotic factors is probably the result of its specialization, stability and long selection. The larvae of *S. feltiae* from Biala Podlaska responded quite differently. Applied doses negatively affected their invasiveness in the soil habitat. Two applied doses of gamma rays (0.1 and 0.05 kGy) caused changes significantly different from the control.

Positive effect of ionising radiation was hard to observe. The same species may respond to a given factor in various ways. Confirmation of the phenomenon of radiation hormesis needs many repetitions but the effect seems accidental. Changes in the nematode genotype under the effect of gamma radiation or of other mutagenic factors might be used in future production of biopreparations.

Conclusions

1. Nematodes *S. feltiae* from the Owinema biopreparation, are resistant to low doses of ionising radiation.

2. Nematodes *S. feltiae* obtained from the field (Biała Podlaska), change their pathogenic properties after exposure to low doses of ionising radiation.

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ODZYSKIWANIE NAPROMIENIOWANYCH NICIENI ENTOMOPATOGENNYCH *Steinernema feltiae* (Filipiev, 1934) ZE ŚRODOWISKA GLEBOWEGO

Zakład Zoologii, Katedra Biologii Środowiska Zwierząt, Wydział Nauk o Zwierzętach
Szkola Główna Gospodarstwa Wiejskiego w Warszawie

Abstrakt: Przeprowadzono badania w celu odzyskania napromieniowanych nicieni entomopatogennych z gleby. Do doświadczenia użyto larw inwazyjne *S. feltiae* pochodzące z biopreparatu Owinema oraz dziki szczep pozyskany z terenu (Biała Podlaska). Nicienie były poddane działaniu promieniowania gamma (źródło ⁶⁰Co). Wykazano różnice w działaniu poszczególnych dawek promieni gamma oraz odmienne reakcje użytych szczepów nicieni na zastosowane promieniowanie.

Słowa kluczowe: promieniowanie jonizujące, nicienie entomopatogenne, *Steinernema feltiae*