Scientific Papers. Series B, Horticulture. Vol. LXVI, No. 1, 2022
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

DEGREE OF CONTROL OF WEEDS UNDER THE INFLUENCE OF AGRO-TECHNICAL MEASURES AND HERBICIDES IN A PEACH PLANTATION (*PRUNUS PERSICA* L.)

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Abstract

The research was carried out on a family farm in Periam, Timis County, and studied the Redhaven peach variety. The soil where the orchard was placed is a chernozem, moist phreatic, moderate hyposodic between 50-100 cm, weak carbonate, deep on medium loessoid materials, medium loam / medium loam. The value of the apparent density (AD) is extremely low in the Atk surface horizon with a value of 1.10 g / cm^3, very low in the range of 18-75 cm, and low in the Amk2 horizon with a value of 1.35 g / cm^3. For this experiment, the randomized block method was used, and 8 experimental variants were chosen, which were placed on 4 rows of trees, resulting in 4 repetitions with 32 experimental plots. The surface of an experimental plot was 12.20 m^2. From the obtained data, can be observed that the effectiveness of the weed control measures materialized through the productions obtained in the two experimental years. Following the application of weed control measures, the production obtained in 2019 had values between 12.78 t / ha and 20.65 t / ha, and in 2020 the production was between 11.50 t / ha and 18, 65 t / ha.

Key words: *peach, herbicide, weed infestation, pest control, production.*

INTRODUCTION

Weed control in peach plantations (*Prunus persica* L.) continues to be a major problem, especially for young plantations (Botu et al., 2003; Hoza, 2000; Drăgănescu 2002; Gradinariu, 2002).
EU farming systems have become more vulnerable and less sustainable due to excessive herbicide dependence and the huge growth of herbicide-resistant weeds (Tataridas et al., 2022).
Human health, biodiversity and plantation sustainability can be affected by the toxic substances of many chemical pesticides, which have been blamed for soil and water degradation. The recent European Union (EU) legislative frameworks set out the needs and requirements of citizens as a major task for the organization of the agricultural sector in the Member States (Peeters et. al., 2020). It is said that climate change will cause temperatures to rise by at least 2 ° C in the 21st century and will negatively affect crop production by increasing biotic and abiotic stress (Raza et al., 2019). The increase in heavy rainfall is another factor that predicts production losses. As stated by Maes et al., 2019, the EU will have more drought events, and temperatures will put pressure on agroecosystems. However, uncertainty remains high as climate change is a continuing phenomenon (Tubiello, 2007). Sustainable crop production is a complex link of decisions and resources that must be properly managed to mitigate the long-term impact of climate change. This task is even more difficult in respect of organic farming systems, where chemical pesticides (Alda, 2007; Cârciu, 2006; Manea, 2006) are not used. The situation is even worse in organic farming, where low tillage is applied and there are perennial weeds, which are normally managed with effective synthetic herbicides, such as glyphosate (Scedei et al.,2021), in conventional systems, but are absent in conventional systems organic culture (Melander et al., 2013). A future scenario implies that crops that are susceptible to more pests and diseases are likely to face higher yield differences in

organic farming compared to conventional production (Rasche, 2021).

Herbicides have been and are being applied for a long time in agricultural systems, representing an important tool for crop protection, especially in the years to come, when weeds are expected to cause more problems in agricultural systems (Kudsk, 2003; Neve et al., 2018).

The total use of herbicides in the EU27 since 1990 indicates that the goal of reducing chemical pesticides by 50% by 2030 remains a major challenge (Figure 1). However, the consecutive use of herbicides is not only observed in the EU, it is also the major component for crop protection in developed and developing countries (Gianessi, 2013; Shattuck, 2021).

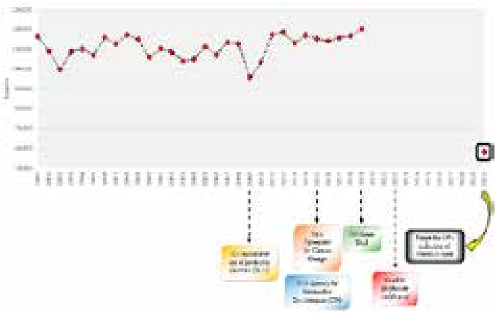

Figure 1. Total herbicide use in the EU_{27} between 1990–2019 and the important milestones and targets for chemical pesticide reduction by 50% by 2030 (https://www.fao.org/faostat)

The question is what is the fate of glyphosate and are there alternatives? Glyphosate is not in line with several sustainable development goals (Krimsky, 2021) and its appearance in the markets beyond 2022 is still unknown, while several effective herbicide generic products have overwhelmed the markets after the expiration of patents (Shattuck, 2021). However, we wonder if there are effective alternatives to glyphosate that need to be integrated into a complex decision-making system for crop protection to keep low costs and maintain ecosystem services (Fogliatto et al., 2020; Kanatas et al., 2021). Concern about the future of herbicides extends beyond the fate of glyphosate and is appropriately stated by Beckie et al., 2020, wondering what the future holds for other successful herbicides.

MATERIALS AND METHODS

The field studies were carried out in a family plantation of peach (Redhaven variety), (*Prunus persica*), from Periam (46 ° 01′41 ″ N 20 ° 53′35 ″ E), Timis county. The value of the apparent density (AD) is extremely low in the Atk surface horizon with a value of 1.10 g / cm^3, very low in the range of 18-75 cm, and low in the Amk2 horizon with a value of 1.35 g / cm^3 (Ianoș, 1995).

The 8 experimental variants were (V1 - untreated, not hoed; V2 - Agro Glyfo Green (4 l / ha) + 1 manual hoeing; V3 - Glyphogan 480 SL (4.5 l / ha) - 1 manual hoeing; V4 - Typhoon 360 SL (5 l / ha) + 1 manual hoeing; V5 - Glyphotim (4 l / ha) + 1 manual hoeing; V6 - Clean Up Xpert (5 l / ha) + 1 manual hoeing; V7 - Roundup Classic Pro (4 l / ha) + 1 hoeing; V8 - Fusilade Forte EC (1.3 l / ha) + 1 manual hoeing) and these were placed on 4 rows of trees (using the randomized block method), in 4 repetitions with a number of 32 plots. The surface of an experimental plot was 12.20 m^2.

The determination of the floristic composition was determined by weed mapping, which is a very complex work and includes several main links, weed species determination, weeding level, weeding mapping and so on. based on them, control measures were established. Each method has its advantages and disadvantages.

Herbicides were administered on each experimental variant. Their application was done manually, with the help of the vermorel type sprayer, using 400 l of solution on an area of 1 ha. They were administered in May.

An herbicide efficacy test has been established in accordance with the standard method of the European and Mediterranean Plant Protection Organization (EPPO) (EPPO / OEPP, 2020).

The optimum time for cultivation is 7 to 21 days after the application of post-emergent herbicides, to allow the translocation of the herbicide into the root of perennial weeds.

The processing and interpretation of the experimental data was done by analyzing the variance (Săulescu, 1967).

RESULTS AND DISCUSSIONS

In the two experimental years (2019-2020) the climatic conditions showed very large oscillations. Temperatures had close values, compared to the amount of precipitation that showed different values from one month to another, which influenced both the level of weeding and production.

The weeding level in 2019 was 114,75 weeds / m^2. The most common weeds were: *Elymus repens* 20,02 weeds / m^2 (17,45%), *Setaria glauca* 18,04 weeds / m^2 (15,72%), *Amaranthus retroflexus* 16,00 weeds / m^2 (13,99%) and *Veronica hederifolia* 14,60 weeds / m^2 (12,72%).

The species *Stellaria media* (0,89%), *Cardaria draba* (0,52%), *Cirsium arvense* (0,21%) and *Digitaria sanguinalis* (0,05%) had a low frequency (Figure 2.).

Monocotyledons accounted for 38,83%, while dicotyledons accounted for 61,17%.

In 2019, 14 plant species were identified, included in 8 botanical families. The *Poaceae* family includes 4 species: (*Elymus repens, Setaria glauca, Cynodon dactylon*, and *Digitaria sanguinalis*). The *Brasicaceae* family includes 3 species (*Capsella bursa pastoris, Sinapis arvensis* and *Cardaria draba*). The *Asteraceae* family includes 2 species (*Sonchus arvensis* and *Cirsium arvense*). The families *Amaranthaceae*,*Caryophyllaceae,Chenopodiaceae, Convolvulaceae* and *Scrophulaceae* include a single species of weed.

The highest participation percentage of 28,58% belongs to the *Poaceae* family (Figure 3.).

The average field after the application of weed control measures was 31,55 weeds / m^2 (27,49%).

Monocotyledonatae holds 10,79% (12,37 weeds / m^2) and dicotyledonatae 16,70% (19,16 weeds / m^2) (figure 4).

The percentage of uncombined monocotyledonous ranges between 3,47% (V7 - Roundup Classic Pro (4 l / ha) + 1hoeing) and 19,57% (V8 - Fusilade Forte EC (1.3 l / ha) + 1 hoeing). The percentage of uncombined dicotyledonous lies between 5,43% and 29.34%

The number of weeds / m^2 in the control variant was 114,75. The average experimental field was 17,38 t / ha.

The absolute production oscillates between 12,78 t / ha, in the V8 variant - Fusilade Forte EC (1,3 l / ha + 1 manual plow and 20,65 t / ha in the V7 variant - Roundup Classic Pro (4 l / ha) + 1 manual hoe (V6 - Clean Up Xpert (5 l / ha) + 1 manual hoeing), the yield obtained was 20,16 t / ha (Table 1).

The relative production is between 73,53% and 118,81%, respectively.

The production increase oscillates between, 1,56 t / ha (V4 - Taifun 360 SL (5 l / ha) + 1 manual hoe) and 3,27 t / ha (V7 - Roundup Classic Pro (4 l / ha) + 1 manual hoeing).

The degree of weed control in variants where the active substance was glyphosate, shows close values. The percentage of weed control is between 57,38% (V8 - Fusilade Forte EC (1.3 l / ha) + 1 manual hoeing) and 92,25% (V7 - Roundup Classic Pro (4 l / ha) + 1 manual hoeing). In variant V2 - Agro Glyfo

Green (4 l / ha) + 1 manual hoeing, the degree of weed control is 90,12% (Figure 5.)

The number of uncontrolled weeds ranged between 8,90 weeds / m^2 and 48,91 weeds / m^2, respectively.

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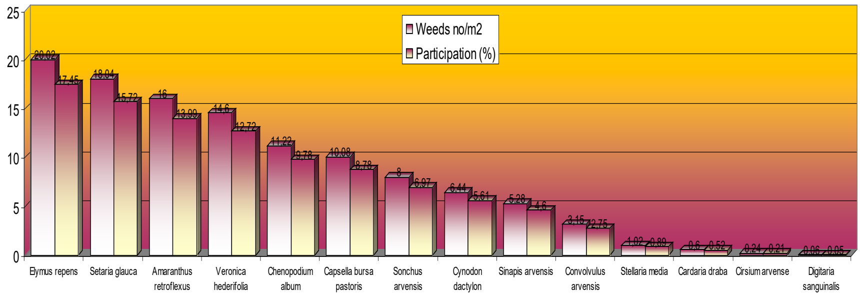


Monocotyledonatae: 44,56 weeds /m^2 (38,83%) Dicotyledonatae: 70,19 weeds/m^2 (61,17%)

Figure 2. Number of weeds and percentage of participation,
in variant V1 - untreated, not hoed, in 201

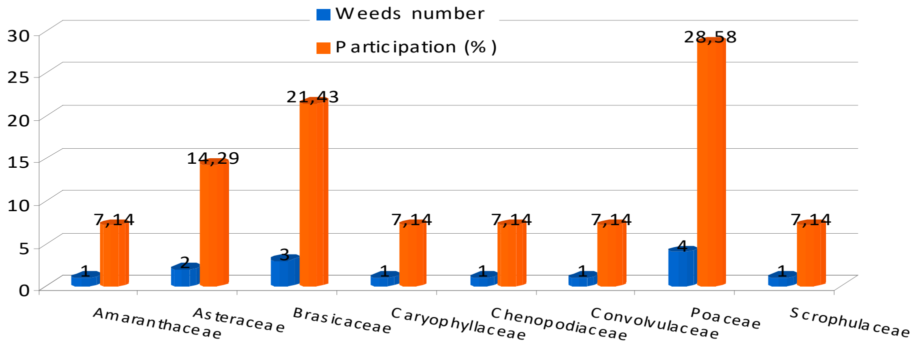


Figure 3. The level of weeding according to the botanical family, in 2019

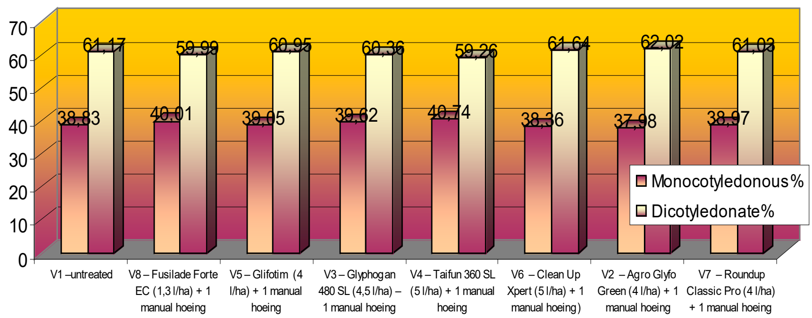
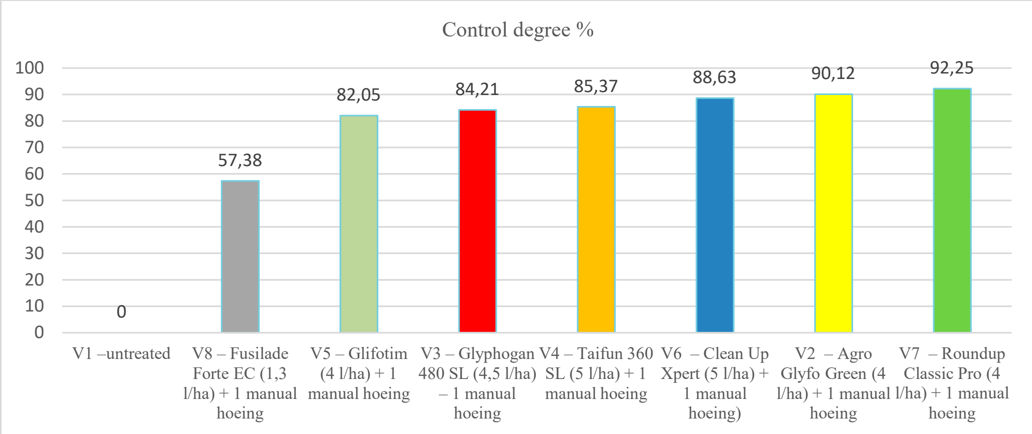


Figure 4. The distribution of weeds in groups, following the application
of control measures, in 2019



DL $_{5\%}$ = 5,93 weeds/m^2; DL $_{1\%}$ = 8,00 weeds/m^2; DL $_{0,1\%}$ = 10,62 weeds/m^2

Figure 5. Intensity of agrotechnical measures, on the level of weeding, in 2019

Table 1. The influence of weed control measures on peach production (t / ha), in 2019

Treatment	Absolute yield (t/ha)	Relative yield (%)	Yield difference (t/ha)	Significance
V_7 – Roundup Classic Pro (4 l/ha) + 1 manual hoeing	20,65	118,81	+3,27	Xx
V_6 – Clean Up Xpert (5 l/ha) + 1 manual hoeing)	20,16	115,99	+2,78	Xx
V_2 – Agro Glyfo Green (4 l/ha) + 1 manual hoeing	19,60	112,77	+2,22	X
V_3 – Glyphogan 480 SL (4,5 l/ha) – 1 manual hoeing	19,35	111,33	+1,97	X
V_4 – Taifun 360 SL (5 l/ha) + 1 manual hoeing	18,94	108,97	+1,56	-
X – Mean	**17,38**	**100,00**	**Mt.**	**-**
V_5 – Glifotim (4 l/ha) + 1 manual hoeing	17,23	99,13	-0,15	-
V_8 – Fusilade Forte EC (1,3 l/ha) + 1 manual hoeing	12,78	73,53	-4,60	00
V_1 – untreated, unhoed	10,40	59,83	-6,98	000

DL $_{5\%}$ = 1,96 t/ha; DL $_{1\%}$ = 64 t/ha; DL $_{0.1\%}$ = 4,61 t/ha.

In 2020 the weeding level was 128,04 weeds / m^2. *Elymus repens* (17,57%), *Cynodon dactylon* (15,81), *Convolvulus arvensis* (14,07%) and *Veronica hederifolia* (12,86%) were very frequent (figure 6.). With low presence we have the species *Chenopodium album* (0,83%), *Cardaria draba* (0,09%), *Polygonum aviculare* (0,06%) and *Stellaria media* (0,03%). Monocotyledonous represent 42,55% and dicotyledonous 57,45%.

The weeds mapped in 2020 belongs to 9 botanical families. The *Poaceae* family includes 4 species (*Elymus repens, Cynodon dactylon, Echinochloa crus-galli* and *Digitaria sanguinalis*), with a participation rate of 28,58%.

The *Asteraceae* family includes 2 species (*Cirsium arvense* and *Sonchus arvensis*) (Figure 7), the participation percentage being 14,29%. Also 2 species of weeds belonging to the family *Brasicaceae* (*Capsella bursa pastoris* and *Cardaria draba*).

The other 6 families include weeds: *Convolvulus arvensis, Veronica hederifolia, Amaranthus retroflexus, Chenopodium album, Polygonum aviculare* and *Stellaria media*, with a participation rate of 42.86%. Following application of control measures, the average value of field in respect to uncontrolled weeds was 30.74%.

The average of uncombined monocotyledonous species represents 13,06% (16,73 weeds / m^2), and dicotyledonous represent 17,68% (22,64 weeds / m^2).

The number of uncontrolled monocotyledonous weeds ranges between 6,03 weeds / m^2 (41,30%) in the V7 variant - Roundup Classic Pro (4 l / ha) + 1 manual hoeing and 25,80 weeds / m^2 (43,25%) in the variant V8 - Forte EC rifles (1.3 l / ha) + 1 manual hoeing. The number of uncontrolled dicotyledonous weeds ranged between 8,57 weeds / m^2 (58,70%) and 33,87 weeds / m2 (56,75%) (Figure 8.).

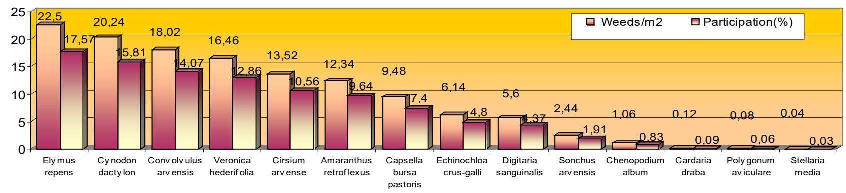
Compared to 2019, in 2020 the effectiveness of weed control measures was lower

Compared to 2019, in 2020 the effectiveness of weed control measures was lower, the degree of weed control ranges between 53,40% (V8 - Fusilade Forte EC (1.3 l / ha) + 1 manual hoeing) and 88,60% (V7 - Roundup Classic Pro (4 l / ha) + 1 manual hoeing). With a high percentage of weed control level, of 86,75%, the variant V2 - Agro Glyfo Green (4 l / ha) + 1 manual hoeing (Figure 9.) is also highlighted.

Following the application of weed control measures, the level of weeds is significantly reduced from 128,04 weeds / m2 (V1 - untreated, not hoed) to 14,60 weeds / m^2 (V7 - Roundup Classic Pro (4 l / ha) + 1 manual hoeing).

The yield obtained in 2020 was lower than that obtained in 2019. The average field, assumed as a control variant, was 15,80 t / ha.

The absolute production obtained for peaches lies between 11,50 t / ha in the V8 variant - Fusilade Forte EC (1,3 l / ha) + 1 manual hoeing and 18,65 t / ha in the V2 variant - Agro Glyfo Green (4 l / ha ha) + 1 manual hoeing. A production of 18,07 t / ha was obtained in the V7 variant - Roundup Classic Pro (4 l / ha) + 1 manual hoeing, with an increase of production compared to the control variant, up to 2,27 t / ha (Table 2). The relative production is between 72,78% and 118,03%, respectively. The highest increase in production was 2,85 t / ha, very significant.



Monocotyledonous: 54,48 weeds/m^2 (42,55 %); Dicotyledonous: 73,56 weeds/m^2 (57,45 %)

Figure 6. Distribution and percentage of weed participation, in variant V1 - untreated, unhoed, in 2020

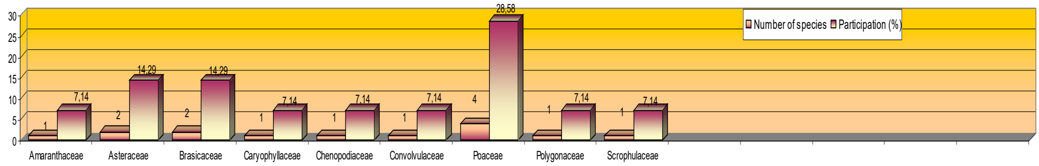


Figure 7. Distribution of weed species according to the botanical family, in 2020

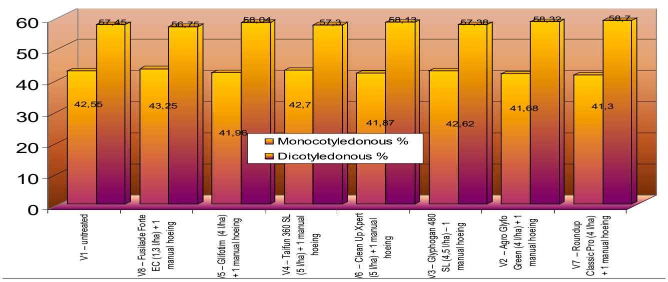
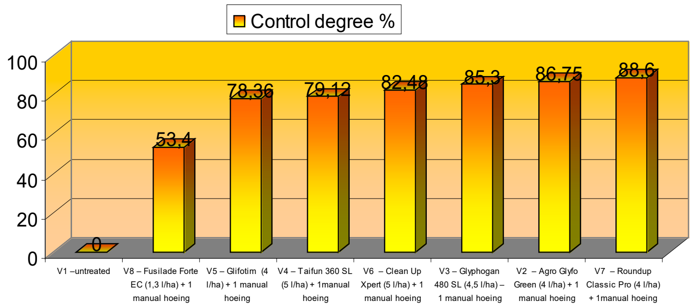


Figure 8. Arrangement of weed species in groups, in the year 2020



$DL_{5\%}$ = 6,12 weeds/m^2 $DL_{1\%}$ = 8,25 weeds/m^2 $DL_{0,1\%}$ = 10,95 weeds /m^2

Figure 9. The influence of agrotechnical measures on the degree of weed control (%), in 2020

Table 2. The effect of weed control measures on peach production (t / ha) in 2020

Treatment	Absolute yield (t/ha)	Relative yield (%)	Yield difference (t/ha)	Significance
V_2 – Agro Glyfo Green (4 l/ha) + 1 manual hoeing	18,65	118,03	+2,85	xxx
V_7 – Roundup Classic Pro (4 l/ha) + 1 manual hoeing	18,07	114,36	+2,27	Xx
V_3 – Glyphogan 480 SL (4,5 l/ha) – 1 manual hoeing	17,80	112,65	+2,00	X
V_4 – Taifun 360 SL (5 l/ha) + 1 manual hoeing	17,22	108,98	+1,42	-
V_6 – Clean Up Xpert (5 l/ha) + 1 manual hoeing)	16,98	107,46	+1,18	-
V_5 – Glifotim (4 l/ha) + 1 manual hoeing	16,47	204,24	+0,67	-
X – Mean	**15,80**	**100,00**	**Mt.**	**-**
V_8 – Fusilade Forte EC (1,3 l/ha) + 1 manual hoeing	11,50	72,78	-4,30	000
manual hoeing	9,75	61,70	-6,05	000

$DL_{5\%}$ = 1,53 t/ha; $DL_{1\%}$ = 2,06 t/ha; $DL_{0.1\%}$ = 2,73 t/ha.

CONCLUSIONS

Following the research conducted in the two experimental years (2019 - 2020), the following conclusions were drawn.

Different climatic conditions in the two experimental years, especially in terms of precipitation, impacting the effectiveness of weed control methods, the degree of control and the production obtained.

In 2019 the weeding level was 114,75 weeds / m^2, and in 2020 128,04 weeds / m^2. The higher level of weeding in 2020 was recorded in May 2020 due to the higher amount of rainfall (128,00 mm).

In 2019 the most widespread weeds were: *Elymus repens* (17,45%), (15,72%), *Amaranthus retroflexus* (13,99%) and *Veronica hederifolia* (12,72%). In 2020, the species *Elymus repens* (17,57%), *Cynodon dactylon* (15,81), *Convolvulus arvensis* (14,07%) and *Veronica hederifolia* (12,86%) were dominant.

In 2019, monocotyledonous represented 38,83%, and dicotyledonous 61,17%. In 2020, the percentage of monocotyledonous increased, which was 42,55%, while that of dicotyledonous was 57,45%. In both years 2019 and 2020, 14 weed species were identified, included in 8 and 9 botanical families, respectively.

The degree of weed control in 2019 ranged between 57,38% and 92,25%. The V7 variant - Roundup Classic Pro (4 1 / ha) + 1 manual hoeing), proved to be the most efficient with a control percentage of 92,25%.

In 2020, the degree of weed control had values between 53,40% and 88,60%, much lower compared to 2019.

The effectiveness of the weed control measures materialized through the productions obtained in the two experimental years. Following the application of weed control measures, the production obtained in 2019 had values between 12,78 t / ha and 20,65 t / ha, and in 2020 the production was between 11,50 t / ha and 18, 65 t / ha. The production increase compared to the field average, in 2019 was 3,27 t / ha, and in 2020 it was 2,85 t / ha.

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