

EFFECT OF *PUCCINIA GRAMINIS* ON COLOR RETENTION RATINGS OF *LOLIUM PERENNE*

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Abstract: The aim of this study was to evaluate the effect of *Puccinia graminis* on important economic characteristics. The experiment was carried out in cooperation with the Breeding Station in Větrov. The results of lawn experiments in 2014 showed that the selection of genotypes of perennial ryegrass less infected by rust was positively reflected not only in improved health but also in better overall appearance of progenies of selected plants. In November, the level of green was very intense while intensity in July and August was weaker. Statistically significant difference between the indigenous populations and the selection was evident only in August (0.008). Monitoring of rust will be extended by forage grasses and the attention will be paid to laboratory testing and artificial infection when testing on the field.

Key Words: plant disease, resistance, race

INTRODUCTION

The *Puccinia* spp. has represented serious danger for turfgrasses especially in the warmer south areas of Europe, New Zeland, Australia and America (Rau et al. 2007). Strong stem rust infection rate was recorded in also Central and Western Europe due to climate change. The rust causes considerable damage to the seed producing areas and to stands of forage production and turfgrasses. Effort of breeders is to create varieties with higher resistance to rusts (Fu et al. 2014).

For a long time, the selection for the resistance against rusts has been performed in the breeding station in Větrov. In the field, only plants with minimal signs of the rusts infection were selected but there was no targeted breeding for resistance. However, such simple choice of healthy or slightly infected genotypes usually did not lead to the desired breeding goal. The progeny of previously selected materials were often attacked by another species of rust. The breeders decided for selection of genotypes resistant against particular species of rusts in separate programs of resistant breeding.

The aim of this paper was to evaluate the impact of *Puccinia graminis* in terms of turfgrass value. Turfgrass types devoted for turfgrass purpose and selected for this work were breded it the Breeding Station in Větrov (*Lolium perenne*). The Breeding Station in Větrov provided exactly identified genotypes-clones or selected plants of individual turfgrass types grown on the different areas in different breeding nursery.

MATERIAL AND METHODS

Characteristic of experimental materials

All the experiments were performed on the plant materials at breeding nursery in the breeding station Větrov (GPS 49.5172314 N, 14.46802278 E). The plant material was *Lolium perenne*. Selection of *Lolium perenne* was carried out and plant materials were identified as VV-LP- 01301.

Evaluation of turfgrass value

The turfgrass experiment was used to verify whether the selection of genotypes resistant to stem rust affects the overall status of grassland established for breeding purposes. In the experiment, there were compared the freshness of turfgrass sown from unselected populations with turfgrass from selected progenies. 24 new breeding populations of perennial ryegrass and 24 other populations

developed by resistant breeding were included in the experiment. 12 toughest of 140 plants in total were selected in the selection plot. The experiment included a total of 48 trial subjects in triplicate per 1m². Turfgrass experiment was treated moderate intensively – with spindle lawn mowing 1–3 times a week, fertilizing 6 times a year with no irrigation and no application of pesticides.

Seasonal color and color retention ratings are a measure of overall plot color. There was used nine-point scale with 1 being brown straw and 9 being dark green. Seasonal color can be used for successful differentiation of color differences based on damage caused by disease or insect pests, nutrient deficiency or environmental stress. Color retention is used to assess the ability of the entry to hold color as seasons change. This is especially useful in quantifying the response of warm-season grasses to temperature changes or frost occurring in fall. A nine-point scale was used for the evaluation - the higher number, the better overall status (9 means the plot was lush green without signs of infestation by leaf diseases; 1 indicates perished vegetation as a result of assault; 5 represents a medium level of resistance). In the experiment, freshness of the lawn was evaluated three times – on the 29th of July at the onset of rust, on the 25th of August 2014 at the time of the full development of rust and on the 9th of November 2014 when rust has receded. The experiment was evaluated by comparing the state of selected and unselected progenies coming from the same starting population.

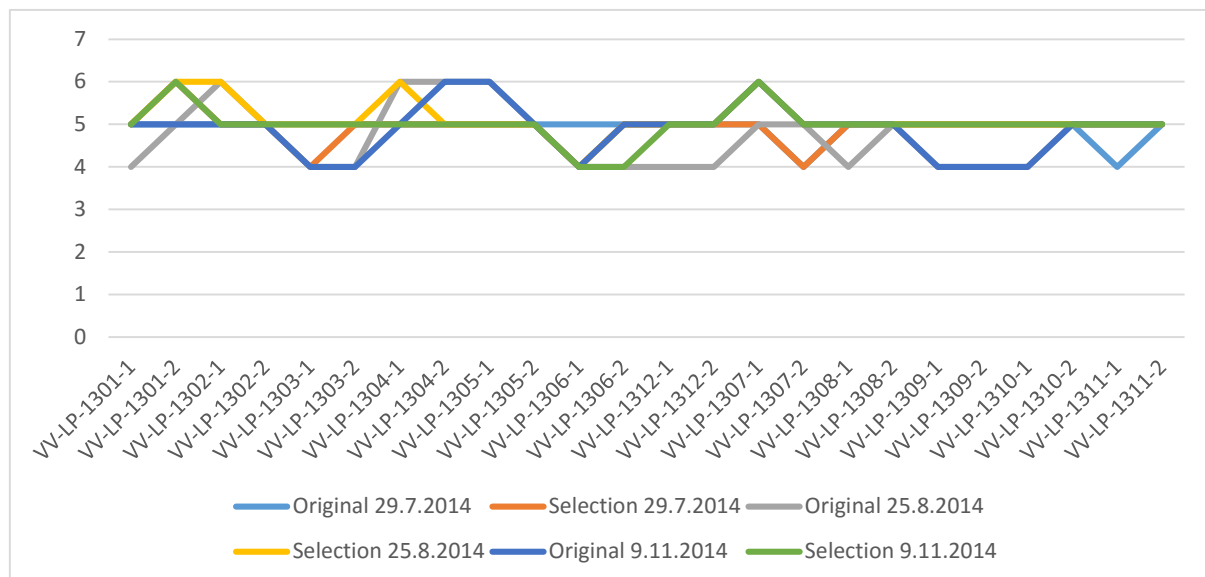
Statistical evaluation

The results were compared using basic statistical indicators. T-test of two dependent samples was carried out, the level of significance was 5% (p = 0.05.), then Kruskal-Wallis test was performed. Statistical analysis was performed in the program Statistica 9.0.

RESULTS AND DISCUSSION

The freshness of the turfgrass was evaluated three times – on the 29th of July 2014 at the onset of rust, on the 25th of August 2014 at the time of the full development of rust, and on the 9th November 2014 when the rust has receded (the Figure 1). The experiment was evaluated by comparing the state of selected and unselected progenies coming from the same starting population. We have chosen 11 variations in 2 samples (original and selected).

Figure 1 Color retention ratings in scale 1-9 for *Lolium perenne* in Větrov 2014



Legend: VV – LP: selections of *Lolium perenne* designation in Větrov, 13 – year of the selection

In November, the level of green was very intense while intensity in July and August was weaker. Large differences were observed between selected and non-selected plants. Within monitoring of the occurrence of rust on the perennial rye-grass across Europe, there was observed rust often occurred in Eastern Europe and on two sites in Italy. Additionally, the disease was observed sporadically in other

places (Germany, France, and Switzerland). The first occurrence was observed in June but the most common occurrence in August (Schubiger et al. 2010).

The rapid increase in the occurrence of the disease was observed during the late summer. Roscher et al. (2007) reported that both of pathogens produced visible sporangia especially in late summer and autumn. *Puccinia graminis* appeared on perennial rye-grass in mid-July, grew quickly and receded slightly in the autumn. The temperatures were slightly above average in the summer and autumn in 2014 which promotes the development of rust until late autumn. In 2014 infection of rust on selected genotypes of perennial ryegrass was lower. Furthermore, better overall appearance of progenies of the selected plants was observed. The different breeding strategies are used in order to achieve the most enduring resistance (Hanzalová et al. 2013).

Diversification of the genetic basis of resistance may also provide a growing lines or varieties with different resistance genes (Terefe et al. 2014). The mixtures for Breeding Station in Větrov are in progress. The intensive agricultural technology associated with using of pesticides increases the resistance. There has been paid less attention in last decade. The breeding for disease-resistance is more important than agricultural technology (Ziems et al. 2014). The emergence and spread of new virulent races is the main problem of breeding for resistance (Tan, Carson 2013).

Table 1 Color retention ratings of *Lolium perenne* using t-test

t-test for dependent samples; identified differences are significant to the level P<0.05 (red number)						
Date	Average	Standard Deviation	N	t	sv	p
29.7. 2014 - original	4.944	0.579	-	-	-	-
29.7. 2014 - selection	4.958	0.542	72	-0.178	71	0.859
25.8. 2014 - original	4.736	0.731	-	-	-	-
25.8. 2014 - selection	5.014	0.682	72	-2.742	71	0.008
9.11.2014 - original	4.889	0.640	-	-	-	-
9.11.2014 - selection	4.972	0.556	72	-0.903	71	0.369

Statistically significant difference between the indigenous populations and the selection was evident only in August (0.008). The rust infection was very intense in all the grasses this month. Infection was weaker in July and November. These results show that the total appearance of the turfgrass can be significantly improved by one-time selection of resistant plants in the period of strong occurrence of rust-breeding for resistance can therefore improve the usefulness of the lawn.

CONCLUSION

The results of turfgrass experiments from 2014 demonstrated the selection of genotypes of perennial rye-grass decreases infection with stem rust. Additionally, it was positively reflected not only in improved health but also in better overall appearance of progenies of selected plants. This confirms the effectiveness of the selection. The very susceptible genotypes were selected among the tested materials. Such materials could serve as carrier of infection in the planned greenhouse tests of resistance against rusts. Genotypes relatively resistant to various rusts were identified as well. If their resistance is confirmed even in the following period, they may be used as donors of resistance at breeding and as resistant standards in assays. The presented results of the first stage of cooperation

are only preliminary and they need to be verified it in the following stages. Monitoring of rust will be extended by forage grasses and the attention will be paid to laboratory testing and artificial infection when testing on the field.

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