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DYNAMICS OF SOLUBLE PROTEIN CONTENT AND GRAIN YIELD IN MAIZE INBRED LINES INFLUENCED BY FORAMSULFURON

Milan BRANKOV*, Vesna DRAGICEVIC, Milena SIMIC, Igor SPASOJEVIC

Maize Research Institute „Zemun Polje“ Beograd-Zemun, Serbia
*Corresponding author: mbrankov@mrizp.rs

Abstract

Soluble proteins are small-length proteins that have significant role in plant metabolism. Under the influence of various herbicides their content can be changed. Sulfonylurea herbicides have very specific mode of action, inhibiting biosynthesis of some amino acids, which lead to blocking of cell division. Alternations in soluble protein content can be an indicator to plant susceptibility/tolerance towards herbicides. The aim of this study was to examine effects of foramsulforon, as sulfonylurea herbicide, applied in 45 g a.i. ha^{-1} and 90 g a.i. ha^{-1} on maize inbreds. The influence of foramsulfuron was observed in alternation in soluble protein content 48h (1^{st} phase) and 21 days (2^{nd} phase) after herbicide application. Grain yield was determined at the end of vegetation. In sensitive lines foramsulfuron increased soluble protein content in 1^{st} phase, especially in dose of 90 g a.i. ha^{-1}, while in second phase smaller variations in soluble proteins were observed. Foramsulfuron decreased grain yield in most lines, in both applied doses.

Key words: *maize inbred lines, foramsulfuron, soluble proteins*

Introduction

Maize hybrid production is a process that is accompanied by many challenges, so the production technology involves the use of a large number of measures and care (Pavlov et al., 2008). As one of the most important measures is a weed control. Seed maize characteristics may significantly differ from the hybrid. This is primarily to unequal growth and lower growth habit, which has an important role in maize-weed competition (Stefanović et al., 2007). The higher sensitivity to different herbicides is also present between seed and hybrid maize. According to previously mentioned, it can see why weeds and herbicides are the main problem in seed maize production. It is known that weeds can completely suppress crop and cause yield loss. Herbicide application includes its selectivity to the crop. In the case of non-selectivity, various phytotoxic symptoms could be manifested. Those negative impacts reduce plants fitness, what results in yield reduction, which is certainly not desirable in maize production (Stefanović et al., 2010). Herbicide application can cause temporary or permanent stress in plants, depending on the genotype, applied herbicide and agro-meteorological conditions (de Carvalho et al., 2009). In case of temporary stress, plants can recover and resume normal growth and development, while in the case of permanent stress, the yield is reduced and in the worst case the plant dies. Herbicide susceptibility testing is possible by measuring alternations in different morphological and physiological parameters compared to control plants. Each herbicide targets the precise location of the plant, inhibiting some essential reaction. Thus, it is possible to measure alternations in the content of different compounds, which are affected by herbicide, directly or indirectly. In case of foramsulfuron, it inhibits protein synthesis, through the inhibition of the synthesis of amino acids such as valine, leucine and isoleucine.

The aim of this study was to test the effect of foramsulfuron herbicide on soluble proteins content of five maize inbred lines 48h and 21 days after application, as well as to inbreeds grain yield.

Material and methods

Experiment was set up on slightly calcareous chernozem in the experimental field of the Maize Research Institute, “Zemun Polje”, during 2010. 2011. and 2012. The four-replicate trail was set up according to the split-plot arrangement. The elementary plot size was 16.8 m^2, with the plant density of 60,000 plants ha^{-1}. Winter wheat was a preceding crop in all years. Influence of foramsulfuron on five maize inbred lines: PL 38, PL 39, L 335/99, L 375/25-6 and L155/18-4/1 RfVg, was observed. Five maize inbred lines were sown in experiment: PL 38, PL 39, L 335/99, L 375/25-6 and L155/18-4/1 RfVg. Foramsulfuron was applied in recommended (45 g a. i. ha^{-1}) and double dose (90 g a. i. ha^{-1}) for hybrid maize.Foramsulfuron was applied in doses recommended and doubled for application in maize hybrid production: 45 g a. i. ha^{-1} and 90 g a. i. ha^{-1}. Herbicide was applied when inbred lines developed 5-6 leaves (BBCH 15-16). Herbicide was applied when maize developed 5-6 leaves (BBCH 15-16).Samples for measuring soluble protein content were collected 48h and 21 days after herbicide application. Samples were dried at 40 °C in a ventilation dryer, and then milled. Soluble protein content was determined by Lowry et al. (1951). Maize grain yield was measured after harvesting and calculated at 14% moisture. Obtained data were statistically processed by ANOVA and differences between means were tested by the least significant difference test (LSD test). Meteorological data for experiment are presented in Table 1. First year (2010) has the most favourable weather conditions for maize growing. In 2011 the drought period occurred at the begginig of vegetation, while 2012 was an extremely dry with low rainfall and high temperature, particulary during grain filling period (June-August).

Table 1.Precipitation and average air temperatures for the period April-September

Months	Precipitation (mm)			Temperature (°C)		
	2010	2011	2012	2010	2011	2012
April	44.0	14.9	64.2	13.2	13.4	14.45
May	64.1	89.6	66.4	17.5	16.8	17.9
June	167.3	26.2	17.5	21.0	21.5	24.56
July	35.6	44.0	30.7	23.2	23.3	27.08
August	68.2	66.0	5.8	23.1	23.9	26.21
September	68.0	32.6	26.0	17.6	21.6	22.14
Average	447.2	273.3	210.6	19.3	20.1	22.05

Results and discussion

In general, the highest effect of foramsulfuron on soluble protein content was observed in double dose treatments with (90g a. i. ha^{-1}). Increased values of soluble proteins were also recorded in line PL 38 and PL 39, at both level of foramsulfuron. In period of 48h after foramsulfuron application soluble protein content was the most increased in line PL 38 (up to 25%) by double dose, compared to untreated control. Double dose of foramsulfuron also increased soluble protein content in line L 335/99, while recommended dose increase observed parameter in line L155/18-4/1 RfVg. In second phase (21 days after foramsulfuron application), an equalization of the contents of the soluble protein in most lines was observable. In comparison to the first, in the second phase a decrease in the content of soluble protein was observed in all maize lines, regardless of foramsulfuron dose (figure 1).

Soluble protein content is significantly influenced by sulfonilurea herbicides. Due to their mode of action, it comes to the inhibition of biosynthesis of amino acids such valine, leucine

and isoleucine (Ray, 1985). This leads to inhibition of protein synthesis. Soluble proteins presented small-length proteins chains. Dragičević et al. (2010) indicates that increased content of soluble proteins could represent result of phytotoxicity in susceptibility maize lines, immediately after herbicide application (48h). Brankov et al., (2010) also stated that application of sulfonylureas in susceptible maize genotypes increase soluble protein content in period of 48h after application.

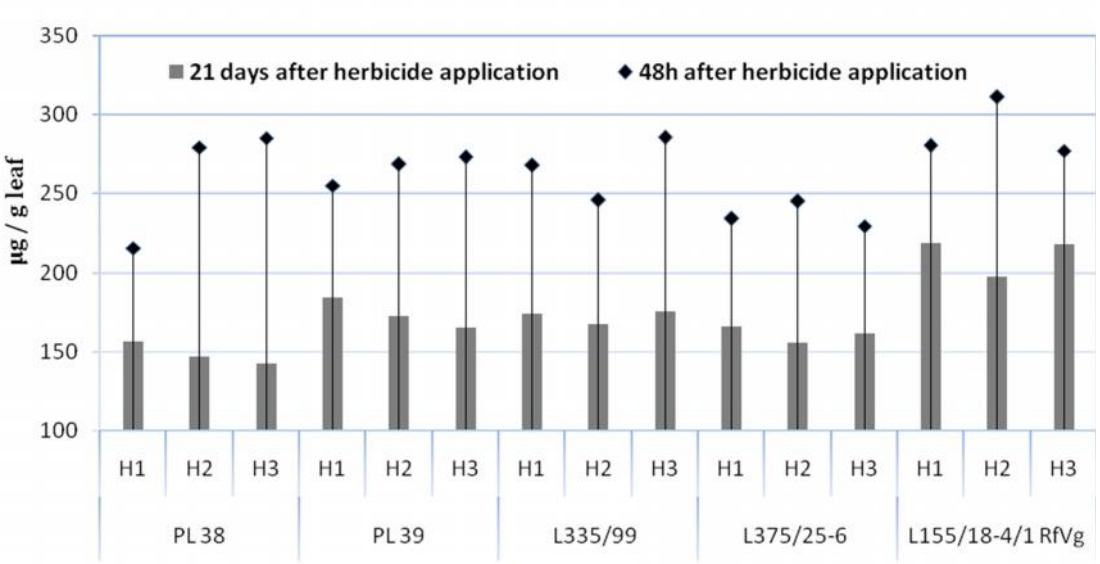

Figure 1. Soluble protein content in maize leaves influenced by foramsulfuron (H1 - control, H2 - reccomended dose of foramsulfuron, H3 - double dose of foramsulfuron), ($LSD_{0.05}$ 48h after herb. application - $LSD_{0.05}$: PL 38 - 3.85; PL 39 - 4.59; L335/99 - 3.15; L375/25-6 - 4.17; L155/18-4/1 RfVg - 3.44), ($LSD_{0.05}$ 21 days after herb. application - $LSD_{0.05}$: PL 38 - 2.93.8; PL 39 - 2,9; L335/99 - 3.42; L375/25-6 - 4.94; L155/18-4/1 RfVg - 3.35)

Application of foramsulfuron significantly decrease grain yield in the most genotypes, except in line L375/25-6, where at double dose of foramsulfuron, the higher yield was recorded. The highest decrease of grain yield was recorded in line PL 38, where a double dose of foramsulfuron reduced yield by 64% compared to control. Dragičević et al., (2012) in trial with 19 maize genotypes, stated that foramsulfuron applied in recommended dose decreased grain yield in most genotypes (figure 2).

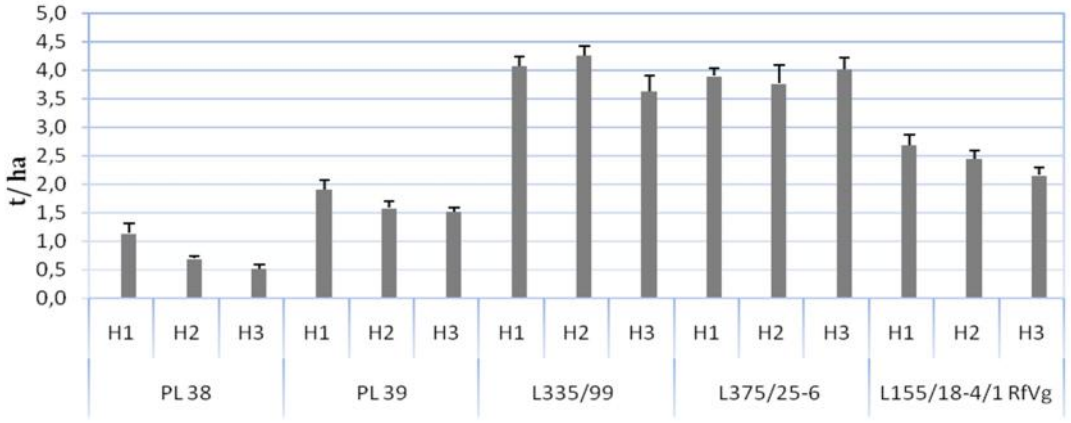

Figure 2. Maize grain yield (average 2010-2012). (H1 - control, H2 - reccomended dose of foramsulfuron, H3 - double dose of foramsulfuron), ($LSD_{0.05}$: PL 38 - 0.07; PL 39 - 0.11; L335/99 - 0.19; L375/25-6 - 0.20; L155/18-4/1 RfVg - 0.15)

Conclusion

Based on the obtained results it can be concluded that the application of foramsulfuron in the recommended and double dose influenced significantly on the content of soluble proteins in maize lines. Much stronger effect on soluble protein alteration was observed by measuring immediately after herbicide application (48 h). Grain yield of the most lines was also decreased with foramsulfuron application.

Acknowledgements

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