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SAFFRON (CROCUS SATIVUS) AND THE NEMATODE FAUNA OF ITS RHIZOSPHERE

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Abstract: This article provides in-depth and comprehensive information on the nematode fauna of field saffron (Crocus sativus L.) and its rhizosphere. A scientific analysis is provided based on new, previously unrecognized and understudied data on the biology of the saffron plant, the characteristics of the rhizosphere environment, the types of phytonematodes found in it, their population composition, the influence of ecological and agrotechnical factors, as well as the interaction of nematodes with each other and with other microorganisms in the rhizosphere of saffron. The article covers the identification of nematodes, population dynamics and their impact on saffron yield, as well as integrated management measures, based on modern morphological and molecular methods.

Relevance of the topic: Field saffron is one of the most valuable and valued spices in the world, and its cultivation is of agroecological and economic importance. Nematodes found in the rhizosphere of saffron have a negative impact on plant growth and yield, but this problem has not been sufficiently studied in many regions. Typically, phytonematodes, especially root parasites and saprotrophic species, are found in the rhizosphere of saffron, which damage the plant root system, disrupt nutrient metabolism and create conditions for the entry of secondary pathogens. Information on the nematode fauna of the rhizosphere of saffron in modern scientific sources is very scarce and fragmentary, and the study of this topic is of great importance for the development of effective phytosanitary management measures in saffron cultivation.

Keywords: Crocus sativus, rhizosphere, nematode fauna, agroecosystem, phytoparasite, siderophore, allelopathy, microbiome, safranal, bioindication.

Main part: Biology and agrotechnical importance of Ekma Saffron (Crocus sativus) Saffron is a perennial, rhizomatous geophyte belonging to the Iridaceae family, the stigmas of which are obtained from its flowers are valued as a medicine, dye and food additive. Experiments on its introduction have begun in the southern regions of Uzbekistan (Surkhandarya, Kashkadarya). The root system of saffron is characterized by smooth and sparse lateral roots, which makes it prone to complex interactions with soil biota

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Nematode fauna of the rhizosphere

Nematodes in the rhizosphere of saffron are mainly divided into the following trophic groups:

- ✓ Phytoparasitic nematodes: Meloidogyne spp., Pratylenchus spp., Heterodera spp. – damage the root system, but in some cases the alkaloids in the saffron root limit their number (allelopathic protection).
- ✓ Free-living bacterivores: Rhabditidae, Cephalobidae – accelerate the decomposition of organic matter in the soil, creating a favorable agro-fund for plants.
- ✓ Mycophages and omnivores: Mononchidae, Dorylaimidae – form a trophic chain with fungi, protozoa and other microorganisms in the rhizosphere.

Nematode-plant interaction

Studies show that secretions (especially crocin) secreted by the roots of Crocus sativus are toxic to some nematodes. At the same time, some saprotrophic nematodes stimulate bioprotective microorganisms on the surface of saffron roots, which prevents root rot. Also, gibberellins and auxins produced by nematodes can stimulate plant growth

Bioindication and agrobiotechnological potential

The number and trophic structure of nematodes can be used to assess the health of the soil, the state of the saffron rhizosphere microbiota, and the effectiveness of agrotechnical measures. In particular, it has been found that allelopathic interactions with other plants grown in rotation with saffron change the spectrum of nematodes. This is important for organizing saffron plantations on an ecologically sustainable basis.

New discoveries

The following new data were identified during the study:

- ❖ A new nematode species, Cephalobus zaferanus, was identified in the rhizosphere of saffron (potentially bacterivorous).
- ❖ Crocus root secretions have an embryotoxic effect on Meloidogyne incognita eggs.
- ❖ The nematode Aphelenchoides crocophilus, which lives in symbiosis with a rhizosphere fungus, prevents root rot.

The root system of Crocus sativus is characterized by its simplicity - it consists mainly of a vertically developed main root, lateral roots are rare. Despite this, the rhizosphere (i.e. the 1-5 mm soil zone around the root) is a very active biotope for microbial and metazoan life. Through this zone, the plant secretes the following secretions:

- Amino acids (serine, glutamate, valine) - stimulate the growth of bacteria.
- Phenolic compounds - toxic to some phytoparasitic nematodes.
- Polysaccharides and plant exudates are a source of food for saprotrophic microorganisms and nematodes.

Functional role of nematodes in the rhizosphere

a) Phytoparasitic nematodes

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Meloidogyne incognita and Pratylenchus penetrans are especially widespread in saffron plantations. They penetrate root cells and form galls (nodules), which slow down the absorption of water and nutrients. However, safranal and flavonoids released from saffron roots act as repellents for some nematodes.

b) Bacterivorous and saprotrophic nematodes

They are representatives of such phyla as Rhabditis, Panagrolaimus, Acrobeloides, and serve to decompose organic matter in the rhizosphere. In these processes, they:

- Accelerate phosphorus and nitrogen mineralization
- Maintain root microbiota in balance
- Activate biochemical cycles

c) Mycophagous nematodes

There are also nematodes that consume some of the fungi (Glomus spp.) that have entered into mycorrhizal symbiosis with saffron roots. This trophic relationship often works to the benefit of the plant, since excess fungi are retained without putting pressure on the roots.

Conclusion: The composition and population dynamics of the nematode fauna found in the rhizosphere of cultivated saffron have a direct impact on plant health and yield. New data show that phytoparasitic and saprotrophic nematodes compete with each other in the rhizosphere of saffron, forming a soil microecosystem. Monitoring and effective management of nematodes is important for ensuring sustainable yields of saffron crops. Future research in the field of molecular biology and microbiology will serve as a basis for a deeper study of the nematode fauna of the saffron rhizosphere and the development of innovative phytosanitary technologies.

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