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THE CONTROL OF OAK MILDEW BY BIOFUNGICIDE

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Abstract

Microsphaera alphitoides Griff. et Maubl. is the most widespread and frequent disease in oak forests.The fungus is primary pathogene attacking plants in all developmental stages. Since it causes the greatest harms on young stands of pedunculate oak, when attacks are strong, chemical protection (treatment by fungicides) is applied. In Serbia fungicides for control of pathogenes in forest ecosystems are not registered. Therefore, it is necessary to select ecotoxicologically favourable fungicides registered in this region and obey FSC policy in application of pesticides. Bionfungicides are used for biological control of fungi causing plant diseases. This paper studies the independent influence of biofungicide AQ10 in concentrations 0.03 g, 0.05 g, and 0.07 g on agent of oak mildew. Preliminary studies of effect of biofungicide AQ10 are conducted by standard OEPP method PP1/69(2) (OEPP/EPPO, 1997) in pedunculate oak nurseries subject to infection potential of parasitic fungus *M. alphitoides.* Leaf infection was estimated by EPPO method (Guideline for efficacy evaluation of fungicides *Podosphaera leucotricha*) PP1/69(2); infection intensity was determined by Towsend-Heuberger's method, and efficiency by Abbott's.

Key words: biofungicide – AQ10, efficiency, *Microsphaera alphitoides*.

Introduction

Serbia is considered as secondary forest land. According to the latest data of Forest Inventory of National Republic of Serbia from the 2009th year, the forest is 29.1% (of which 37.6% is in the middle part of Serbia and 7.1% in Vojvodina) of the total area of the territory of Serbia. In relation to the global aspect, the forested area of Serbia is closer to the world, which is 30% and was significantly lower than European, which reaches 46%.

The total area of forests in Serbia is 2,252,400 ha, and the most important species of oak is on the surface – 720,800 ha. Since then, forest of *Q. cerris* L. stretch of 345,200 ha, *Q. petrea* (Matt.) Liebl. forest the 173,200 ha, forest *Q. frainetto* Ten. on 159,600 ha, of *Q. robur* L. forests and 32,400 ha, of forest *Q. pubescens* Willd. to 10,400 ha.

Several species of powdery mildew are known to infect oaks. These include *Erysiphe abbreviata* (syn. *Microsphaera abbreviata*), *E. alphitoides* (syn. *M. alphitoides*), *E. calocladophora* (syn. *M. calo-*

cladophora), *E. extensa* (syn. *M. extensa*), and *E. hypophylla* (syn. *M. hypophylla*) (Braun 1987, Braun and Takamatsu 2000, Braun et al. 2003).

E. alphitoides is common, widespread in Asia and Europe on numerous species of the genus *Quercus*, and has been introduced in various other parts of the world (Braun 1987, Butin 1995, Bunkina1991). In Europe, it is morphologically rather uniform (Braun 1995), whereas in Asia, above all in China, Japan and Korea, its chasmothecia are more variable (Homma 1937, Nef and Perrin 1999, Otani 1988, Rajkovic and Tabakovic-Tosic 2008).

Because of the desire for reducing the negative consequences of applying chemicals, and the possibility of resistance, biological control is becoming increasingly important. For biological control of plant disease causing fungi used biofungicides. Efficiency of biofungicides improves by adding the polymer during its application.

The biofungicide AQ10 (Ecogen Inc., Langhorne, PA) is a pelleted formulation of conidia of *Ampelomyces quisqualis* Ces. ex Schlechtend., a fungus that parasitizes powdery mildew colonies. It is intended for use as part of an integrated management program; therefore, information is needed on its compatibility with conventional chemical fungicides (Rajkovic et al. 2009).

Material and Methods

The experiments were made in the nursery „Rogut" which is located in Batocina, near Kragujevac, at altitude 115 m. The investigations were carried out on the oak seedlings *Q. robur* L., aged 6 years, seed origin. The seeds from which seedlings produced comes from recognized seed stands oak, reg. No C 02.11.01.01, which borders with the nursery. Height of seedlings are from 0.30 cm to 1.70 m (mostly about 1.20 m), because the part of seedlings were cating in the first and second vegetation period. Seedlings were planted densely in rows length of about 60 m (8 rows in total, an average of 6 seedlings per m^2), with space between the row around 40 cm. For the experiment were used two rows. The control was estimate in the second row.

Biofungicide – AQ10 is a new biofungicide that contains fungal spores of for the control of powdery mildew by parasiting and killing the fungal organisms that cause the disease. It is approved for the efficient and biotical use of Powdery Mildew. For its activation it needs 60% of air humidity therefore application should be made in the early morning or late evening when the humidity is at its highest, with the addition of some wetting agent. When spores of *A. qisqualis* penetrate into Powdery Mildew mycelia (2–4 hours) their efficacy is depending on external influences not any more. This biofungicide is mostly preventive product but it acts also "eradicatively" and is efficient also against mycelia which passed the winter. Initial application should begin before the appearance of the symptoms and at the latest when three spots on 100 leaves have been observed. AQ10 has very short pre-harvest interval, only 24 hours, so it can be applied up to and including the day of harvest.

Fungicide Sulphur SC (a. i. Elementary sulphur 810.50 $g.l^{-1}$) in use 0.5% (Galenika-Phytopharmacy a.d. Belgrade-Zemun).

The appearance and development of powdery mildews is followed by the first appearance to the development of disease in control in the degree when it is possible to establish clear differences between control and variations where biofungicides were used. The trials were set by the instructions of methods PP 1/152 (2) (EPPO 1997b) and the plan is fully randomized block design. The experiment was conducted in four repetitions. The basic plot consisted of 8 trees (1x3 m apart) 25 m^2. Estimation on leaves by secondary infection of powdery mildew: 15 well-developed leaves were selected on shoot from the outer zones of branched part of each tree. Recommendations are to avoid the shoots with primary infection of powdery mildews and shoots completely infected by powdery mildews and shoots that arise from the interior foliage.

Amount of water per unit surface: Application of fungicides was performed using the backstroke sprayer "Solo"; with the consumption of 1000 $l.ha^{-1}$ of water. Time of application of biofungicide and its combination with polymers: 07.07.2010. FF: Shoots are 15–20 cm length. The intensity of disease assessed by the method of EPPO, 1997a: Guideline for the efficacy evaluation of fungicides – *Podosphaera leucotricha*, No PP 1/69 (2) in Guideline for the efficacy evaluation of Plant Protection Products (EPPO 1997a: 100–102). Time of estimation: 11.07.2009. Phytotoxity is estimated by instructions of PP methods (1/135 (2) (OEPP, 1997d). Weather conditions: during the treatments there were more favorable conditions for the application of biofungicide: the wind was below 1 $m.s^{-1}$, and the temperature 18.8–26.4°C, with sunny intervals of 2–3 hours after treatment. Before treatment there was no rain 48 h, and after 6–8 hours of treatment there was no rainfall, while the relative humidity was 80%, because the nursery is protected with old forest plantations in surrounding. Data of land: in the oak nursery soil is poorly processed. Weeds were repressed by hand mower. Irrigation was not applied. Type of land at the tested locality was vertisol, wet, deep 80 to 120 cm. Other measures in the experimental field: Treatments by insecticides and bioinsecticides were done in 07.05.2009. For the suppression of gypsy moths in the variants where the product AQ10 is applied in all used concentrations, used a biological product Forey (0.3 $l.ha^{-1}$). In variants where AQ10 combined with Nu film 17 in the lower and higher doses were used applying insecticides Avaunt 15SC (200 $ml.ha^{-1}$). The variant where the AQ10 was applied in combination with Nu P film was used Coragen 20 SC (200 $ml.ha^{-1}$). On the control variants there was no application of any pesticides or biopesticides.

Statistics

Data processing was performed using standard statistical methods (intensity of infection by Towsend-Heuberger (Towsend and Heuberger 1943), the efficiency of the Abbott (Abbott 1925), analysis of variance and Duncan test (Duncan 1955) and methods PP/181 (2) (EPPO 1997c). Differences of intensity of disease were evaluated by analysis of variance and LSD-test.

Results

We are presented the data of realized powdery mildews infestation on the oak

Table 1. Intensity of attacks *M. alphitoides* on oak leaves and efficiency of biofungicide AQ10 in the locality Batočina – Kragujevac.

No	Fungicide	Doses/Conc.	Infection, %	Efficacy, %	Standard, %
1	AQ10	0.03 kg.ha^{-1}	15.35 bc	21.68	28.33
2	AQ10	0.05 kg.ha^{-1}	2.15 ab	63.52	83.00
3	AQ10	0.07 kg.ha^{-1}	6.15 a	68.62	89.67
4	Sumpor SC	0.5 %	4.60 a	76.53	100.00
5	Untreated	–	19.60 c	0.00	0.00
	lsd 005		6.65		
	lsd 001		9.33		

leaves in the Table 1. Biofungicide was applied in three doses, at the lowest application dose (30 g) percentage of infection was 15.35%, in the middle dose 7.15% and in the highest dose was 6.15%. This results of investigations shows that if this application of biofungicide in two higher doses had succesfuly control.

There are no statistically differences between the highest dose of application of biofungicide AQ10 and fungicide Sulfur. Fungicide Sulfur SC showed the efficiency of 84.43% which is low efficiency for chemical fungicides but still satisfactory for practice. Infection on control variant was 19.75% which means that the presence of pathogens was significant that could be carried out this experimental essay and to properly assess the effectiveness of the investigated preparations.

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References

Abbott W.S. 1925. A method for computing the effectiveness of an insecticide. JEcon Entomology 18: 265–267.

Braun U. 1987. A monograph of the Erysiphales (powdery mildews). Beihefte zur Nova Hedwigia 89: 1–700.

Braun U. 1995. The powdery mildews (Erysiphales) of Europe. Gustav Fischer Verlag, Jena, 337 p.

Braun U., Cunnington J.H., Brielmaier-Liebetanz U., Ale-Agha N., Heluta V. 2003. Miscellaneous notes on some powdery mildew fungi. Schlechtendalia 10: 91–95.

Braun U., Takamatsu S. 2000. Phylogeny of Erysiphe, Microsphaera, Uncinula (Erysipheae) and Cystotheca, Podosphaera, Sphaerotheca (Cystotheceae) inferred from rDNA ITS sequences d some taxonomic consequences. Schlechtendalia 4: 1–33.

Butin H. 1995. Tree diseases and disorders. Causes, biology and control in forest amenity trees. Oxford University Press, Oxford, 252 p.

Bunkina I.A. 1991. Porjadok Erysiphales Gwinne-Vaughan. In:Azbukina ZM (ed.), Nizshie rastenija, griby i mohoobraznye Sovetskogo Dal´nego Vostoka, Griby, Vol. 2. Askomicety, Erizifal´nye, Klavicipital´nye, Gelocial´nye. Nauka, Leningrad: 11–142.

Duncan D.B. 1955. Multiple-range and multiple F test. Biometrics, 11: 1–42.

EPPO 1997a. Guideline for the efficacy evaluation of fungicides – *Podosphaera leucotricha*, No PP 1/69 (2) in Guideline for the efficacy evaluation of Plant Protection Products, 1997: 100–102.

EPPO 1997b. Guidelines for the efficacy evaluation of plant protection products: Design and analysis of efficacy evaluation trials – PP 1/152 (2), in EPPO Standards: Guidelines for the efficacy evaluation of plant protection products, 1, EPPO, Paris: 37–51.

EPPO 1997c. Guidelines for the efficacy evaluation of plant protection products: Conduct and reporting of efficacy evaluation trials PP 1/181 (2), in EPPO Standards: Guidelines for the efficacy evaluation of plant protection products, 1, EPPO, Paris: 52–58.

EPPO 1997d. Guidelines for the efficacy evaluation of plant protection products: Phytotoxicity assessment – PP 1/135 (2), in EPPO Standards: Guidelines for the efficacy evaluation of plant protection products, 1, EPPO, Paris: 31–36.

Homma Y. 1937. Erysiphaceae of Japan. Journal of the Faculty of Agriculture, Hokkaido Imperial University 38: 183–461.

National forest inventory of the Republic of Serbia, Forest Fund of the Republic of Serbia 2009. Monograph, 1 edition, Ministry of Agriculture, Forestry and Water Management, Department of Forests, Planeta print, Belgrade.

Nef L., Perrin R. 1999. Damaging agents in European forest nurseries. Practical handbook. European Communities, Italy.

Otani Y. 1988. S. Ito´s Mycological Flora of Japan Vol. III. In: Ascomycotina, No 2. Yokendo, Tokyo. Roll-Hansen F, 1961. Microsphaera hypophylla Nevodovskij (M. silvaticaVlasov) an oak powdery mildew fungus. Reports of the Norwegian Forest Research Institute 17: 38–54.

Rajkovic S., Tabakovic–Tosic M. 2008. Controling measures of Powdery mildew. Forest Science No 4, 64 p.

Rajkovic S., Tabakovic-Tosic M., Golubovic-Curguz V. 2009. AQ10 – new preventive biolofungicide. Information Bulletin EPRS IOBS, No 9, Kiev:175–177.

Towsend G. R., Heuberger J. W. 1943. Methods for estimating losses by diseases in fungicide experiments. Plant Disease Reporter 24: 340–343.