

## RESISTANCE OF CERTAIN ALFALFA CULTIVARS (*Medicago sativa* L.) TO ROOT ROT IN FIELD CONDITIONS<sup>1</sup>

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*Content:* Level of resistance of alfalfa cultivars to root rot was investigated in field conditions during 2002 and 2003. By visual examination of the alfalfa root vitality at the end of vegetation in the second research year number of diseased plants was evaluated and degree/level of resistance determined according to percentage of healthy and diseased plants. Among investigated cultivars a difference in the level of resistance to root rot from resistant to susceptible was established. Cultivar Zaječarska 83 with 23,1% diseased plants was resistant, cultivars NS Mediana ZMS V, NS Banat ZMS II, K23 and K28 with 28-45,3% of diseased plants were medium susceptible and cultivar K22 with 53,8% diseased plants was susceptible to root rot in field conditions.

*Key words:* alfalfa, root rot, resistance, cultivar.

### Introduction

Main breeding goals in case of alfalfa (*Medicago sativa* L.) are increase of the yield stability in years of utilization and longevity of crops. In realization of such goals correct and timely application of agro techniques and efficient pesticides especially in stopping of damaging insects is of significant importance. For development of breeding programmes aiming to increase the yield and longevity of alfalfa knowledge of reactions of existing assortment/selection of this plant species to biotic and abiotic factors is very important. Resistance of plants in field conditions to root rot is considered as most important factor of alfalfa reaction to biotic factors. Therefore, striving of breeders in creating of resistant cultivars is firstly to carry out studies of reactions of various cultivars to different causers of root rot and based on these results select resistant genotypes for breeding programme of alfalfa in order to improve the vitality of plants in field conditions.

Alfalfa is most susceptible to pathogens causing the vascular wilting, root and crown rot, in years of its utilization. According to literature data, most frequent causers of mentioned diseases of alfalfa are following pathogenic fungi: *F. oxysporum* f. sp. *medicaginis* (Weimer) Snyder & Hans., *Verticillium albo-atrum* Reinke & Berth., *Rhizoctonia solani* Kuehn., *R. crocorum* DC. ex Fr. (syn. *R. violaceae* Tul.) and *Fusarium* spp. (Chi et al., 1964; Booth, 1971; Graham et al., 1979; Nedelnik 1988; Hwang et al., 1989; Burgess et al., 1994). The most frequent alfalfa pathogens from the species of *Fusarium* genus are *F. oxysporum* Schlecht. Emend. Snyder & Hans., *F. solani* (Mart.) Appel & Wollenw. Emend. Snyder & Hansen, *F. avenaceum* (Fr.) Sacc. and *F. tricinctum* Berk & Rav.

Root and crown rot represent one of the most important factors affecting the yield of alfalfa (Nedelnik, 1988). Damage to the crop frequently occurs in the second and subsequent years of the stand. Often the fungus enters the plant through damaged roots but can infect crowns directly. These infections can be through mechanical injuries, insect damage or portions of the plant killed during the winter due to low temperatures (winter injury). Disease symptoms are manifested as chlorosis of leaves and lower plants. Dark brown areas appear on buds or stems of the plant and spread to the crown and upper roots, where affected tissue forms letter "V". Infection of buds occurs in early spring and bud decay occurs as the growing season progresses. Destruction of bud tissue reduces new stem formation and causes weakness in plants, resulting in stand thinning (Anonymous, 2004).

Evaluation of the level of plant resistance to pathogens is carried out in controlled conditions (laboratory tests and tests in greenhouse) and/or field conditions. Tests of resistance in field conditions give results of field resistance of alfalfa which are more reliable compared to results obtained in controlled conditions considering the complex (polygene) nature of the disease – root rot. Therefore, objective of our research was investigation of resistance of several domestic selections of alfalfa to root rot in field conditions.

### Material and methods

In two year research (2002-2003) resistance to root and crown rot of six alfalfa cultivars (K22, K23,

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K28, NS Mediana ZMS V, NS Banat ZMS II and Zaječarska 83) was investigated in field conditions. Trial was set in spring of 2002 on experimental field of the Institute for Animal Husbandry, Belgrade-Zemun, on soil type degraded chernozem. Trial was designed according to random block system and alfalfa cultivars distributed in five repetitions. Size of parcel was 1 m<sup>2</sup>. Plants within small parcel were planted in three rows with 15 plants in each row. Distance between rows was 20 cm. Total number of plants was 45 per small parcel or 1350 per plot.

During both investigation years the appearance of disease of alfalfa leaf was monitored and at the end of vegetation in the second year (2003) all plants were pulled out, soil was removed of them and intensity of root rot evaluated. By visual examination of plants number of diseased plants with symptoms of crown rot area and longitudinal root section was evaluated. Obtained results per small parcels were analyzed statistically using the method of variance analysis – F-test. Individual comparisons were using LSD test ( $P < 0,05$ ) were carried out. Susceptibility of investigated cultivars was expressed also through percentage of diseased plants per cultivar during two year researched vegetation period.

Level of resistance of investigated alfalfa cultivars was evaluated according to *Dan and Stephens (1995)* scale: 0% diseased plants – highly resistant cultivars; less than 25% of diseased plants – resistant cultivars; less than 50% of diseased plants – medium susceptible cultivars; less than 75% of diseased plants – susceptible cultivars; 100% of diseased plants – highly susceptible cultivars.

### Results

On above ground parts of diseased plants symptoms of mosaic were registered, also chlorosis of leaves and wrinkled leaves, dwarfish and asymmetric growth of alfalfa. In spring period, during two investigated vegetation periods 2002 and 2003, occurrence of spotty, freckled leaves caused by fungus *Stemphylium botryosum* Wallr was registered. In summer period, occurrence of spotty, freckled leaves caused by fungus *Pseudopeziza medicaginis* (Lib.) Sacc. and alfalfa rust caused by fungus *Uromyces striatus* Schroet were registered. Of insect species, presence of aphides, alfalfa beetle (*Phytodecta fornicata* Brüg.) and alfalfa plant bug (*Adelphocoris lineolatus* Goeze) was registered. At the end of the second vegetation general wilting of plants or total dying of plants wasn't registered.

In diseased plants, in majority of cases, initial stage of rot development was concluded in the form of wedge-shaped necrosis on the crown. Only in few cases, necrosis in the form of rare lines of red-brown colour spreading over the vascular tissue in the zone bellow the crown was observed. Colour of necrosis in the area around the crown varied from light brown, brown, dark brown and black.

Results of the investigation of the resistance of alfalfa cultivars to root rot in field conditions are presented in Table 1. Based on average number of diseased plants per small parcel (1 m<sup>2</sup>) it was established that cultivars Zaječarska 83, NS Mediana ZMS V and NS Banat ZMS II have demonstrated the highest level of resistance and statistically they differed significantly in relation to other investigated cultivars, except the cultivar K23. Resistance of the cultivar K23 showed no statistically significant difference to resistance determined in cultivar K28. Cultivar K22 demonstrated the lowest level of resistance in field conditions and it was statistically significantly different in regard to resistance to other investigated cultivars, except K28.

Table 1. The resistance of some cultivars of alfalfa to root rot in field conditions

Alfalfa cultivars	Diseased plants			Resistance level <sup>c</sup>
	Number		%	
	Ms <sup>a</sup>	Sd <sup>b</sup>		
Zaječarska 83	10,4a	4,62	23,1	R
NS Mediana ZMS V	12,6a	2,19	28,0	MS
NS Banat ZMS II	13,4a	3,65	29,8	MS
K23	15,6ab	7,92	34,7	MS
K28	20,4bc	4,93	45,3	MS
K22	24,2c	5,31	53,8	S

a Average number of diseased plants per parcel. Mean values without mutual marks (Latin letters) are statistically different on the level of  $P < 0,05$

b Standard deviation (Sd) for average number of diseased plants on small parcel

c Level of resistance of alfalfa cultivars according to scale described by Dan and Stephens (1995): R - resistant, MS – medium susceptible and S – susceptible

The highest percentage of diseased plants with symptoms of root and crown rot in field conditions after two year research was established in cultivar K22 (53,8%), followed by cultivars K28 (45,3%), K23 (34,7%), NS Banat ZMS II (29,8%), NS Mediana ZMS V (28,0%) and Zaječarska 83 (23,1%) (Table 1). Based on percentage of diseased plants, cultivar Zaječarska 83 belongs to resistant cultivars, NS Mediana ZMS V, NS Banat ZMS II, K23 and K28 could be classified as medium susceptible cultivars, whereas cultivar K22 belongs to group of susceptible cultivars of alfalfa to root rot in field conditions.

#### *Discussion*

Resistance of alfalfa is complex trait characterizing the ability of plant to survive the action of negative factors of abiotic and biotic nature. Due to mentioned reasons, alfalfa resistance is investigated in its natural habitat where complex ecological interactions occur (so called coactions) which cannot be simulated in tests in laboratory or greenhouse. Resistance in the field is phenomenon which relates to interaction of host population and pathogens during vegetation period, in other words ontogenesis in given system. Dynamic character is specific and is related to plasticity of living organisms (*Nedelnik, 1992*). Phytopathological categories which represent main part of resistance include resistance to pathogen organisms and resistance in the field.

In field trial, different level of resistance of six investigated domestic cultivars of alfalfa to root and crown rot were established. At the end of vegetation period in the second year of research percentage of diseased plants in trial plot was within the range of 23,1% (Zaječarska 83) to 53,8% (K22), or there were no highly resistant and highly susceptible cultivars. In similar investigations but for cultivars of red clover, *Nedelnik (1992)* established the survival of only 24,3% of red clover plants. According to this author, majority of plants died during the first year of utilization (37,5%).

Different types of stress of biotic or abiotic nature speed up the development of root rot of alfalfa. For instance, diseases of leaves, insects affecting leaves and root, frequent or late cuttings, early frosts, insufficient fertilization, severe winters, low intensity of light and low pH value of soil are examples of stress which speed up the development of root rot of alfalfa (*Graham et al., 1979*).

Due to complex nature of root rot of alfalfa, as prevention measures prompt cutting is recommended, preservation of adequate nutrient level, especially potassium, and avoiding of mechanical damages (*Graham et al., 1979*).

#### *Conclusion*

Based on obtained results of the investigation of resistance level of few domestic alfalfa cultivar selections in field conditions the following can be concluded:

In diseased plants, in majority of cases, initial stage of development of root rot in form of wedge-shaped necrosis on the crown was registered. At the end of second vegetation period occurrence of general wilting of plants or dying of plants was not determined;

In field conditions, cultivar Zaječarska 83 is resistant, cultivars NS Mediana ZMS V, NS Banat ZMS II, K23 and K28 are medium susceptible and cultivar K22 is susceptible to root rot;

Considerable variability established between investigated cultivars suggests that in domestic selection material of alfalfa there is source of resistance to root rot in field conditions. Zaječarska 83 cultivar has satisfactory resistance and it can be recommended for breeding and creating of new cultivars. It is necessary to continue with such research but include more alfalfa genotypes.

## OTPORNOST NEKIH SORTI LUCERKE (*Medicago sativa* L.) PREMA TRULEŽI KORENA U POLJSKIM USLOVIMA

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### Rezi me

Nivo otpornosti sorti lucerke prema truleži korena ispitivan je u poljskim uslovima u toku 2002. i 2003. godine. Vizuelnim pregledom vitalnosti korena lucerke na kraju vegetacije druge godine ispitivanja ocenjen je broj obolelih biljaka i utvrđen stepen otpornosti prema procentu zdravih i obolelih biljaka. Među ispitivanim sortama ustanovljena je razlika u nivou otpornosti prema truleži korena od otpornih do osetljivih. Sorta Zaječarska 83 sa 23,11% obolelih biljaka je otporna, sorte NS Mediana ZMS V, NS Banat ZMS II, K23 i K28 sa 28-45,33% obolelih biljaka su srednje osetljive i sorta K22 sa 53,78% obolelih biljaka je osetljiva prema truleži korena u poljskim uslovima.

*Ključne reči:* lucerka, trulež korena, otpornost, sorte.

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