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WEEDS AS VECTORS OF DISEASE AND PESTSIN ORGANIC PRODUCTION OF LEAF LETTUCE *LACTUCA SATIVA* L. SUBSP. SECALINA ALEF. (ASTERALES, ASTERACEAE)

KOROVI KAO VEKTORI BOLESTI I ŠTETOČINA U ORGANSKOJ PROIZVODNJI SALATE LISNATE- *LACTUCA SATIVA* L. SUBSP. SECALINA ALEF. (ASTERALES, ASTERACEAE)

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ABSTRACT

During the vegetation period of 2009 in organic production of leaf lettuce (Lactuca sativa L. subsp. secalina Alef.) in the open area 14 weed species were found. The investigation was made in the village of Kisač (Serbia). According to Kovačević J. (1976), the identified weed species are vectors of at least 64 taxa which are carriers of various diseases and pests (the least 18 fungi, 29 insects and 17 nematodes). The important vectors of diseases and pests, and thus the most undesirable weeds in leaf lettuce crop are: Amaranthus retroflexus, Chenopodium album, Cirsium arvense, Convolvulus arvensis, Sinapis arvensis and Stellaria media. It is necessary to prevent their growth with "selective plucking", so that the weeds, which are not significant vectors of diseases and pests, would prevent draining of soil in the periods of drought. In addition, crops in crop rotations are the most important, and often the only measure in fighting weeds, diseases and pests.

***Key words**: organic production, leaf lettuce, flora of weeds, fungus, insects, nematodes, viruses.*

REZIME

Dugogodišnje korišćenje konvencionalnih metoda poljoprivredne proizvodnje dovelo je do brojnih negativnih posledica (zagađenja životne sredine, pogoršanja kvaliteta hrane, ugrožavanja ljudskog zdravlja). Zbog toga se sve više poljoprivrednih proizvođača usmerava ka organskoj poljoprivredi. Zabrana korišćenja hemijskih mera, u organskoj proizvodnji, uzrok je velikih problema u zaštiti bilja, pre svega u borbi protiv korova koji smanjuju prinos gajenih biljaka. Najveći problem, pri organskoj proizvodnji, je tehnologija regulacije korova, s obzirom da sinuzija korova i gajene biljke treba da bude u ravnoteži. Stoga, poznavanje biologije i ekologije korovske flore, te bolje razumevanje kompeticije između gajene biljke i korova neophodan je preduslov u izboru metoda njihove kontrole i suzbijanja. Pri njivskoj organskoj proizvodnji salate lisnate (Lactuca sativa L. subsp. secalina Alef.), tokom vegetacionog perioda 2009. godine, u ataru sela Kisač (Srbija), u flori korova konstatovano je 14 biljnih vrsta. Na osnovu podataka koje navodi Kovačević J. (1976) konstatovane korovske vrste vektori su najmanje 64 taksona koji su prenosioci raznih bolesti i štetočina (najmanje 18 vrsta gljiva, najmanje 29 vrsta insekata i najmanje 17 vrsta nematoda). Značajniji vektori bolesti i štetočina, a time i najnepoželjniji korovi u usevu salate lisnate su: Amaranthus retroflexus, Chenopodium album, Cirsium arvense, Convolvulus arvensis, Sinapis arvensis i Stellaria media. Njihov rast treba sprečiti »selektivnim pročupavanjem« kako bi korovi, koji nisu znatniji vektori bolesti i štetočina, smanjili isušivanje zemljišta u periodima velikih suša. Pored toga, gajenje useva u plodoredima je najznačajnija mera u borbi protiv korova, bolesti i štetočina.

***Ključne reči**: organska proizvodnja, salata lisnata, flora korova, gljive, insekti, nematode, virusi.*

INTRODUCTION

The main task of agricultural production is to provide enough food and raw materials of organic origin for the current human population. Due to the constant need to increase the productivity of production, agricultural techniques based primarily on the use of artificially synthesized substances (fertilizers, pesticides, growth promoters, hormones, etc.), machanization and others have been developed. Extensive use of these conventional methods of agricultural production has led to many negative consequences (pollution, deterioration of food quality, threat to human health). Therefore, more and more farmers are moving toward organic agriculture with the aim of creating safe food and sustainable agriculture while preserving the ecosystem, biodiversity and protecting the environment (*Diver, 2001; Kristiansen, 2003; Kovačević D., 2008; Knežević et al., 2008; Biliaderis, 2008; Aćimović, 2009;Radosavljević, 2010*). Organic production, as a part of ecologically sustainable development, is based on application of the principles of agroecology. It is regulated by the Law on Organic Production and Organic Products (Official Gazette of the Republic of Serbia, No. 62/06) and includes control and certification of production and products (*Lazić and Malešević, 2010*). Agricultural households in Serbia have been able to register as organic since 2007 by obtaining the corresponding certificate.

Prohibition of using chemicals in organic production is the cause of major problems in plant protection, especially in fighting against weeds which reduce yields of crops (*Bárberi, 2002; Kristiansen, 2003; Kovačević D., 2008*). Weed control is carried out by regular plucking or digging. However, crops in crop rotation are not only the most important but often the only measure that helps protection of crops from weeds, pests and diseases (*Kovačević D. et al., 2008*).

The aim of this study is to point to the weeds as vectors of disease and pests in organic production of leaf lettuce in the open area.

MATERIAL AND METHOD

Researching flora of weeds in organic production of lettuce leaf (*Lactuca sativa* L. subsp.*secalina* Alef.), in the open area, was carried out during the vegetation period of 2009 on the farm "Vozar", registered for organic vegetable production in the village Kisač (Serbia, Vojvodina). The land on which leaf lettuce is grown is calcareous meadow black soil on loess terrace (*Nejgebauer et al., 1971*). The preceding crop for leaf lettuce during the growing season of 2008 was beet (*Beta vulgaris* L. subsp. *esculenta* Salisb.).

The experiment was set up on the surface of 156,6 m^2 which was divided in plots of 1,8m width and 3m length, with the space of 0.3 m between them. Seedlings of leaf lettuce was planted in mid April. On each plot, 4 rows of lettuce leaf seedling were planted with 12 plants in a row. Hilling and the first list of weeds were done in mid May, while the second list of weeds was done in early June. The identified weed flora was determined according to the following publications: Flora SR Srbije (*Josifović, 1970-1977),* Flora Europaea *(Tutin et al. 1964-1980*) and Iconography of the Flora from the South-Eastern part of Central Europe (*Jávorka and Csapody, 1975*). On the list of the identified weeds, for each plant species its taxonomic affiliation is listed according to *Takhtajan (1997),* and its life form and month of flowering (I-XII) according to *Čanak et al. (1978)*. The list of fungi, insects, nematodes and viruses which are transferred by the identified weed species are according to *Kovačević J. (1976)*.

RESULTS AND DISCUSSION

In organic production of leaf lettuce (*Lactuca sativa* L. subsp. *secalina* Alef.) during the vegetation period of 2009, in the village of Kisač (Serbia, Vojvodina), 14 species were found in the weed flora. The weed species were allowed a period of undisturbed growth until the beginning of mass flowering and fruiting. Hilliing before the start of flowering and fruiting prevented formation of a large number of weed seeds because most of them belong to the group of therophytes (out of 14 weed plant species 11 are therophytes). However, during the period of undisturbed growth, a great number of the identified weed species were the vectors of various types of fungi, insects, nematodes:

***Amaranthus retroflexus* L.**
Fam. Amaranthaceae
Life form: T
Flowering time: VI-IX
Fungi: *Alternaria sp.*
Insects: *Tullgrenia (Tychea) phaseoli*.
Nematodes: *Heterodera schachtii, Meloidogyne arenaria, M. hapla, M. incognita, M. acrita, M. penetrans, Pratylenchus penetrans.*
Viruses: -

***Anagallis arvensis* L.**
Fam. Primulaceae
Life form: T
Flowering time: V-X
Fungi: -
Insects: -
Nematodes: *Ditylenchus dipsaci*, *Longidorus maximus*, *Meloidogyne incognita*, *Meloidogyne* sp.
Viruses: -

***Chenopodium album* L.**
Fam. Chenopodiaceae
Life form: T
Flowering time: VI-XI
Fungi: *Cercospora dubia, Peronospora variabilis, Cineraria* sp.
Insects: *Pegomya hyoscyami, Microsetia seguitella, M. hermanella, Liryomyza bryoniae, Aphis fabae, A. rumicis, Blitophaga* sp., *Cassida nebulosa, Piesma quadrata, Myzus persicae.*
Nematodes: *Aphelenchoides ritzembosi, Ditylenchus dipsaci, Heterodera schachtii, Longidorus maximus, Meloidogyne* sp., *Meloidogyne arenaria, M. hapla, M. incognita, M. incognita* (*acrita*)*, M. javanica, Nacolus batiformis, Pratylenchus penetrans.*
Viruses: -

***Cirsium arvense* (L.) Scop.**
Fam. Asteraceae
Life form: G
Flowering time: VI-VIII
Fungi: *Albugo tragoponis, Bremia lactucae, Ramularia cirsii, Septoria cirsii*
Insects: *Coleophora äereipennis*.
Nematodes: *Aphelenchoides ritzembosi, Ditylenchus dipsaci, Meloidogyne sp., Pratylenchus penetrans*.
Viruses: -

***Convolvulus arvensis* L.**
Fam. Convolvulaceae
Life form: G
Flowering time: VI-IX
Fungi: *Cercospora sp., Erysiphe convolvuli, Phyllosticla calystegiae, Ramularia sp., Septoria convolvuli, Erysibe polygoni, Mycosphaerella adusta.*
Insects: *Stigmella freyella, Bedelia somnulentella, Manestra pisi*.
Nematodes: *Ditylenchus dipsaci, Longidorus maximus, Meloidogyne sp., Meloidogyne javanica, Pratylenchus penetrans.*
Viruses: -

***Datura stramonium* L.**
Fam. Solanaceae
Life form: T
Flowering time: VI-IX
Fungi: -
Insects: *Liriomyza bryoniae.*
Nematodes: -
Viruses: -

***Galinsoga parviflora* Cav.**
Fam. Asteraceae
Life form: T
Flowering time: V-X
Fungi: -
Insects: *Aphis nasturtii*
Nematodes: -
Viruses: -

***Heliotropium europaeum* L.**
Fam. Boraginaceae
Life form: T
Flowering time: VII-IX
Fungi: *Phytomyza atricornis*
Insects: -
Nematodes: -
Viruses: -

***Hibiscus trionum* L.**
Fam. Malvaceae
Life form: T
Flowering time: VI-VIII
Fungi: -
Insects: -
Nematodes: -
Viruses: -

***Polygonum lapathifolium* L.**
Fam. Polygonaceae
Life form: T
Flowering time: VI-IX
Fungi: -
Insects: -
Nematodes: *Ditylenchus dipsaci*, *Meloidogyne* sp., *M. javanica*.
Viruses: -
***Sinapis arvensis* L.**
Fam. Brassicaceae
Life form: T
Flowering time: V-IX
Fungi: *Plasmodiophora brassicae, Cystopus candidus, Peronospora parasitica*.
Insects: *Aphis brassicae, Brevicoryne brassicae, Pieris brassicae, Phyllotrela* sp., *Haltica* sp., *Plutella maculipennis, Eurydema ornata, E. oleracea, Meligethes aeneus, Cutorrchynchus pleurostigma, Cortophila brassicae*.
Nematodes: *Ditylenchus dipsaci, Heterodera cruciferae, H. schachtii, Meloidogyne* sp.
Viruses: -
***Solanum nigrum* L.**
Fam. Solanaceae
Life form: T
Flowering time: VI-X
Fungi: *Synchytrium endobioticum*
Insects: *Aphis evonymus*, *Myzus persicae.*
Nematodes: -
Viruses: -
***Sorghum halepense* (L.) Pers.**
Fam. Poaceae
Life form: G
Flowering time: VI-VII
Fungi: -
Insects: -
Nematodes: -
Viruses: -
***Stellaria media* (L.) Vill.**
Fam. Caryophyllaceae
Life form: T
Flowering time: I-XII (III-V)
Fungi: -
Insects: *Phytobia* (*Trilobomyza*) *flavifrons*, *Myzus persicae.*
Nematodes: *Aphelenchoides ritzembosi*, *Ditylenchus dipsaci*, *Heterodera galeopsidis*, *H. schachtii*, *H. trifolii*, *Longidorus maximus*, *Meloidogyne* sp., *Meloidogyne hapla*, *M. incognita*, *M. incognita* (*acrita*), *Pratylenchus crenatus*, *P. penetrans*.
Viruses: -Out of the 14 recorded weed species on the basis of literature data cited by *Kovačević J. (1976):*

None of the identified weed species in the leaf lettuce crop were the vector of virus. *Hibiscus trionum* and *Sorghum halepense* were not vectors of pathogenic fungi, insects, nematodes or viruses. *Heliotropium europaeum* is only the vector of fungus *Phytomyza atricornis*. Two plant species, *Datura stramonium* and *Galinsoga parviflora*, are vectors of only insects. Two plant species, *Anagalis arvensis* and *Polygonum lapatifolium*, are vectors of only nematodes. *Solanum nigrum* is a vector of fungi and insects. *Stellaria media* is a vector of insects and nematodes. There was no crop that is a vector of fungi and nematodes. Five plant species (*Amaranthus retroflexus, Chenopodium album, Cirsium arvense, Convolvulus arvensis* and *Sinapis arvensis*) are vectors of fungi, insects and nematodes.

In summary, the 14 identified weed species are vectors of at least 18 species of fungi, at least 29 species of insects and at least 17 species of nematodes, as a total of at least 64 taxa. The most important vectors of diseases and pests, and thus the least desirable weeds in the leaf lettuce crop were: *Amaranthus retroflexus, Chenopodium album, Cirsium arvense, Convolvulus arvensis, Sinapis arvensis and Stellaria media*.

Weeds mechanically suppress cultivated plants and reduce the amount of nutrients and water in the soil, thus weed control is successfully performed by hilling. However, the weeds can be useful because in periods of major droughts they prevent drying of the soil, providing higher yield of leaf lettuce. Therefore, it is believed that the growth of weeds can be prevented by “selective plucking" that would include, apart from the most unwanted weeds, also the weeds which are vectors of many diseases and pests, leaving the crops with the weeds which are not among these. In this way, the weed species which are not significant vectors of disease and pests would prevent significant drying of soil in the greatest periods of drought. In addition, crops in crop rotation are the most important measures in fighting against weeds, diseases and pests. Crop rotation effectively prevents excessive development of certain weed species and prevents their spreading, while monoculture can be a significant source of infection by some pathogenic organisms for crops and a cause of excessive presence of weeds (*Kovačević D. et al., 2008)*.

CONCLUSION

Since the organic production do not apply chemical weed control measures, weeds are a big problem because they reduce the yield of crops, and many of them are vectors of various diseases and pests. In organic production of leaf lettuce (*Lactuca sativa* L. subsp. *secalina* Alef.) during the vegetation period of 2009, in the village of Kisač (Serbia, Vojvodina), 14 species were found in the weed flora. These weed species are vectors at least 64 taxa that are carriers of various diseases and pests. The most important vectors of diseases and pests, and thus the least desirable weeds in the leaf lettuce crop were: *Amaranthus retroflexus, Chenopodium album, Cirsium arvense, Convolvulus arvensis, Sinapis arvensis and Stellaria media*.

The biggest problem in organic production is weed control technology, because synusia of weeds and cultivated plants should be in balance. Therefore, knowledge of the biology and ecology of the weed flora, and better understanding of competition between cultivated plants and weeds are a necessary prerequisite in choosing the methods for their control and suppression. It is believed that the growth of weeds can be prevented by "selective plucking". In this way, weed species, which are not significant vectors of diseases and pests, prevent drying of soil in periods of drought. In addition, crops in crop rotation are the most important, and often the only measure in fighting against weeds, diseases and pests.

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