



EFFECT OF SIMULTANEOUS APPLICATION OF BRASSINOSTEROIDS AND REDUCED DOSES OF FUNGICIDES ON *VENTURIA INAEQUALIS*

Stevanović Miloš, Trkulja Nenad, Nikolić Bogdan, Dolovac Nenad, Ivanović Žarko
Institute for Plant Protection and Environment, Belgrade, Serbia.
Contact e-mail: stevanovicmilos14@yahoo.com

INTRODUCTION

Apple scab caused by the fungus *V. inaequalis* (Cooke) G. Wint. is one of the most serious diseases of apple that occurs in almost all apple-producing areas and causes huge economic losses (MacHardy, 1996). Recent years, the frequent occurrence of apple scab resistance to fungicides indicates the need for fungicides to reduce the expanse of their use and develop alternative environmentally friendly approach to control *V. inaequalis* (Balaž et al., 2010). Russian and Chinese scientists have applied brassinosteroids and reduced doses of pesticides in sunflower (Dorozhkina et al., 2007) and cucumber (Xia et al., 2009). Yield of crops is preserved and also the level of plant protection.

MATERIAL AND METHODS

The trials were arranged in a randomized complete block design with four replications and plot size was 4 trees according to EPPO methods (EPPO PP 1/152 (2), 1997). The percentage of disease development on the leaves was rated on a scale developed by Croxall et al. (1953). The percentage of disease development of the fruits was rated on a EPPO scale (EPPO PP 1/5 (3), 2004) : 1 = no attack, 2 = 1-3 spots per fruit, 3 = > 3 spots per fruit. The disease severity (DS) was evaluated using the Townsend-Heuberger's formula (Townsend and Heuberger, 1943). The fungicide efficacy (FE) was calculated using Abbott's formula (Abbott, 1925). The data were analyzed separately for each trial using ANOVA and the means were separated by Duncan's multiple range test.

Table 2. *Venturia inaequalis* – disease intensity on apple leaves and fungicide efficacy on locality Morović in 2011

Fungicides	Conc.	Ms	Sd	E%
Akord + Mankogal-80	0.015%+0.1%	18.50c	4,08	57.59
Akord + Mankogal-80+ Epin Extra	0.015%+0.1%+0,034%	11.75b	1,54	73.35
Akord + Mankogal-80+ Cirkon	0.015%+0.1%+0,03%	15.94c	1,98	63.47
Akord + Mankogal-80+ Amalgerol Premium	0.015%+0.1%+0,75%	15.00bc	2,11	65.62
Akord + Mankogal-80+ Drin	0.015%+0.1%+0,75%	14.69bc	2,74	66.33
Akord + Mankogal-80	0.03%+0.2%	6.50a	1,08	85.10
Control	-	43.63d	2,97	-

Table 5. *Venturia inaequalis* – disease intensity on apple fruits and fungicide efficacy on locality Obrenovac, 2011

Fungicides	Conc.	Ms	Sd	E%
Akord + Mankogal-80	0.015%+0.1%	17.88e	1,60	61.56
Akord + Mankogal-80+ Epin Extra	0.015%+0.1%+0,034%	10.38b	1,11	77.69
Akord + Mankogal-80+ Cirkon	0.015%+0.1%+0,03%	16.25de	1,55	65.05
Akord + Mankogal-80+ Amalgerol Premium	0.015%+0.1%+0,75%	12.75bc	1,94	72.58
Akord + Mankogal-80+ Drin	0.015%+0.1%+0,75%	14.13cd	1,45	69.62
Akord + Mankogal-80	0.03%+0.2%	5.63a	1,11	87.90
Control	-	46.50f	2,34	-

Table 3. *Venturia inaequalis* – disease intensity on apple leaves and fungicide efficacy on locality Obrenovac in 2011

Fungicides	Conc.	Ms	Sd	E%
Akord + Mankogal-80	0.015%+0.1%	20.00c	3,11	53.96
Akord + Mankogal-80+ Epin Extra	0.015%+0.1%+0,034%	9.25a	0,87	78.71
Akord + Mankogal-80+ Cirkon	0.015%+0.1%+0,03%	14.25b	1,24	67.19
Akord + Mankogal-80+ Amalgerol Premium	0.015%+0.1%+0,75%	14.50b	1,10	66.62
Akord + Mankogal-80+ Drin	0.015%+0.1%+0,75%	15.56b	0,99	64.17
Akord + Mankogal-80	0.03%+0.2%	6.88a	1,36	84.17
Control	-	43.44d	3,96	-

Table 1. Application details with designated number and time of treatments in orchards

No. application	Locality			
	Obrenovac		Morović	
	Time application	BBCH	Time application	BBCH
1	06.04.2011.	15	04.04.2011.	15
2	12.04.2011.	19	11.04.2011.	19
3	19.04.2011.	51-55	18.04.2011.	51-55
4	26.04.2011.	71	27.04.2011.	71
5	05.05.2011.	72	04.05.2011.	72
6.	11.05.2011.	72-74	10.05.2011.	72-74
7.	18.05.2011.	75	17.05.2011.	75
8.	24.05.2011.	75-77	25.05.2011.	75-77
9.	02.06.2011.	77	03.06.2011.	77
Time assessment	16.06.2011	78-79	17.06.2011	78-79

RESULTS

During the 2011 environmental conditions were not favorable for infection caused by *V. inaequalis*, however intensive disease development was recorded in untreated control plots with infection rate of 43.44-43.63% on leaves and 37.25-46.50% on fruits. Lowest infection rate of the leaves on both localities was recorded in plots with full dose of fungicides applied, that is 6.5% in Morović and 6.88% in Obrenovac. In comparison with full dose of fungicides, a reduced dose of brassinosteroids "Epin-extra" showed a disease intensity from 9.25% to 11.75%. Similar to the infection of the leaves, disease intensity on the fruits was the lowest in plots treated with a full dose of fungicides, from 5.63% to 5.88%. Plots treated with reduced dose of fungicides and brassinosteroids "Epin-extra" combination had shown disease intensity from 8.38% to 10.38%.

Table 4. *Venturia inaequalis* – disease intensity on apple fruits and fungicide efficacy on locality Morović in 2011

Fungicides	Conc.	Ms	Sd	E%
Akord + Mankogal-80	0.015%+0.1%	15.25bc	1,94	59.06
Akord + Mankogal-80+ Epin Extra	0.015%+0.1%+0,034%	8.38a	2,21	77.52
Akord + Mankogal-80+ Cirkon	0.015%+0.1%+0,03%	18.25c	1,32	51.01
Akord + Mankogal-80+ Amalgerol Premium	0.015%+0.1%+0,75%	13.13b	2,32	64.77
Akord + Mankogal-80+ Drin	0.015%+0.1%+0,75%	14.38b	1,65	61.41
Akord + Mankogal-80	0.03%+0.2%	5.88a	1,31	84.23
Control	-	37.25d	3,17	-

DISCUSSION

The aim of this study was to clarify whether or not the use of reduced dose of fungicides in combination with brassinosteroids has a satisfactory effect in protection and yield preservation of apple as well as on cucumber and sunflower presented in studies by Russian and Chinese scientists (Dorozhkina et al., 2007; Xia et al., 2009), compared to the conventional fungicides use. On the both localities the highest level of leaves and fruits protection was shown in plots treated with full dose of fungicides, 84.17-85.10% (on leaves) and 84.23-87.90% (on fruits). Half a dose of fungicides has no satisfactory effect on disease severity reduction. In comparison with full dose of fungicides, a lower degree of efficacy was determined in combination of brassinosteroids and reduced dose of fungicides, that is 73.35-78.71% (on leaves) and 77.52-77.69% (on fruits). Based on these results, the brassinosteroids have a positive effect when applied with fungicides enabling the use of much lower doses of fungicides in plant protection. The combined effect was probably more than additive, but synergistic effect is yet to be explored.