Effect of Fungicide Application on Seed Yield of Perennial Ryegrass

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ID # 03-07

EFFECT OF FUNGICIDE APPLICATION ON SEED YIELD OF PERENNIAL RYEGRASS

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Abstract

In four plot experiments established according to random blocks, application effectiveness of propiconazol + carbendazim (Tilt), propiconazol + fenpropimorph (Archer), flusilazol + carbendazim (Alert) and epoxiconazol + crezoxim-metil (Juwel) pesticides regarding the infection by fungal diseases of plant inflorescence structure, biological floret site utilisation, thousand seed weight and harvested seed yield of perennial ryegrass cv. Anna (2n) and cv. Maja (4n) was analysed. The Archer preparation was found to be the most effective, both in the case of Anna and Maja cultivars. Its application was found to increase seed yield in Anna and Maja cultivars by, respectively, 21,5% and 14,5%. Yield harvest was increased, primarily, due to improved plant health and biological floret site utilisation. On the basis of the analysis of profitability index, it turned out that the application of all the examined fungicides in seed plantations of Anna and Maja cultivars of perennial ryegrass was economically justified.

Keywords: Disease control, fungicide, perennial ryegrass, seed yield

Introduction

One of the agrotechnical treatments on seed plantations of perennial ryegrass is the application of fungicides. Such treatments protect plants against fungal diseases (Rijckaert, 1995; Rolston et al., 1989; 1997). Fungicide application leads to increases in seed yields which is attributed to the long-term maintenance of bigger leaf assimilation area and better spikelets health condition (Hampton and Hebblethwaite, 1984). However, this effect in seed plantations of perennial ryegrass varies considerably. Rolston et al. (1989) report that it can range from 5-43%. Therefore, the application of fungicides is not economical in all conditions of seed production of perennial ryegrass.

Application of fungicides on seed plantations of perennial ryegrass is rare in Poland. The purpose of the performed experiments was to assess the influence of selected fungicides on disease control, seed yield structure and quantity of perennial ryegrass, including the determination of their application profitability.

Material and Methods

Experiments were carried out in years 1998-1999 at the Brody Experimental Station of the Department of Grassland Science (52º 26' N, 16º 18' E) using for this purpose four experimental plots situated on brown soil of light clay sand mechanical structure with a high content of phosphorus and magnesium and a very high content of potassium and slightly acid reaction. In 1997 and 1998 perennial ryegrass (*Lolium perenne* L.) cv. Anna (2n) and cv. Maja (4n) were sown in the amount of 400 seeds m^{-2} at row spacing of 15 cm into spring barley which was used as a companion crop. Treatments were arranged in a randomised block design with four replications in all trials. Observations were made on plots of 25 m^2 in the first year of utilisation. The following five experimental treatments were distinguished: 1/ propiconazol + carbendazim: 125 g ha^{-1} + 250 g ha^{-1} (Tilt 37,5 WP); 2/ propiconazol + fenpropimorph: 125

g ha^{-1} + 300 g ha^{-1} (Archer 425 EC); 3/ flusilazol + carbendazim: 125 g ha^{-1} + 250 g ha^{-1} (Alert 375 EC); 4/ epoxiconazol + crezoxim-metil: 125 g ha^{-1} + 125 g ha^{-1} (Juwel 250 SC); 5/ control. Nitrogen fertilisation was applied in the autumn at the dose of 30 kg ha^{-1} and in the spring - 60 kg ha^{-1}. Fungicides were applied before flowering of perennial ryegrass using a plot sprayer. The estimation of plant infection by fungal diseases was carried out a few days after the termination of flowering using the scale of 1-9º (1º – very strong infection, 9º – no infection). Inflorescence structure, biological floret site utilisation as well as the weight of thousand seeds were also analysed. Seeds were harvested from 14 m^2 plots using a Wintersteiger combine harvester. Seed crop was assessed after drying (10-12% water) and cleaning of seeds. Current prices of seed sale and purchase of fungicides as well as spraying were used to calculate the profitability index expressing the ratio between the increase of the seed crop value to costs of fungicide application.

Results and Discussion

The most frequent diseases were rusts and spots on leaves and stalks. They included: leaf spots (*Drechslera sp.*), black stem rust (*Puccinia graminis ssp. graminicola*) and crown rust (*Puccinia coronata var. coronata*). The applied fungicides reduced considerably infections with diseases but they did not entirely protect plants against such infections (Table 1). From among the examined fungicides Archer was found to be the most effective as plants on experimental plots treated with this preparation were the healthiest (6.0º - cv. Anna and 5.25º - cv. Maja). This, undoubtedly, resulted in the prolongation of the period during which assimilates were manufactured in leaves and contributed towards increased seed crop, as emphasised by Rolston et al. (1989).

It turned out, that in comparison with the control object, the effect of fungicide application increased seed yield by 6.8-21.5% (Table 2). This range was confirmed by

investigations carried out by Rijckaert (1995) and Rolston et al. (1989). The highest seed yield increase was achieved when Archer preparation was applied, on average by 161 kg ha^{-1}, for Anna cv. and by 134 kg ha^{-1} for Maja cv. The poorest seed yield of perennial ryegrass was recorded after spraying with Alert fungicide – on average, for all cultivars, by 55-63 kg ha^{-1}. The cause of the observed yield increase was, primarily, an enhanced biological floret site utilisation. The value of this trait, in comparison with the control treatment, increased by 8.1-17.3% (Table 1). Moreover, the use of fungicides was found to have increased the length of the spike. The reported phenomenon was noticeable more in the case of Anna cultivar (8.0-18.5%) than in cv. Maja (0.0-3.3%). In treatments where fungicides were applied, a greater number of spikelets in the spike was observed, especially in cv. Anna (by 1.9-22.3%). Furthermore, the thousand seed weight was also found to increase – in the case of the best experimental preparations: Juwel in cv. Anna – by 7.4% and Archer in cv. Maja – by 3.3%.

In order to justify the application of different variants of chemical plant protection against disease infections in perennial ryegrass seed plantations, the authors used a profitability index. From this point of view, Archer fungicide was assessed as the most effective one with the index of 3.43. It is worth emphasising here that even in the case of the worst fungicide – Alert – a positive value of the profitability index of 1.61 was recorded. It can, therefore, be concluded that the application of fungicides on perennial ryegrass seed plantations (cv. Anna and Maja) is economically justified.

References

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Table 1 - Effect of fungicide application on disease control, inflorescences structure and biological floret site utilisation in perennial ryegrass (means 1998-99)

	Disease (1-9º)		Inflorescence length (cm)		No. of spikelets per spike		Biological floret site utilisation (%)	
Treatments	Anna	Maja	Anna	Maja	Anna	Maja	Anna	Maja
propiconazol + carbendazim	5.50	5.00	19.2	24.3	16.33	22.8	71.12	71.20
propiconazol + fenpropimorph	6.00	5.25	19.1	24.9	19.60	23.1	71.19	69.48
flusilazol + carbendazim	5.75	5.00	17.9	24.3	17.15	23.3	68.23	66.07
epoxiconazol + crezoxim-metil	5.50	5.00	17.5	24.1	18.08	23.0	72.87	68.64
control	4.50	4.00	16.2	24.1	16.03	22.9	63.09	60.68
$LSD_{.05}$	-	-	2.15	ns	1.924	ns	3.276	3.896

Table 2 - Effect of fungicide application on seed yield, thousand seed weight and profitability indicator in perennial ryegrass (means 1998-99)

	Seed yield ($kg\ ha^{-1}$)		Thousand seed weight (g)		Profitability indicator	
Treatments	Anna	Maja	Anna	Maja	Anna	Maja
propiconazol + carbendazim	880	1031	2.28	3.38	3.99	3.17
propiconazol + fenpropimorph	910	1061	2.30	3.47	4.12	3.43
flusilazol + carbendazim	804	990	2.32	3.37	2.34	1.61
epoxiconazol + crezoxim-metil	854	1014	2.46	3.40	3.00	2.49
control	749	927	2.29	3.36	-	-
$LSD_{.05}$	48.3	37.5	ns	ns	-	-