RESEARCH ON THE SELECTIVITY AND EFFICACY OF HERBICIDES FOR CONTROLLING WEEDS FROM THE WHEAT CROP IN PEDOCLIMATE CONDITIONS FROM NARDI FUNDULEA

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Abstract
This paper present the results obtained at National Agricultural Research and Development Institute Fundulea, during 2021-2022, according to the new herbicide treatments: Floramix (70,8 g/kg piroxsulam + 14,2 g/kg florasulam + 70,8 g/kg cloquintocet-mexil - safener) + Dasoil 26-2 N (Adjuvant); Pallas (7.5% piroxsulam + 7.5% cloquintocet-mexil safener) + Adjuvant; Omnera + Foxtrot 69 EW (135 g/l fluroxypyr + 30 g/l thifensulfuron metil + 5 g/l metsulfuron metil 69 g/l fenoxaprop-P-etil + 34,5 g/l cloquintocet mexil - safener) și Pixxaro Super (2 g/l halauxifen-metil + 280 g/l fluroxipir meptil + 12 g/l cloquintocet-mexil), postemergently applied for the weeds controlling from the w. wheat crop. The main objective of this work focused on the study of the selectivity and effectiveness of the application of herbicide treatments to combat monocotyledonous and dicotyledonous weeds present in the wheat crop.
Wheat is an important crop affected by many weeds which, fortunately, can be effectively controlled by specific applications of herbicides. The herbicides must be correlated with the infestation degree of weed, the spectrum and dominance of weeds, the time of application, the technical potential for efficacy, the local climatic conditions.

Key words: *weeds, herbicides, time of application, selectivity and efficacy.*

INTRODUCTION

Wheat, which is one of the basic nutrients of humans, is the world's most cultivated crop among cereal crops. The crop flora is very diverse and numerous, due to the numerical ratio of weed species present, especially the numerous combinations between the various biological groups. This variety is explained by the diversity of pedoclimatic conditions existing in the areas where this crop plant is grown (*Anghel et al., 1972*).

The presence of weeds in field crops is a reality in all their cultivation areas. The damage caused by weeds can be diverse and often lead to a reduction in production, an increase in production costs, a deterioration in the quality of products, ideal hosts for pathogens and pests, etc. (*Mortensen et al., 2000; Roman and Lăzureanu, 2012*). Weeds have the highest negative impact at around 37% compared to insects (18%), fungi and bacteria (16%) and viruses (2%) (Oerke, 2006). Weeds have the greatest negative impact, around 37%, compared to insects (18%), fungi and bacteria (16%) and viruses (2%) (*Oerke, 2006*).

Effective weed management is one of many critical components of successful wheat production. Weeds compete with wheat for light, nutrients, water and space, while often harboring harmful insects and diseases. Severe weed infestations can essentially eliminate wheat production and/or crop efficiency while also creating weedy plant fragments, often reducing food and forage value.

In the field of weed control in field crops, the main objective is, permanently, to eliminate the competition of weeds below the level of the damage threshold throughout the vegetation period, in order to reduce the consumption of water and nutrients by them,

so that in the future the plants culture to have a normal development, which will lead, in the end, to obtaining high productions/ha, qualitative and at the level of the biological potential of the cultivated varieties. (*Popescu 2007*)

Herbicide is one of the most valuable works in the entire complex of works performed in plant protection actions and constitutes the most expensive and demanding technological link (*Berca, 2004*).

In a modern agriculture, in the integrated management of weeds, the use of the chemical control method remains a very important link contributing to the increase of productions by reducing the competition of weeds (*Sharpe et al., 1975; Vlăduțu et al., 1988*). Although the nature of crop production varies greatly around the world, herbicides have become a primary tool for weed control in most areas. (*Peterson et al., 2017*). A global consumption of pesticides in Europe amounts to 318 active substances where the respective quantities are: herbicides – 48%, insecticides – 25%, fungicides – 20%, others – 3% and growth regulators – 2%. Moreover, among new pesticides, the use of herbicides increases to 59%, while that of fungicides and insecticides reaches 22% and 19%, respectively (Markovic et al., 2000).

Herbicides will remain in future agriculture an efficient tool for control of weeds as part of an integrated weed control. The application of herbicides requires only a quarter of the fuel used than one passage over the same surface with a row crop cultivator (*Hanna M., 2001 cited by Gianessi, L., 2013*)

The purpose of the research was to identify the technological solutions to combat the weeds present in the wheat culture by using new treatments with herbicides, with the objective of widening the spectrum of combat, synergism, persistence and without negative impact on the environment.

The main objective of this work focused on the study of the selectivity and the efficacy of the application of herbicide treatments to combat the weeds present in the wheat crop.

Table 1

The herbicide treatments applied in the wheat crop. Experimental variants

No var	Herbicides treatments	Active ingredient	Dose g,l /ha	Time of application
1	Untreated	-	-	-
2	Floramix + Dasoil 26-2 N (Adj)	70.8 g/kg piroxsulam + 14.2 g/kg florasulam + 70.8 g/kg cloquintocet-mexil (safener)	260 g/ha + 0,6 l/ha	Postemergence BBCH 31
3	Pallas 75 WG + Adjuvant	7.5% piroxsulam + 7.5% cloquintocet-mexil safener	250 g+ 0,5 l/ha	
4	Omnera + Foxtrot 69 EW	135 g/l fluroxypyr + 30 g/l thifensulfuron metil + 5 g/l metsulfuron metil 69 g/l fenoxaprop-P-etil + 34,5 g/l cloquintocet mexil (safener)	1,0 + 1,0 l/ha	
5	Pixxaro Super	2 g/l halauxifen-metil + 280 g/l fluroxipir meptil + 12 g/l cloquintocet-mexil)	0,5 l/ha	

Table 2

Monthly sum of precipitation (mm)

	Mar	Apr	May	Jun
LTA (1968-2017)	37.0	46.4	60.9	76.5
St. Dev. LTA	26.0	23.2	45.2	45.3
2021	59.0	31	57.6	135.0
2022	12.3	47.6	30.0	59.4

Table 3

Monthly average temperature (°C)

	Mar	Apr	May	Jun
LTA (1968-2017)	5.0	11.2	17.1	20.8
St. Dev. LTA	2.4	1.6	1.5	1.4
2021	5.1	9.7	17.2	21.1
2022	4.4	12.1	17.9	22.6

MATERIAL AND METHOD

The research was carried out in the period 2021-2022, at the National Institute for Agricultural Research and Development - Fundulea, being studied the application of new herbicide treatments to wheat crop. The research was carried out in the experimental field, the experiment being located on a soil of cambic chernozem type (3.2% organic matter, 37% clay, 6.5 pH), using the Glosa wheat variety created by the institute -Fundulea. Glosa is an early variety, with good resistance to falling, it is resistant to winter, drought, and heat. The organization of the experiment was done according to the method of randomized blocks, with a plot area of 25 m^2, in 3 replications, the amount of water used was 300 l/hectare.

In this experiment, we observed the degree of selectivity of w. wheat plants and the degree of control of weeds by applying herbicide treatments (table 1): Floramix (70.8 g/kg piroxsulam + 14.2 g/kg florasulam + 70.8 g/kg cloquintocet-mexil (safener) + Dasoil 26-2 N (Adj); Pallas 75 WG (7.5% piroxsulam + 7.5% cloquintocet-mexil safener) + Adjuvant; Omnera (135 g/l fluroxypyr + 30 g/l thifensulfuron metil + 5 g/l metsulfuron metil) + Foxtrot 69 EW (69 g/l fenoxaprop-P-etil + 34,5 g/l cloquintocet mexil (safener); Pixxaro Super (2 g/l halauxifen-metil + 280 g/l fluroxipir meptil + 12 g/l cloquintocet-mexil).

The herbicide treatments were applied in the post-emergence (growth and development stage of winter wheat: BBCH 31). After the application of herbicide treatments, the observations of selectivity (%) were made at different intervals (7 - 14 - 28 days after the application of treatments) and the degree of control (%) of weeds at different intervals 14 - 28 days from the application of treatments.

The average monthly air temperature in March-June was close to normal in 2021 and with 0.7°C warmer in 2022 (Table 2). These months were drier than long term average with 62 mm in 2021 and 71 mm in 2022 (Table 3).

For yield data visualization and group comparison were used the libraries “tidyverse”, “ggpubr”, “emmeans” and “rstatix” (Kassambara, A., 2019) were used in R Studio with R version 4.2.

RESULTS AND DISCUSSIONS

In the wheat experience carried out in the experimental field at the NARDI - Fundulea, the culture showed a high infestation degree of - 71%, with monocotyledonous and dicotyledonous weeds, extremely diversified, depending on the local pedoclimatic conditions of the years of research. The most representative (Figure 1) weed species were monocotyledonous: *Avena fatua* and annual dicotyledonous: *Matricaria inodora, Galium aparine, Poligonum convolvulus, Papaver rhoeas, Viccia cracca.*

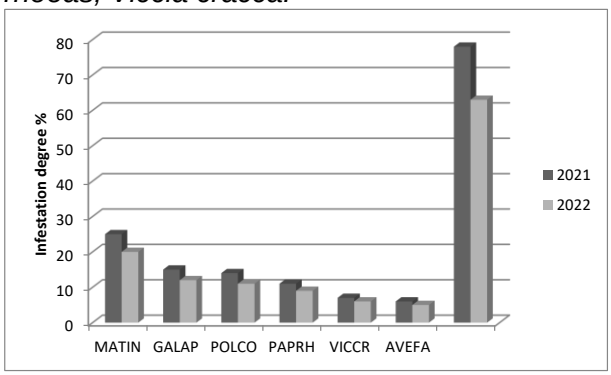

Figure 1 The infestation degree (%) with weed species present in the untreated plot from wheat crop.

In the experimental field, all the selectivity observations made for the wheat variety cultivated Glosa, not recorded phytotoxic phenomena (EWRS scale = 0).

In the wheat crop, following the treatments with herbicides applied post-emergence (BBCH 31), the results obtained showed a good weed control effect, highlighting the effectiveness of the treatments through a single application. After the application of the new treatments with herbicides, good results were obtained regarding the fight against weeds, depending on: the climatic conditions, the degree of infestation, the spectrum and the dominance of the species present in this crop.

In the variant treated with Floramix (70.8 g/kg piroxsulam + 14.2 g/kg florasulam + 70.8 g/kg cloquintocet-mexil - safener) + Dasoil 26-2 N, it was applied in a dose of 260 g/ha + 0.6 l/ha, being a new systemic herbicide, with post-emergence application, intended to combat grass and broadleaf weeds in the wheat crop. Following the application of this treatment, the results show a very good control effect (97-88%) for the annual dicotyledons:

Matricaria inodora, *Galium aparine* and *Papaver rhoeas*. The weed species *Polygonum convolvulus* and *Viccia cracca* recorded an average effectiveness of 72% and 74%, respectively. Regarding the therophytic species, the spring annual - *Avena fatua* showed a very good control effect of 95%. (Figure 2)

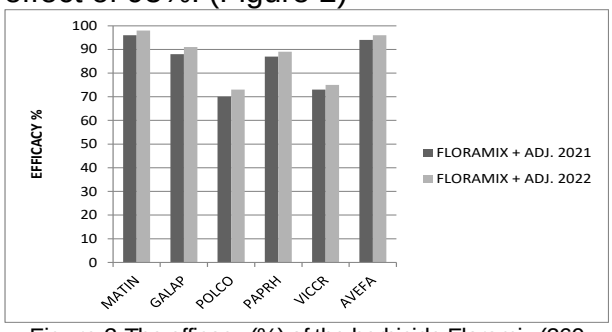

Figure 2 The efficacy (%) of the herbicide Floramix (260 g/ha) + Adj. (0,6 l/ha) for the weeds controlling from the wheat crop during 2021-2022)

Figure 3 shows the average effectiveness results (%) recorded at the post-emergence application of the Pallas treatment (7.5% piroxsulam + 7.5% cloquintocet-mexil safener) + Adj used in a dose of 250 g + 0.5 l/ha. This is a systemic herbicide, the control is influenced by the developmental stage of the weeds, the young stages being more easily controlled. Optimal control for grasses - until twining for Avena fatua - and for dicotyledonous weeds at 4-6 leaves.

The obtained results show a very good control effect for the annual dicotyledon *Matricaria inodora*-98% and the annual monocotyledon *Avena fatua* - 96%. Following the application of this treatment, the annual dicotyledonous *Papaver rhoeas*- 91%, *Galium aparine* - 89% and *Viccia cracca* - 86% presented a good combat effectiveness. The annual dicotyledonous weed species - *Polygonum convolvulus* recorded an average control effect of 72%.

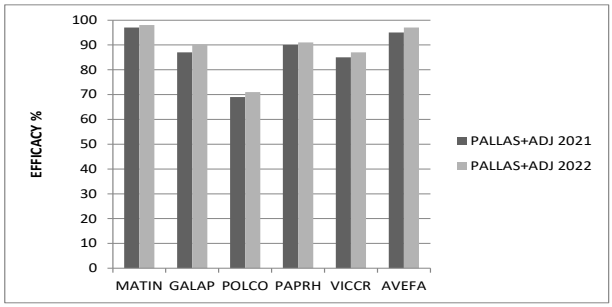

Figure 3 The efficacy (%) of the herbicide Pallas (250 g/ha) + Adj. (0,5 l/ha) for the weeds controlling from the wheat crop during 2021-2022

Figure 4 shows the average effectiveness results (%) recorded after the post-emergence application of Foxtrot 69 EW (1.0 l/ha) + Omnera (1.0 l/ha) herbicide combinations. Foxtrot 69 EW (fenoxaprop-P-ethyl 69 g/l + cloquintocet mexil 34.5 g/l (safener) is a systemic herbicide to combat annual monocotyledonous weeds, a graminicide dedicated to the protection of cereals, selective for the crop thanks to the safener incorporated in formulation. For the herbicide Omnera (fluroxypyr 135 g/l + thifensulfuron methyl 30 g/l + metsulfuron methyl 5 g/l) the degree and duration of control may depend on: the spectrum of weeds and the degree of infestation, the stage of the weeds at the time of application, the applied technology, and environmental conditions during and after treatment. The average effectiveness results obtained highlight a superior control effect - 100% for the annual dicotyledons: *Matricaria inodora*, *Galium aparine* and *Polygonum convolvulus*. The two weed species Papaver rhoeas - 95% and *Viccia cracca* - 97% showed a very good control effect after applying the treatment. Regarding the annual monocot species - *Avena fatua* showed a very good control effect of 97%.

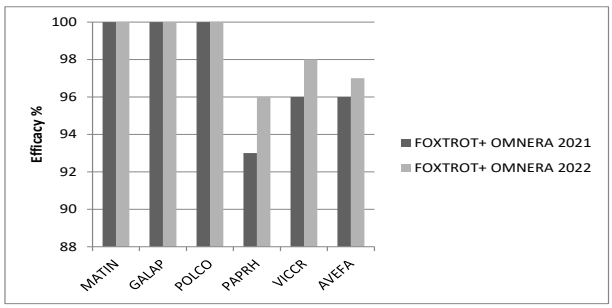

Figure 4 The efficacy (%) of the herbicides Foxtrot (1,0 l/ha) + Omnera (1,0 l/ha) for the weeds controlling from the wheat crop during 2021-2022

Pixxaro Super (12 g/l halauxifen-methyl + 280 g/l fluroxypyr meptil + 12 g/l

cloquintocet-mexyl) is a systemic herbicide that was applied post-emergence in a dose of 0.5 l/ha, intended for use in cereal crops, both autumn and spring, for the control of a broad spectrum of broadleaf weeds.

Following this treatment (Figure 6), the annual dicot species Polygonum convolvulus was completely controlled (100%). For the other annual species, the effect of the herbicide was: *Matricaria inodora* - 97%, *Galium aparine* - 98.5%, *Viccia cracca* - 95% and *Papaver rhoeas* -89%.

Regarding the annual monocotyledonous species - *Avena fatua* - it was not combated.

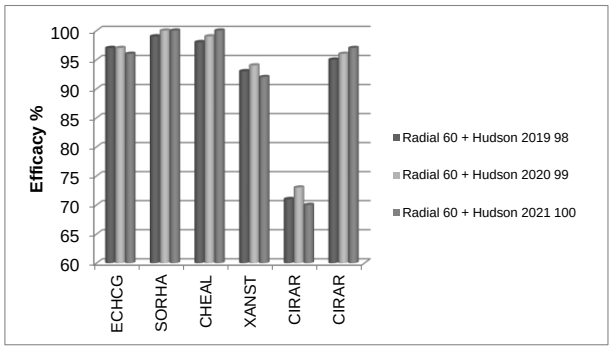

Figure 5 The efficacy (%) of the herbicide Pixxaro Super (0,5 l/ha) for the weeds controlling from the wheat crop during 2021-2022

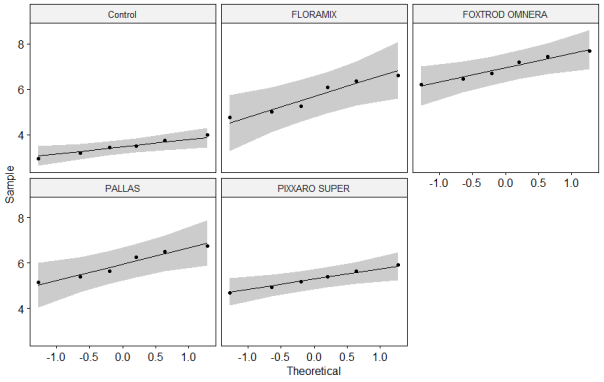

Figure 6 The quartile -quartile (Q-Q) plot for wheat yield under the treatments for weed control.

The Shapiro-Wilk's tests and the visual inspection of the quantile-quantile plots suggest that data for wheat yields within each treatment may have a normal distribution (Figure 6).

The yearly yield varied from 4.93 t/ha (for control in 2022) to 7.43 t/ha (for Foxtrot + Omnera in 2021). In both years the hierarchy of the treatments was identical (Figure 7).

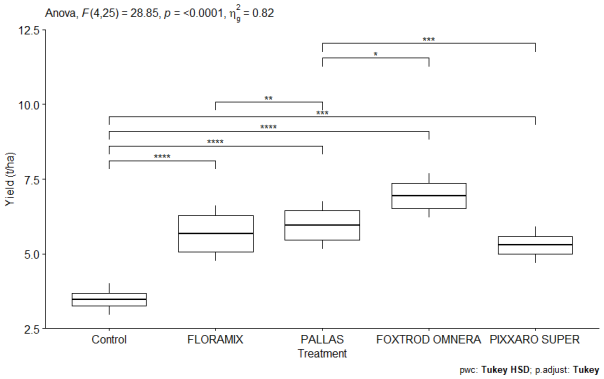

Figure 7 The yields averages for two years .

The Tuckey's HSD test used for the examinations of the yield differences between treatments (pooled values from the two experimental years) suggested that there are significant differences between control and each treatment and significant differences within the treatments. The two years average yield for the herbicide Foxtrot + Omnera was 6.95 t/ha

The chemical control of the weed species existing in the wheat culture, on the type of cambic chernozem soil from Fundulea, represents an especially important and necessary technological measure. In the field of weed control, the main objective is to reduce the degree of infestation and, finally, to identify the most effective combinations of substances, to reduce both the impact on the environment and the costs per hectare.

In our country, special attention is paid to the control of weed species by using and applying new herbicide treatments due to the infestation degree, the dominance and diversified spectrum of weeds present in the wheat crop.

CONCLUSIONS

The wheat crop showed a high degree of weeding and diversified with characteristic weed species: *Avena fatua, Matricaria inodora, Galium aparine, Poligonum convolvulus, Papaver rhoeas* and *Viccia cracca*.

Treatments with post-emergence herbicides applied (BBCH 31) did not register phytotoxic phenomena for the cultivated wheat variety - GLOSA.

In the 2021-2022 research years, the use and application of new treatments with post-emergent applied herbicides had a good control effect, highlighting their effectiveness through a single application.

The degree of control of herbicide treatments depends on the level of infestation, dominance, weed spectrum, applied dose and climatic conditions.

The production obtained was in close correlation with the biological potential of the wheat variety, the efficiency of each treatment and the recorded climatic conditions.

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