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DISTRIBUTION OF *Meloidogyne incognita* IN POTATO PLANT (*Solanum tuberosum* L.) IN GAZAKH-TOVUZ ECONOMIC REGION

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РАСПРОСТРАНЕНИЕ *Meloidogyne incognita* НА КАРТОФЕЛЕ (*Solanum tuberosum* L.) В ГАЗАХ-ТОВУЗСКОМ ЭКОНОМИЧЕСКОМ РАЙОНЕ

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Abstract. Samples were taken in order to study the distribution of *Meloidogyne incognita* in different organs (root and lower part of the stem) of potato plants in the farms of Gazakh-Tovuz economic region. During the examination of the samples by the Berman method, it was determined that the infection of potato with *M. incognita* was 46.7% in Gadabey district and 31.4% in Gazakh district. High intensity of infection was recorded in Shamkir (2-30 nematodes), Gadabey (2-29 nematodes), Tovuz (2-25 nematodes), and relatively low intensity in Gazakh (3-15 nematodes), Aghstafa (2-17 nematodes) regions. A total of 304 nematodes were found in the samples taken from the researched areas. The article provides information about the symptoms of the disease caused by the nematode *M. incognita* in plants, and the life cycle is reflected in a picture. Taking into account the serious economic damage caused by *M. incognita* species to the farms, recommendations were given regarding appropriate measures to combat its spread. *M. incognita* causes severe changes in the physiology, morphology and growth of the potato plant causing leaf wilting. The disease (nematodosis) occurring in the potato plant causes various changes in the above-ground and underground parts of the plant. The effect of *M. incognita* on the above-ground parts of the plant is manifested by symptoms such as retardation of plant development, yellowing of leaves, chlorosis of leaves, complete destruction of plants and poor growth of shoots. The symptoms of the underground part of the plant are manifested in the form of deformation of the roots, knotted roots, the formation of tumors and bumps. The most characteristic symptom of *M. incognita* when the infestation is high is the formation of nodules of different sizes (15 mm) on the primary and secondary roots.

Аннотация. С целью выявления распространения вида *Meloidogyne incognita* на разных органах растения картофеля (корень и нижняя часть стебля), в хозяйствах Газах-Товузского экономического района были взяты пробы. Образцы были исследованы методом Бермана и установлено, что зараженность растений картофеля *Meloidogyne incognita* составила в Гедабейском районе — 46,7% и в Газахском районе — 31,4%. Высокая интенсивность заражения была отмечена в Шамкире (2–30 особей), Гедабеке (2–29 особей) и Товузе (2–25 особей), относительно слабая интенсивность в Газахе (3–15 особей), Агстафе (2–17 особей). Всего в пробах, взятых с исследуемых территорий, обнаружено 304 особи нематод. В статье приведены симптомы заболевания, вызываемого нематодой *Meloidogyne incognita*, и на основе рисунка отражен жизненный цикл. Учитывая серьезный экономический ущерб, наносимый хозяйствам видом *Meloidogyne incognita*, рекомендуется разработать и реализовать соответствующие меры борьбы с его распространением. *Meloidogyne incognita*

вызывает серьезные физиологические и морфологические изменения, такое как увядание листьев, что приводит к задержке роста картофеля. Заболевание (нематодоз), возникающее в растении картофеля, вызывает различные изменения наземных и подземных частях растения. Симптомы заражения *Meloidogyne incognita* наземных органов растения проявляются задержкой роста растений, пожелтением листьев, хлорозом листьев, слабым ростом побегов и полной гибелью растения. Подземные симптомы проявляются деформацией корней, образованием узловатых корней, опухолей и бугорков. Наиболее характерным признаком *M. incognita* при высокой зараженности является образование узелков разного размера (15 мм) на первичных и вторичных корнях.

Keywords: potato, *Meloidogyne incognita*, moisture, temperature.

Ключевые слова: картофель, галловая нематода, влажность, температура.

Potato plant is the most consumed important food product after wheat, rice, corn and barley. Potato is rich in potassium, vitamins, carbohydrate, protein and other important nutrients, and its extraction is also used as a colorant in the food industry. Root-knot nematodes affect the development of potato production, which is one of the main areas of agriculture, and the quality of valuable food products obtained from potatoes. Root-knot nematodes (*Meloidogyne spp.*) cause a sharp reduction in the yield and quality of potato plants, especially in warm, moist, sandy soil conditions.

The species *Meloidogyne incognita*, belonging to the genus *Meloidogyne*, which damages various field and vegetable crops, especially potatoes, is one of the most widespread species in Azerbaijan [1, p. 1-17].

The purpose of studying *M. incognita* species is that it is a cosmopolitan species, it has a wide distribution and has a high damage to potatoes.

Material and Methodology

In order to detect *Meloidogyne incognita* nematodes in the potato plant, samples were taken from the underground part of the roots and stems of 285 plants from the potato fields of the mountainous and foothill zone of the Gazakh-Tovuz economic region (Gadabey, Tovuz, Aghstafa, Shamkir, and Gazakh). The Berman method was used in the study of potato nematodes. A 10-15 cm long rubber tube is inserted into the glass funnel. An iron net with holes 0.25-0.5 mm in diameter is placed up to half of the funnel. The funnel is attached to the tripod and water with a temperature of 38-39 °C is poured over it. Then a piece of soil or root sample is placed on the net. After 1-2 hours, the sediment is filtered into a test tube.

An Olympus microscope was used to identify nematodes in the sediment [5, p. 131-137].

Classical methods were used in the morphological determination of root-knot nematodes. For this purpose, larvae and adults were obtained from the root part of potato plant infected with nematode. After keeping the larvae in a laboratory water bath at 65 °C for 2 minutes, they were fixed in a mixture of 7 ml of 40% formaldehyde + 2 ml of triethanolamine + 91 ml of distilled water (Hooper 1986). After the fixation stage of nematodes, one part of the solution was kept in a mixture of 1:79 glycerol and distilled water at 35-40 °C for 12 hours, and the second part was kept in a mixture of 5:95 glycerol and 96% ethanol at 40 °C for 3 hours. Then species were determined using glycerol [6, p. 629].

Conclusions and Discussion

M. incognita grows and reproduces well in soils with 30% clay and 72-91% sand. The optimal temperature for hatching nematode larvae is 15-30 °C. Nematode lifespan decreases as temperature increases, but the hatching rate of J₂ larvae increases over a certain range of temperatures. Root-knot nematodes can complete their life cycle in three to four weeks (37 days) under suitable environmental conditions. Hatching of *M. incognita* occurs in wet sandy soil. The first molt (J₁ larval stage) occurs inside the egg. The second larval stage, J₂, enters plant roots to lay eggs, forming nodules of various sizes (Figure 1).

The gelatinous matrix surrounding the egg mass protects the nematode from lack of moisture. Newly hatched J₂ larvae undergo a short free-living phase before entering the plant. Optimum soil moisture for J₂ larval growth and development should be between 10-30%. Soil moisture greater than 30% adversely affects hatching and survival of the J₂ stage.

J₂ larvae enter plant root tips using a protruding stylet and cell wall-degrading enzymes. Under favorable conditions, the J₂ stage progresses to J₃, then to J₄, and finally to the adult stage [4, p. 667-676; 7, p. 4-26].

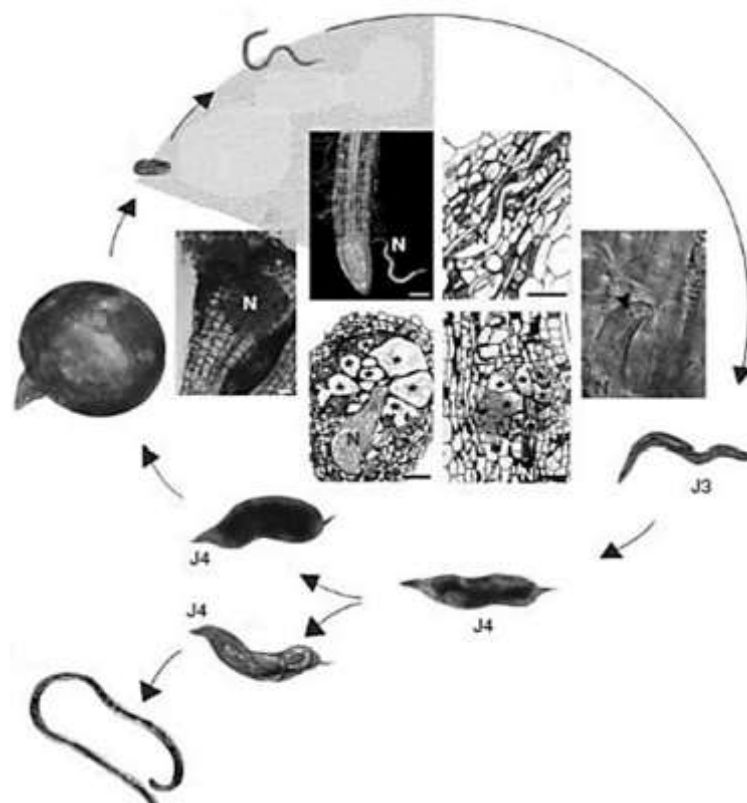


Figure 1. Life cycle of *Meloidogyne incognita*: a) female, b) egg, c) egg mass, d) J₂ stage larva, e,f) Development of the nematode in J₃ and J₄ stages and the formation of a bulge in the adult stage; g, h) adult females lay >1000 eggs, mating

M. incognita causes severe changes in the physiology, morphology and growth of the potato plant causing leaf wilting. The disease (nematodosis) occurring in the potato plant causes various changes in the above-ground and underground parts of the plant. The effect of *M. incognita* on the above-ground parts of the plant is manifested by symptoms such as retardation of plant development, yellowing of leaves, chlorosis of leaves, complete destruction of plants and poor growth of shoots [8, p. 114-121]. The symptoms of the underground part of the plant are manifested in the form of deformation of the roots, knotted roots, the formation of tumors and bumps (figure 2).

The most characteristic symptom of *M. incognita* when the infestation is high is the formation of nodules of different sizes (15 mm) on the primary and secondary roots [2, p. 1-8; 3, p. 1-12].



Figure 2. Symptoms caused by *Meloidogyne incognita* on potato: 1— Twisting and drying of leaves; 2 — the formation of nodes of different sizes in the root; 3— yellowing of leaves and formation of spots

285 potato bushes from private potato farms located in different administrative regions of Gazakh-Tovuz economic region were studied (Figure 3).

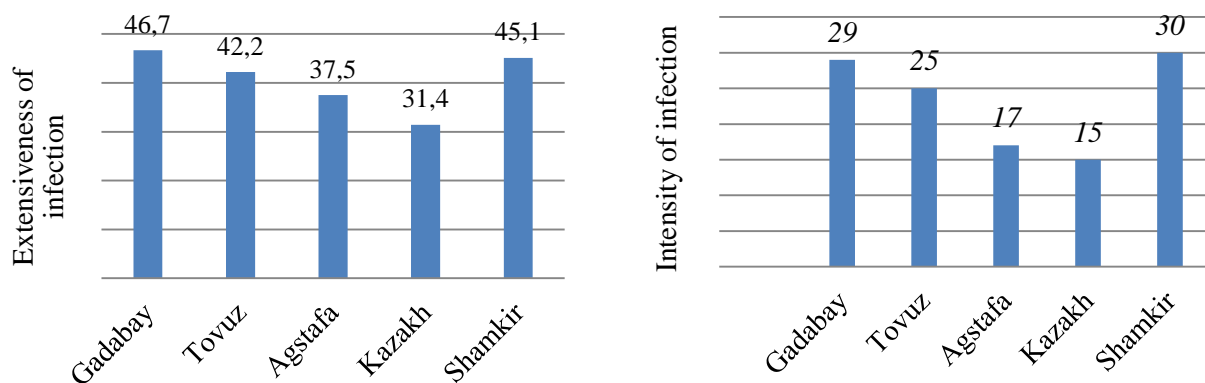


Figure 3. Dynamics of infection of potatoes with *M. incognita* in Gazakh-Tovuz economic region

It is clear in the diagram that the extensiveness and intensity of *M. incognita* was high and widespread in potato farms of Gadabay, Tovuz, Aghstafa, Gazakh, Shamkir regions of Gazakh-Tovuz economic region. The damage caused by this species to the potato plant was very high, and it was determined that the degree of spread was wider than other species. Thus, the high extensiveness of the invasion was found in Gadabay (46.7%), Shamkir (45.1%) and Tovuz (42.2%); relatively weak extensiveness was recorded in Agstafa (37.5%) and Gazakh (31.4%) regions. In total, the infection with *M. incognita* in potato plant samples in the studied areas was 41.6%.

High intensity of infestation was recorded in Shamkir (2-30 nematodes), Gadabay (2-29 nematodes) and Tovuz (2-25 nematodes), relatively weak intensity in Agstafa (3-15 nematodes) and Gazakh (2-17 nematodes). A total of 304 nematodes were found in the samples taken from the researched areas.

The comparative analysis of the obtained results shows that infection of potato plants with nematodes depends on environmental factors.

Conclusion

The conducted studies showed that the nematode *M. incognita* is a plant parasite that causes serious economic damage to potatoes.

Infection of potatoes with nematodes directly depends on environmental factors.

Modern, biological and chemical control methods can be used to control the spread of the nematode *M. incognita*.

Crop rotation with non-resistant or resistant varieties should be carried out as a modern control method.

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