

NEMATODA *DITYLENCHUS DIPSACI* (KÜHN, 1857) ON GARLIC CULTIVATED IN THE GARDEN CONDITIONS

NEMATODA *DITYLENCHUS DIPSACI* (KÜHN, 1857) LA CULTURA USTUROIULUI ÎN CONDIȚII DE GRĂDINĂ

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Abstract. In the Republic of Moldova to the cultivation of garden garlic, quite widespread is the stem parasitic nematode *Ditylenchus dipsaci* (Kühn, 1857). The extent of the invasion constitutes in many cases 78-90%, which often leads to total crop losses. In the vegetal tissue of the infested plants in the initial stages of ditylenchosis, collected during the summer period (June), was observed a monotypic primary popular of the vegetal tissue only with the species *D. dipsaci* (females, males, larvae, eggs). Subsequent observations have shown that in advanced stages of ditylenchosis the monotypic primary population is substituted by the heterotypic secondary population. In such tissue, the distribution of parasitic nematodes takes place as follows: parasitic nematodes *D. dipsaci* (females, males, larvae), account for 10.1% of the total; secondary parasitic nematodes (females, males, larvae) - 83.6%, most being of the order Rhabditida (species from the families Panagrolaimidae, Diplogasteridae, Cephaloidae); eggs-6.3%.

Key words: nematode, infested, garlic culture, monoculture

Rezumat: În Republica Moldova la cultura usturoiului de grădină, destul de răspândită este nematoda parazită de tulpină *Ditylenchus dipsaci* (Kuhn, 1857). Extensivitatea invaziei constituie în multe cazuri 78 - 90%, ceea ce duce deseori la pierderi totale ale recoltelor. În țesutul vegetal al plantelor infestate în stadii inițiale de ditylenhoză, colectate în perioada de vară (luna iunie), s-a observat o populare primară monotipică a țesutului vegetal doar cu specia *D. dipsaci* (femele, masculi, larve, ouă). Observările de mai departe au demonstrat, că în stadii avansate de ditylenhoză popularea primară monotipică este substituită cu popularea secundară heterotipică. În asemenea țesut, distribuirea nematodelor parazite are loc în felul următor: nematodelor parazite *D. dipsaci* (femele, masculi, larve), le revine - 10,1% din total; nematodelor parazite secundare (femele, masculi, larve) - 83,6%, majoritatea fiind din ordinul Rhabditida (specii din familiile Panagrolaimidae, Diplogasteridae, Cephaloidae); ouălor - 6,3%.

Cuvinte cheie: nematode, infestare, usturoi, monocultură

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INTRODUCTION

In the Republic of Moldova, garlic (*Allium sativum*) is a profitable and perspective crop. Garlic is a product consumed throughout the year, which man has been cultivating for thousands of years all over the world - India, China, Spain, Egypt, Romania, the Russian Federation, the USA, Ukraine. The largest areas are located in warm countries, including China, also called the "land of garlic", which ranks first by supplying 80% of global garlic production (FAO, 2004-2007, 2008).

At the same time, it is known that despite the high qualities, garlic culture is distinguished by increased sensitivity to various diseases and pests. One of the most dangerous parasites of the onion and garlic stem is nematode *Ditylenchus dipsaci* (Kühn, 1857). The damage caused to this crop is considerable, sometimes compromising production. In Brazil, *Ditylenchus dipsaci* causes 100% pesthole in garlic cultivation (Charchar and Teneente, 2003). Outbreaks of 54.9% invasion have been observed in onion areas in Turkey (Mennan, 2005), and in southern Italy the highest crop losses in both onion and garlic crops are caused by *D. dipsaci* (Greco, 1993). In the Russian Federation till today the onion and garlic nematode has been detected in 120 regions, the maximum density in garlic plants being observed at temperatures of 20-22°C, and the extensivity increases from north (4%) to south (7%) (Shubina, 2004).

In the Republic of Moldova, as a rule, garlic is cultivated by farmers in villages and private individuals on lots near the house or in the field. Usually, autumn and spring varieties: Yuzhnyy fioletovyy, Ukrainskiy belyy, Polet, Strelet, De Cahul (local variety), de Bacău (Romanian variety) etc are cultivated. Previous multiannual researches on garlic crops, grown in field conditions, has shown a widespread of *D. dipsaci* (Melnic, 2008; Melnic, 2012). During the vegetation period on some massifs infested 10-21% of the total number of plants were lost. In the following researches it was observed that the main source of spread of *D. dipsaci* is the infested seed material (20-35%) (Melnic, 2008). The present researches have focused on the garden garlic cultivation.

MATERIAL AND METHOD

The object of study - phytoparasitic nematode *Ditylenchus dipsaci* (Kühn, 1857) in crops of the genus *Allium* on individual lots (garden crops). The research was carried out during the years 2015-2019 in some households in the suburbs of the Chisinau (Colonița, Vatra, Bacioi), as well as some households from Ialoveni and Hancesti districts. Samples of plants and soil from their rhizosphere (horizon from a depth of 0-30 cm) were collected by the route method. At extracting the nematodes, the modified Baermann method was applied (Nesterov, 1979), with a 24-hour exposure at room temperature. For assessing the intensity of the infestation, the plant samples were weighed in

advance to establish the ratio between the number of nematodes extracted and the amount of material analyzed. The nematodes were heat treated (60°C) and fixed with 4% formalin, then transferred to glycerin using paraffin rings (Seinhorst, 1962) to obtain fixed preparations.

RESULTS AND DISCUSSIONS

Laboratory analyzes, performed in the Republic of Moldova on garlic plantations, as well as crop yields have shown that this crop is variously infested with *D. dipsaci*. A higher level of infestation was observed in garlic grown in monoculture, or in garden culture, in the case of planting on the same lot (fig. 1).



Fig. 1 Harvest of garden garlic, infested with *Ditylenchus dipsaci* (extent of invasion-90%)

Plantations with an invasion of 78% only with *D. dipsaci* were observed in Hincești district, during the technical ripening period. But in Ialoveni district and the suburbs of Chisinau (Colonita, Bacioi) an extension of the invasion of 90-97% on garlic plantations was observed (tab. 1).

In the research process, it was observed that in the initial stages of ditylenchosis of garlic plants (collected from individual lots of Hincești district during the technical ripening period), the monotypic primary population of plant tissue occurs only with species *D. dipsaci* (females, males, larvae, eggs). It was determined that in a garlic plant, collected during the vegetation period (May) with a gross weight of 100 grams, in the initial stages of ditylenchosis, there is a pure culture of *D. dipsaci*, the density of which is 81.3×10^3 individuals (females, males, preimagus larvae)

(Melnic and Bivol, 2012). It has been observed that such garlic is often exposed on the city's markets (fig.2; 3).

Table 1

Spread of nematode *Ditylenchus dipsaci* in garlic culture, years 2014-2019

Collection places	Date of collection	Culture	Surface	Invasion, %	Collection places	Date of collection
Colonita village, Chisinau suburb	15.06.2014	garden	3 m ²	90	<i>D. dipsaci</i> + saprofite	Different varieties
Bacoi village, Chisinau suburb	20.06.2014	field	200 m ²	90	<i>D. dipsaci</i> + saprofite	Different varieties
Chisinau suburb	26.05.2015	garden	2 m ²	90	<i>D. dipsaci</i> + saprofite	Alb ukrainean
Buteni village, Hincesti district	27.05.2015	field	700 m ²	78	<i>D. dipsaci</i>	Alb ukrainean
Ialoveni district	06.06.2016	garden	10 m ²	97	<i>D. dipsaci</i> + saprofite	Different varieties
Chisinau city	02.11.2019	garden	2 m ²	70-80	<i>D. dipsaci</i>	-



a



b

Fig. 2 Garlic in garden culture infested with *D. dipsaci* (extent of invasion 90-97%), in the case of the monotypic primary population, exposed for sale (**b**); **a**- healthy garlic

As a result of the parasitic impact, the infested tissue becomes necrotic (macerated), which is also the most common reaction to nematological infestations caused by migratory endoparasitic species.



Fig. 3 a - *D.dipsaci* nematodes (females, males), which were extracted from garden garlic plants; **b** - *D.dipsaci* nematode, female with eggs, laid outside and larva L₂, hatched from egg.

Such infested tissue, as well as galleries formed by phytoparasitic nematodes, are factors of attraction and penetration of secondary parasite species and primarily of saprophytic nematode species, most being bacteriovores of the order Rhabditida and fungivores of the order Aphelenchida, which bring with them bacterial and fungal infections. Such substrate is attracted by various species of mites. In the advanced stages of dithylenosis the monotypic primary population is substituted by the heterotypic secondary population (fig. 4).



Fig. 4 Garlic infested with parasitic nematodes, in the case of the heterotypic secondary population

In such dominant plants are saprophytic species (total - 31,600 individuals/plant). The distribution of nematodes takes place as follows (fig. 5): nematode *D. dipsaci*, total - 10.1%, saprophytic nematodes, most being of the

order Rhabditida with the dominance of the family Panagrolaimidae - 83.6%; eggs (total) - 6.3%.

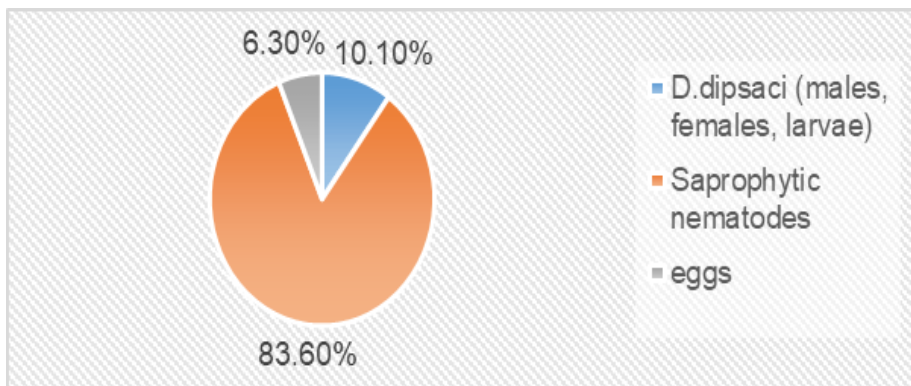


Fig. 5 Percentage distribution of parasitic nematodes in the case of heterotypically secondary population

Part of the main parasite *D.dipsaci* leaves such tissue, moving towards the ground, forming foci. In the time of laboratory analysis, its total number constituted 3800 units (males, females, larvae), being less than the total number of saprophytic nematodes 8.3 times, of which 2000 units were - males, 1200 - females and 600 - larvae.

It should be mentioned that the species *D.dipsaci* is kept in garlic plants for a long time. According to observations, in a dry plant, after a long storage - for 4 or more years in laboratory conditions, the extracted nematodes, being transferred to water, move very briskly.

In the process of multiannual researches, it was found that the causes of the widespread of nematode *D. dipsaci* in garden garlic plantations are: planting from year to year on the same lot, infested seed material, infested soil with remains of plants and climatic conditions - high humidity and temperature, favorable for reproduction and development of the parasite. *D.dipsaci* nematode is distinguished by a high invasive capacity. Some authors mention that the presence of only 20 or more individuals in a kilogram of soil does not allow the harvest of garlic and onions (Tomina, 1976).

One of the effective measures to control the parasite is use of perfectly healthy seed material, from crops, following the laboratory control performed periodically, proved to be free of nematodes. Among the main measures preventing the emergence and development of a massive nematode infestation, is the observance of the anthelmintic crop rotation with the introduction of resistant plants to *D.dipsaci*. In previous research it was determined that of the 6 varieties of potatoes studied - Agata, Romano, Irga, Albăstriu-mov, Kondor and

Concordia, which were artificially inoculated with the species *D.dipsaci*, the race that parasitizes onion and garlic crops. As a result none of them became infested with this nematode (Melnic *et al*, 2018), which allows to include the potato as a soil cleaning crop of *D dipsaci*. Based on data obtained by us and some authors (Melnic, 2008; Melnic and Bivol, 2012; Bazarbecov, 2003; Ivanova, 1971), in such crop rotation will be included several crops resistant to *D.dipsaci*: potatoes, tomatoes, eggplants, corn, sunflower.

CONCLUSIONS

1. In the Republic of Moldova for garden garlic, grown in monoculture conditions, quite widespread (78-90%), is the parasitic stem nematode *Ditylenchus dipsaci*. In such cases the losses of the garlic crop are total.

2. Nematode *D.dipsaci* is kept in dried infested garlic plants quite a long time (4 and more years), after being extracted from plant tissue and transferred in water, they moving very briskly. This ability of *D.dipsaci* presents a great danger for future plants, if the infested waste remain in the soil, where garlic was grown.

3. In the infested garlic plants in advanced stages, exposed to laboratory analyzes, the distribution of parasitic nematodes took place as follows: parasitic nematodes *D.dipsaci* (females, males, larvae) - 10.10%; saprophytic nematodes (females, males, larvae) - 83.60%, most being of the order Rhabditida; eggs - 6.30%.

4. To avoid the spread of nematode *D.dipsaci*, the race that parasitizes garlic and onions, it is necessary to plant seed material free of nematodes.

5. Use anthelmintic rotation, for a period of 3-4 years, with the introduction of resistant crops (potatoes, tomatoes, eggplant, corn etc) to this parasite.

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