Scientific Papers. Series A. Agronomy, Vol. LXIII, No. 2, 2020
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

INFLUENCE OF THE APPLICATION TIME ON THE HERBICIDES EFFICACY AGAINST THE WEEDS IN MAIZE (*Zea mays* L.)

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Abstract

Maize is the third most important crop in Bulgaria. Weed infestation is one of the key factors responsible for the lower productivity and poor quality of the maize production. Reduction in grain yield ranges from 33 to 50% or even more depending on the intensity and nature of the weed flora. During 2018 and 2019 cropping seasons field trials were conducted in the region of Plovdiv, Bulgaria. The trials were situated on the base for training and implementation of the Agricultural University - Plovdiv. The experiments were carried out in non-irrigated conditions. The aim of the resent research is to establish the suitability of applying some new herbicide products and to investigate their efficacy in different application timings: pre-emergence (BBCH 00) and early post-emergence (BBCH-13). Several herbicides and mixtures were tested: mezotrione 50 g/l + terbutilazine 326 g/l SC - 180 ml/da; mezotrione 50 g/l + terbutilazine 326 g/l SC - 230 ml/da; mezotrione 75 g/l + terbutilazine 375 g/l + clomazone 40 g/l - 150 ml/da; mezotrione 75 g/l + terbutilazine 375 g/l + clomazone 40 g/l - 200 ml/da; S-metolachlor 312.5 g/l + terbutilazine 187.5 g/l - 350 ml/da. The obtained data was compared with untreated control. The experimental field was naturally infested with Sorghum halepense (L.) Pers., Setaria viridis L., Chenopodium album L., Xanthium strumarium L., Amaranthus blitoides L., Datura stramonium L., Solanum nigrum L. and Portulaca oleracea L. After evaluating the efficacy of the herbicides we concluded that during the testing period when the soil was very dry the efficacy of the herbicides applied during the early post emergence (BBCH-13) showed higher efficacy against the weeds existing on the field.

Key words: *weed infestation, herbicide, efficacy.*

INTRODUCTION

Maize (*Zea mays*) originated in central Mexico in around 5,000 BC. The crop was introduced to Europe in the sixteenth century, from where it spread to Africa and Asia. It is now one of the most widely-grown crops around the world in both temperate and tropical regions. It is among the 10 most important world crops by value.

Production of maize (*Zea mays* L.) is increasing globally, and this trend is evident throughout the Europe. We may expect this trend to continue in the future (Tatsumi et al., 2011), with maize also being the most dominating crop for biogas production (Amon et al., 2007). Weed management had a major effect on success of maize growth because the competition ability of maize is relatively low (Ghanizadeh et al., 2014). With respect to weed control, due to its sowing period in Europe (Mars Bulletin 2012), this crop is very often characterised by a complex plural specific weed flora, composed of grass and broadleaved weeds

Maize (*Zea mays* L.) is main grain-forage crop with adaptive ability to different geographical and climatic conditions. That is the reason for the successful growing of this crop in many regions around the globe. In Bulgaria it is strategical field crop. Maize has the highest energy value in comparison to the others forage crops (Tomov & Yordanov, 1984). One of the main negative factors for agricultural production are the weeds. They decrease the yields and the quality of maize. In Bulgaria, economically the most important weeds at this crop are *Amaranthus retroflexus* L., *Datura stramonium* L., *Xanthium strumarium* L., *Solanum nigrum* L., *Chenopodium album* L., *Abutilon theophrasti* L., *Sinapis arvens*is L., *Echinochloa crus-gali* L., *Setaria viridis* L., *Sorghum halepense* L., *Convolvulus arvensis* L., *Portulaca oleracea* L., *Cynodon dactilon* L. and *Cirsium arvense* L. (Hristova et al., 2012; Kalinova et al., 2012). The maize grain yield can decrease from 24% to 96.7% (Mukherjee and Debnath, 2013; Oerke & Dehne, 2004; Zhalnov & Raikov, 1996). The monoculture growing of maize can lead to increase of the population of *Sorgum. halepense* L., *Cirsium arvense* L., *Cynodon dactilon* L. and other perennial weed species. The most efficient and economically most effective and environmentally safest is the integrated weed control. It includes application of different weed control methods - mechanical, chemical, cultural, biological etc. (Tonev, 2013). The chemical method is the most often used by the farmers. The method is highly effective, fast and easy to apply. The proper herbicide application reduces the weed management costs up to 60%. The fuel cost as well the soil erosion are also decreased (Valcheva, 2011). The aim of the resent research is to establish the suitability of applying some new herbicide products and to investigate their efficacy in different application timings: pre-emergence (BBCH 00) and early post-emergence (BBCH-13). The effect of chemical weed control with reduced herbicide rates (pre-emergency, pre-emergency + post-emergency, post-emergency.) on weed population density.

MATERIALS AND METHODS

During the 2018 and 2019 a field experiment was carried out in the experimental field of the Department of Agriculture and Herbology of the Agricultural University - Plovdiv, Bulgaria. The studied maize (*Zea mays* L.) hybrid was "P 9241" (FAO 370) from Corteva. The trial was conducted by the randomized block design in 4 replications. The size of the treated plot was 28 m^2. Several herbicides and mixtures were tested.
The variants of the trial were:
CLIK PRO (mezotrione 50 g/l + terbutilazine 326 g/l) SC - 180 ml/da;
CLIK PRO (mezotrione 50 g/l + terbutilazine 326 g/l) SC - 230 ml/da;
TONALE (mezotrione 75 g/l + terbutilazine 375 g/l + clomazone 40 g/l) - 170 ml/da;
TONALE (mezotrione 75 g/l + terbutilazine 375 g/l + clomazone 40 g/l) - 200 ml/da;
GARDOPRIM GOLD (S-metolachlor 312.5 g/l + terbutilazine 187.5 g/l) - 350 ml/da.
The obtained data was compared with untreated control.
The herbicides were applied in two timings:
- Pre emergency (BBCH 00)
- Early post emergency (BBCH-13)
The herbicides treatment was carried out by a dorsal sprayer with a working solution of 250 l/ha. The experiments were carried out in non-irrigated conditions.
The experimental field was naturally infested with *Sorghum halepense* (L.) Pers., *Setaria viridis* L., *Chenopodium album* L., *Xanthium strumarium* L., *Amaranthus blitoides* L., *Datura stramonium* L., *Solanum nigrum* L. and *Portulaca oleracea* L.

RESULTS AND DISCUSSIONS

The results were compared with untreated control. The experiments were carried out with different rates of the herbicides and in different timings of application. The reporting of herbicide efficacy and selectivity was made on the twenty-eight, forty -third and seventy days after treatment with herbicides. In all variants during the evaluation dates, we have not found visual manifestations of phytotoxicity on tested hybrid of maize P 9241. The efficacy is evaluated based on EWRS scale. The weeds *Amaranthus retroflexus* L., *Solanum nigrum* L., *Datura stramonium* L. and *Chenopodium album* L. were controlled 100% from all herbicides and rates tested in the experiment.
The efficacy against *Setaria viridis* L. is from 80 to 90% in different herbicides and rates.
The efficacy against *Xantium strumarium* L. is 100% in tested herbicides and rates, but the efficacy from the standard product (S-metolachlor 312.5 g/l + terbutilazine 187.5 g/l) is very low - 5 % only. The tested herbicides in different rates cannot control successfully the weed *Portulaca oleracea* L. - the efficacy 35 days after the application is from 40-60% only.
The efficacy against the weed *Sorgum halepense* L. from seeds is almost 100% from all tested herbicides and rates, but they do not control at all the weed *Sorgum halepense* L. from rhizomes. The efficacy from all herbicides

against *Cynodon dactylon* L. Pers. and *Convolvulus arvensis* L. is 0%. For reference - the total amount of rainfall for April were 71 l/m² in 2018 and 74.3 l/m² in 2019. They were evenly distributed in the different days of the month. During the 7 days before, 7 days after and during the herbicide treatment, no temperature values were reported that could contribute to a wrong assessment of the efficacy, selectivity and phytotoxicity of the studied herbicides.

Picture 1. Untreated control

Picture 2. CLIK PRO (mezotrione 50 g/l + terbutilazine 326 g/l) SC - 230 ml/da

Picture 3. TONALE (mezotrione 75 g/l + terbutilazine 375 g/l + clomazone 40 g/l) - 200 ml/da

Climatic characteristic of the experimental season of maize.

On Figure 1 are presented the average minimum and maximum monthly temperatures as well as the precipitation during the vegetation of maize. The meteorological data is provided by the department of Botany and Agro meteorology at the Agricultural University of Plovdiv, Bulgaria. According to the meteorological data during the vegetation we can determine how weather conditions affect the growth and development of the plants.

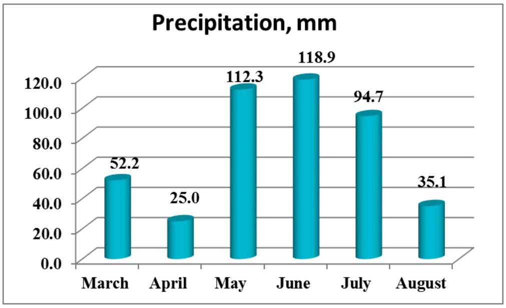

Figure 1. Average monthly precipitation during the vegetation of maize (mm)

The sum of the monthly precipitation during the vegetation is total of 438.2 mm, which is a prerequisite for relatively good moisture storage and normal flow of the vegetation. The average minimum and maximum monthly temperatures were very appropriate for germination after sowing. The maize requires minimum temperature of 10-11°C for good of germination. After germination and during the whole vegetation the plants have optimal temperatures for growing and development as the optimal temperatures during the flowering period are in the rage of 25-32°C.

CONCLUSIONS

The experimental conditions for the growing season of 2018 and 2019 were favorable for the growth, development and realization of the productive abilities of the maize hybrid "P 9241" (FAO 370) from Corteva grown in the study.

The temperature values and precipitation during the 7 days before, 7 days after and during the herbicide treatment were suitable for appropriate assessment of the efficacy, selectivity and phytotoxicity of the active substances;

After evaluating the efficacy of the herbicides we concluded that during the testing period when the soil was very dry the efficacy of the herbicides applied during the early post emergence (BBCH-13) stage showed higher efficacy against the weeds existing on the field then the pre-emergency (BBCH 00) used herbicides. We propose to the farmers to apply the herbicides on maize yearly post.

The efficacy of all applied herbicides to against against *Cynodon dactylon* L. Pers. and *Convolvulus arvensis* L. was 0%. In order to control those weeds we recoment a tank mixute of herbicides with active ingredient flyroxipyr.

ACKNOWLEDGEMENTS

This research work was carried out with the support of the Department of Herbology from the Agricultural University- Plovdiv and the full support of Prof. Tony Tonev, PhD.

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