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RESEARCH ON THE WEEDS CONTROL IN MAIZE CROP

ALINA ȘIMON¹, MARIUS BĂRDAȘ², ALIN POPA³

Abstract: *The purpose of this paper is to evaluate the degree of dicotyledonous weed species of maize culture, the effectiveness of weed control products and the evaluation of maize yield. Experimental factors A-treatment variants: a₁- pre-emergence herbicide with Tender 1.5 l/ha + Merlin Flex 0.4 l/ha (control); a₂- pre-emergence herbicide with Tender 1.5 l/ha + Merlin Flex 0.4 l/ha and post-emergence with Titus Plus 300 g/ha; a₃- pre-emergence herbicide with Tender 1.5 l/ha + Merlin Flex 0.4 l/ha and post-emergence with Arigo 320 g/ha; a₄- pre-emergence herbicide with Tender 1.5 l/ha + Merlin Flex 0.4 l/ha and post-emergence with Principal Plus 420 g/ha; factor B - climatic conditions in the experimental years: b₁-2016; b₂-2017; b₃-2018. In order to achieve the objectives during the period 2016-2018, determinations were carried out regarding the natural enrichment of maize crops by numerical determination of weed species before herbicide and after herbicide treatment at 14, 21 and 28 days, but also before harvesting the crop of maize when carried out and gravimetric determination of the weeds by drying at the oven. Following the determinations made during the growing period of the maize crop, the treatment variant applied to the herbicides Tender 1.5 l/ha + Merlin Flex 0.4 l/ha in pre-emergence and the herbicide Titus Plus 300 g/ha in post-emergence had the best result in combating the weed species existing at the time of the treatment but also the degree of weed reinfestation of the maize crop. Regarding the yield of grain maize determined in the four variants, the highest grain yield (over 6901 kg/ha) was obtained in the fourth treatment variant, with a very significant yield difference compared to the control variant at which only pre-emergence herbicide was performed.*

Keywords: maize, weed control, yield, climatic conditions

JEL Classification: Q 01, Q15, Q16

INTRODUCTION

Maize is considered one of the most important crop plants, both in the agriculture of our country and worldwide, due to the large areas that are cultivated, the high yields that can be obtained and the possibilities of exploiting the production (Muntean et al., 2011).

With a slow growth in the first 4-6 weeks after emergence, maize is a plant of culture sensitive to weeding in the first phases of vegetation (Wilson, 1998) but also during the development, due to the small number of plants/m².

Taking into account the fact that a maize crop where weeds are not controlled by any method can have production losses of up to 90% depending on the degree of soil tillage, it is necessary to use at least one method of eliminating the existing species.

Herbicide cultivation of maize is done by the use of selective herbicides depending on the category of weeds using a single product or more for weed control, and the use of applied herbicides is correlated with the degree of intoxication (Guş et al., 2004).

In maize cultivation, the methods of using weed control products differ from the pre-emergent stage, which is important in removing weeds from the early stages of development, being known that once they have reached an advanced stage, their control becomes a process of increasingly complex, at the post-emergent one which aims to eliminate the weeds that are in competition with the maize plants for light, water and nutrients.

The purpose of this paper is to evaluate the degree of intoxication with dicotyledonous species of maize crop, the efficiency of weed control products as well as the evaluation of maize production.

MATERIALS AND METHODS

The researches were carried out during 2016-2018 at the Agricultural Research and Development Station Turda, located in the Transylvanian Plain.

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The experimental factors studied A-treatment variants: a₁- pre-emergence herbicide with Tender 1.5 l/ha (*metolachlor* 960g/l) + Merlin Flexx 0.4 l/ha (*isoxaflutol* 240 g/l + *cyprosulfamide* 240g/l) (control); a₂ - pre-emergence herbicide with Tender 1.5 l/ha (*metolachlor* 960g/l) + Merlin Flexx 0.4 l/ha (*isoxaflutol* 240 g/l + *cyprosulfamide* 240g/l) and post-emergence with Titus Plus 300 g/ha (3.26% *methyl rimsulfuron* + 60.87% *dicamba*); a₃ - pre-emergence herbicide with Tender 1.5 l/ha (*metolachlor* 960g/l) + Merlin Flexx 0.4 l/ha (*isoxaflutol* 240 g/l + *cyprosulfamide* 240g/l) and post-emergence with Arigo 320 g/ha (12% *nicosulfuron* + 3% *rimsulfuron* + 36% *mesotrione*) a₄-pre-emergent herbicide with Tender 1.5 l/ha (*metolachlor* 960g/l) + Merlin Flexx 0.4 l/ha (*isoxaflutole* 240 g/l + *cyprosulfamide* 240g/l) and post-emergence with Principal Plus 420 g/ha (2.3% *methyl rimsulfuron* + 9.2% *nicosulfuron* + 55% *dicamba*); factor B - the climatic conditions of the experimental years: b₁-2016; b₂-2017; b₃-2018.

In order to achieve the objectives for the period 2016-2018, determinations were made regarding the natural sprouting of the maize crop, by numerically determining the weed species before herbicide and after herbicide at 14, 21 and 28 days, but also before harvesting the maize crop, when the gravimetric determination of the weeds was carried out by drying in the oven.

The obtained results were statistically processed by the method of analysis of variance and the determination of the smallest significant difference - DL - (5%, 1% and 0.1%) (ANOVA, 2015).

Climatic data conditions are presented according to Turda Weather Station, located on the longitude coordinates: 23°47'; latitude: 46°35'; altitude: 427 m. Over the past 60 years, the average multiannual temperature recorded was 9.1°C and the precipitation amount was 531 mm.

The average temperatures recorded during the months of the vegetation period of the maize crop varied during the three years, but being higher than the 60 year average, with + 0.9°C in 2016, a year considered warm, with + 1.4°C in the year 2017, considered warm and with + 2.1°C in 2018, considered warm.

As can be seen from the data presented in Figure 1, the average monthly temperatures are constantly increasing, with values higher than the average of 60 years, especially during the vegetation period of the maize crop.

The precipitations dropped during the vegetation period and their distribution in the important phenophases of the crop are very important in the production, so from the data presented in figure 2, it can be observed that the monthly precipitation amount is variable, with periods in which significant quantities have fallen, but and periods when the amount of precipitation was well below the average of 60 years, affecting the maize crop by their non-uniformity or their lack in important phenophases.

Figure 1. Termic regime, Turda 2016-2018

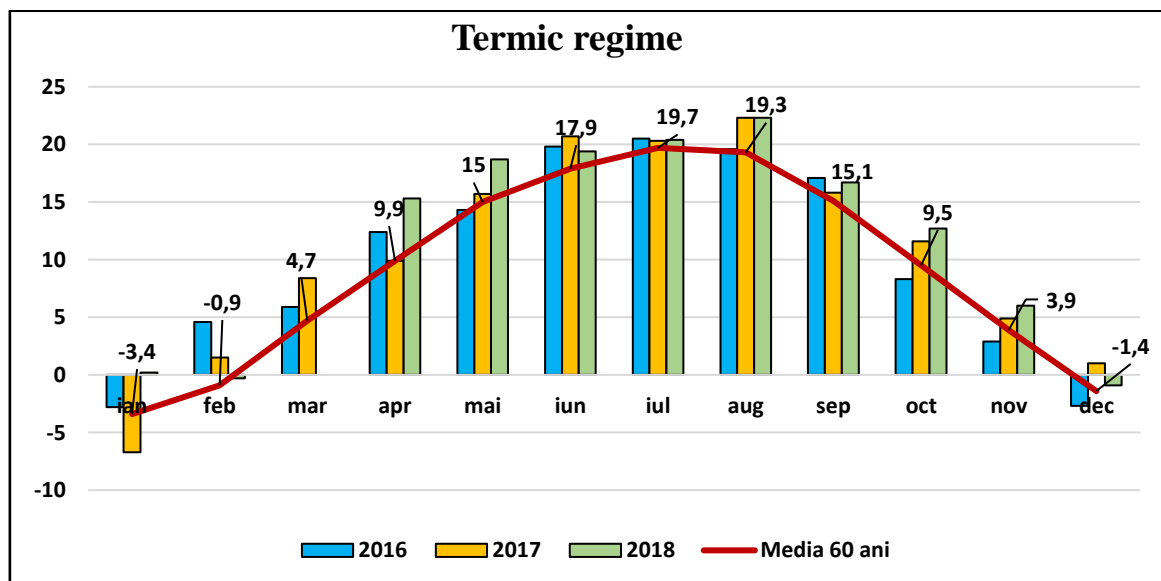
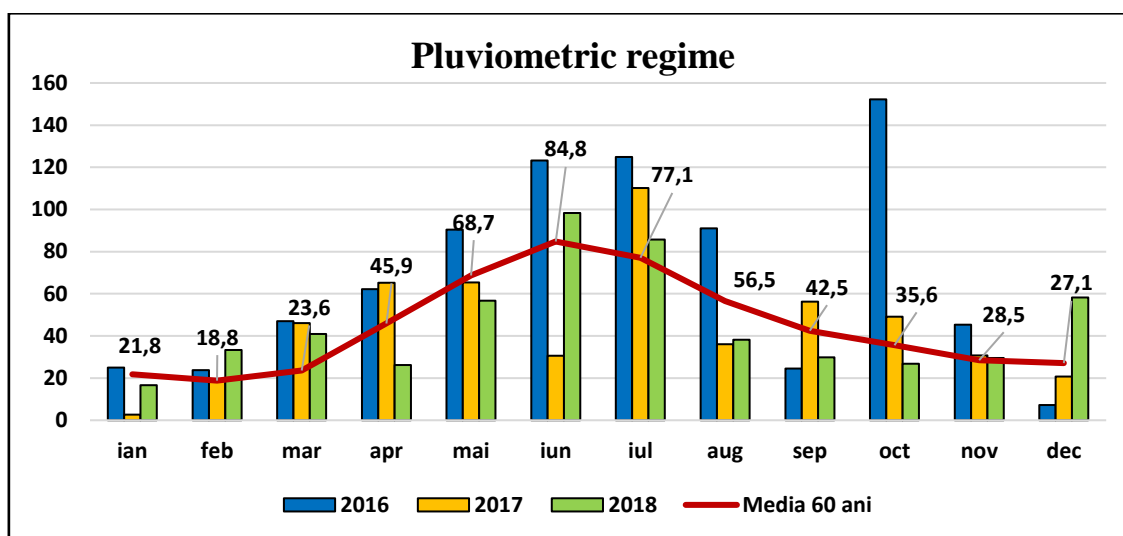


Figure 2. Pluviometric regime, Turda 2016-2018



RESULTS AND DISCUSSIONS

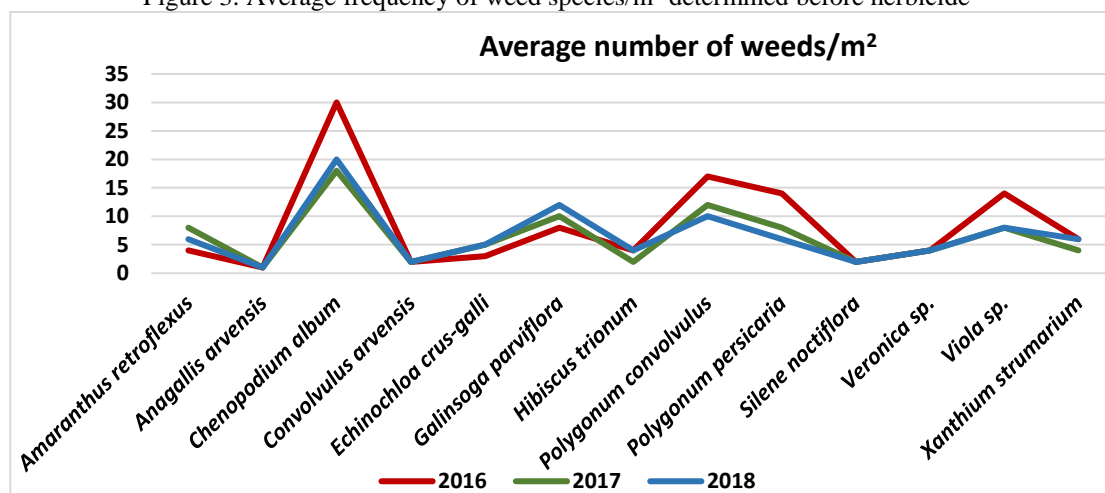
The climatic conditions of the area are favorable for the growth of the maize crop in the first part of the vegetation, in the majority with species of annual dicotyledonous weeds, some years being favorable and for the weeding with a significant share of annual monocotyledonous species.

The spectrum of weeds determined at the beginning of the research is quite diverse, comprising a number of 13 species, identified by frequency, depending on the climatic conditions of the year, their presence was higher or lower both monocotyledonous and dicotyledonous species. Of these species, about 5 are very high frequency species, 4 are low frequency species and the others are isolated species.

Of the species identified, those with a high frequency, with presence in all experimental variants and which require more attention in terms of control are the species: *Chenopodium album*, *Galinsoga parviflora* and *Polygonum convolvulus*. The average degree of corn cultivation is higher in 2016, reaching 109 weeds/m².

During the studied period there was an increase in the frequency of drunkenness following the application of only a single control treatment, especially in the dry spring, when the weed emergence was delayed, because in the years when the climatic conditions are favorable to the culture, favorable conditions are created and weed development, the effectiveness of weed control products is generally better in the rainy spring years.

Figure 3. Average frequency of weed species/m² determined before herbicide



The effect of applying herbicides in post-emergence, in maize cultivation, has been observed from the first week of application, in which weeds have started to show changes in the development process depending on their development stage. Since the second week after treatment in all variants, the species *Setaria glauca* was reported, a species that later emerged and remained until the crop was harvested (Table 1).

Following the determinations made during the vegetation period of the maize crop, the treatment variant to which were applied the Tender herbicides 1.5 l/ha + Merlin Flexx 0.4 l/ha in pre-emergence and the herbicide Titus Plus 300 g/ha in post-emergence had the best result in the control of the weed species existing at the time of treatment but also of the degree of weed reinfestation of the maize crop.

Plowing tillage is still one of the most important methods of reducing the number and species of weeds in maize cultivation, but by using herbicides the number of both weed and the weed is being reduced. The importance of using post-emergent herbicides was also demonstrated by Cheung's research and published in 2013.

Table 1. The frequency of weed species/m² determined at 14, 21 and 28 days after the herbicide

Species	Number of weeds/m ²											
	At 14 days				At 21 days				At 28 days			
	V1	V2	V3	V4	V1	V2	V3	V4	V1	V2	V3	V4
<i>Amaranthus retroflexus</i>	8	1	1	0	8	0	0	0	8	0	0	0
<i>Anagallis arvensis</i>	1	1	1	0	1	1	1	0	1	0	1	1
<i>Chenopodium album</i>	52	16	4	6	74	2	1	3	108	1	1	0
<i>Convolvulus arvensis</i>	2	2	2	2	2	2	0	0	2	0	0	2
<i>Echinochloa crus-galli</i>	4	1	2	1	6	1	1	0	8	1	1	0
<i>Galinsoga parviflora</i>	20	8	8	4	36	1	2	1	48	0	0	1
<i>Hibiscus trionum</i>	4	1	1	1	6	1	0	1	8	1	0	1
<i>Polygonum convolvulus</i>	4	4	4	4	7	2	1	1	8	1	1	0
<i>Polygonum persicaria</i>	6	4	4	2	7	1	0	1	9	1	0	1
<i>Setaria glauca</i>	8	2	4	1	12	1	4	0	16	1	4	0
<i>Silene noctiflora</i>	2	1	1	1	2	0	0	1	4	0	0	1
<i>Veronica</i> sp.	1	1	1	1	1	1	0	0	1	1	0	0
<i>Viola</i> sp.	2	1	1	1	4	0	1	0	4	0	1	0
<i>Xanthium strumarium</i>	2	1	2	1	2	0	1	1	2	0	1	1
Total	116	44	36	25	168	13	12	9	227	7	10	8

Although the second variant of herbicide had the best efficiency, nevertheless the most significant average production was registered in the fourth variant, with a very significant positive difference from the control of 4278 kg/ha, as shown in table 2. Success weed control is vital because it can reduce production by over 86%, as Týr, 2015 also states.

Table 2. The influence of post-emergent herbicide variants on maize yield

Variant	Yield (kg/ha)	Difference (kg/ha)	Significance
Untreated variant (control variant)	3306	-	cv.
Titus Plus	7389	4083	***
Arigo	7215	3909	***
Principal Plus	7584	4278	***
LSD (p 5%) 64	LSD (p 1%) 92	LSD (p 0.1%) 136	

The climatic conditions are the decisive factor in the production of a crop, thus, as it results from the data presented in table 3, 2016 was the year with the best climatic conditions for the maize crop, at the opposite pole being the year 2017, in which the production of maize decreased with very significant differences from the average of the three years studied, considered a control variant.

Table 3. The influence of experimental years on maize yield

Variant	Yield (kg/ha)	Difference (kg/ha)	Significance
Average years (control variant)	6374	-	cv.
2016	6814	440	***
2017	5635	-739	000
2018	6672	299	***
LSD (p 5%) 47	LSD (p 1%) 63	LSD (p 0.1%) 85	

From the interaction of the two factors (herbicide variants and climatic conditions) the best herbicide variant is the fourth variant with the highest yields obtained, over 6901 kg/ha registered in 2017, year in which the climatic conditions have were less favorable to the maize crop, due to the lack of precipitation during the important moments of the crop development, as seen in table 4.

Table 4. The influence of interaction of post-emergent herbicide variants and experimental years on maize yield

Variant	Yield (kg/ha)	Difference (kg/ha)	Significance
a ₁ x b ₁ (control variant)	3775	-	cv.
a ₂ x b ₁	7758	3983	***
a ₃ x b ₁	7721	3946	***
a ₄ x b ₁	8001	4226	***
a ₁ x b ₂ (control variant)	2557	-	cv.
a ₂ x b ₂	6831	4274	***
a ₃ x b ₂	6250	3692	***
a ₄ x b ₂	6901	4344	***
a ₁ x b ₃ (control variant)	3585	-	cv.
a ₂ x b ₃	7578	3993	***
a ₃ x b ₃	7675	4089	***
a ₄ x b ₃	7851	4265	***
LSD (p 5%) 99	LSD (p 1%) 138	LSD (p 0.1%) 192	

From the economic point of view, the fourth treatment option is also the least expensive due to the price of the product/quantity per hectare, if we take into account that all other expenses are the same for each variant and the production obtained per hectare, as well as its efficiency.

CONCLUSIONS

From the data presented in the paper it can be seen that the best studied variant with high production yields but also with effective control is the variant applied in the postemergence herbicide Principal Plus.

The development of a better weed control management can be achieved through a better understanding of the biology of the weeds and the factors that trigger the germination of the weed seeds, as well as by knowing the methods of prevention but also of the control of the species.

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