

NEW ASPECTS WITH WEED COMPETITION AND CONTROL FROM THE SUNFLOWER CROP

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Abstract

Having a more developed leaf system, one might think that the sunflower can fight much better with weed species during the growing season. Young plants, however, are the most vulnerable, as in the case of other cultivated plants. Weed biomass currently exceeds 10-12 t/ha, and their spectrum is diverse. On average, production losses due to weeding exceed 1.0-1.5 t/ha of seeds. As a structure, MA constituted on average 8.6 t/ha, DA 2.6 t/ha, and DP 1.0 t/ha. Weeding as often as needed has proven somewhat more effective than in the case of other cultivated plants. Herbicide with specific products contributed year after year to obtaining obvious increases in production. In the case of the application of single herbicides, the increases were below 1.0 t/ha, and in the case of the combined and associated ones, the increase in production was around 1.5 t/ha. Today, reducing herbicide doses still requires adequate research.

Key words: competition, herbicides, hoeing, sunflower, weeds control.

INTRODUCTION

Sunflower plants get massively weeded (Ionescu & Șarpe, 2001), just like any spring plant sown in sparse rows. Although young sunflower plants experience relatively more obvious growth (Swanton et al., 2015), the degree of weeding that occurs is just as dangerous (Kempenaar et al., 2002). As it is known, the taproot of the plants obviously penetrates the soil and should compete a little better with the segetal species that appear. From practice, it has been proven that this aspect is relative (Silva et al., 2012), and weeding occurs at high levels. And in sunflowers, methods are used to avoid the establishment of unwanted competition (Tagour, 2015). on the one hand, the emergence of weeds is avoided during the emergence of cultivated plants. At this moment, it is good that the seedlings do not get weeded, in this case also avoiding the dangerous stress for the first moments (Ionescu, 2024). on the other hand, 1-2 treatments are used from the sunflower plant vegetation, for the segetal species that continue to appear, through the spring and summer forms (Simiș et al., 2011). as well as those that emerge towards the warm season (generically called summer species), are

equally dangerous in the sunflower culture (Chauhan et al., 2012). On the one hand, we opt for the use of effective and specific herbicides, and on the other hand, we resort to 2-3 treatments. Normally the first treatment considered mandatory will resolve both the monocots and dicots spectrum. This treatment is applied in most pre-emergent cases. On the other hand, they are used through 1-2 herbicide treatments in plant vegetation. The most suitable moment for sunflower plants is that of 4-6 leaves, with the presence of weeds. At the same time, weed nets are used for the most effective weed control (Ionescu et al., 2014). These are interspersed among chemical treatments, and their effectiveness has proven to be very good. On the reduced areas of sunflower culture, you can also resort to manual weeding, which has the role of increasing the effectiveness of other weed control measures. Chemical measures, along with mechanical ones, but also others (for example rotations suitable to the farming system practiced) are included among the new rules, accepted by Chauhan et al., 2012). Overall, they provide a more beneficial direction for the integrated management of weeds in sunflower culture. The research carried out to find newer, but also diverse, ways is currently aimed at

prospecting the need to reduce the degree of weeding in this valuable crop plant: the sunflower, including through chemical strategies (Pannacci et al., 2007). The purpose of their promotion is, on the one hand, the avoidance of human effort, the increase of productivity, along with the reduction of the cost price per product unit. Both plant and seed biomass are targeted. The present results, although considered relatively new, further experimentation and specific studies are needed. Thus, investigations of an ecological nature have begun regarding the interrelationships between weed species, the economic thresholds of damage, as well as non-chemical control methods. The present paper presents results obtained from several experimental directions: demonstration of the competition between weeds and sunflower plants, investigation of new, ecological ways by carrying out weeding, along with new chemical methods of weed control (Kudsk, 2003). The results obtained so far support very well the conclusions obtained from the sunflower culture in the area of heavy clay soils in the south of the country.

MATERIALS AND METHODS

The studies whose results are presented in the paper were carried out over a period of several years. Their presentation will be done through specific research series. On the one hand, sunflower weeding was studied, and on the other hand, control methods, both by cultivation and by herbicides. Thus, within the competition between weeds and sunflower plants, weed species formed from the respective botanical categories, known, were determined every year (Chauhan et al., 2012). The natural distribution of weed species included both compact areas, separate areas and even sporadic areas. With the data obtained, both the correlation between the total biomass and the production losses of sunflower seeds were expressed. On the other hand, it was demonstrated how the degrees of natural weeding influenced the growth and development of crop plants. In another multi-year study, the effectiveness of the nets, both mechanical and manual, and the complexity between them was followed. Between the two

methods: chemical and non-chemical, comparisons were made for their acceptance at the level of production farms. By combining weeding with weeding, a new study has recently been started to determine the interrelationships, the economic advantages, then the application period, as well as the possibilities of reducing herbicide doses.

In another specific direction studied, reference is made to the exclusive use of herbicides, as chemical means of weed control. On the one hand, the aim was to reduce the degree of weeding, and on the other hand, both the protection of the soil and the protection of the sunflower plants were taken into account. Over the years, permanent progress has been made both by professional companies and by researchers in the field, so that all farmers have at their disposal the most modern, effective and even cheap options. The recommendations also included the possibilities that agricultural producers have for adapting to the new situations that appear every year. In a series of separate experiments, several classic herbicides, as well as newer ones, were studied, with the aim of highlighting the new directions of the European Union. The possibilities of reducing herbicide doses for three products are targeted: alachlor and oxyfluorfen, along with promethryn.

The experimental variants were located in the specific research field of the resort. The placement method was that of the Latin rectangle, in 4 repetitions. The surface of the variants was in all cases 25 m². Plant samples, both for weeds and sunflowers, were collected decadal throughout the vegetation period. For the deposition of the dry matter from the sunflower seeds, samples were collected every 5 days. In both cases the samples were collected with the metric frame from all repetitions. The drying process of the samples was carried out classically, at 105°C, for 8 hours (Clawson method). The statistical processing was done according to the variance analysis method (anova test), and the Excel program was used to express the average data. The hybrids used were those grown by farmers in the area, and the applied technology was the one recommended by the resort.

RESULTS AND DISCUSSIONS

Due to the appearance of a whole vegetable carpet from weeds since the first sunflower moments, it was studied from the beginning. On the one hand, the multitude of existing species was taken into account, along with some specific to the natural conditions of the white clay-soil (Ionescu & Popescu, 2024). The wide floristic composition existing in each sunflower growing area, most produce economic, physiological damage to the sunflower. The interaction between weeds and sunflower plants can be researched either according to a more aggressive weed species, or simultaneously for all species

in the crop. In the application of means of control of the entire spectrum of weeds, it is recommended that the weeding be considered in all its composition.

The natural composition of sunflower weeds. The weed species observed, noted and weighed from the untreated & unseeded control was diverse, being specific to the sunflower cultivation area (Table 1; Figures 1 and 2). Among the species, annual dicotyledons (DA) dominated, then perennial dicotyledons (DP) and less annual monocots (MA) and perennials (MP) in number. It is also noted that some species from the three categories were problem species, being highlighted in the table.

Table 1. The main weed species from sunflower crop

No.	Perennial dicots	Annual dicots	Annual monocots	Perennial monocots
1.	<i>Cirsium arvense</i>	<i>Amaranthus retroflexus</i>	<i>Echinochloa crus-galli</i>	<i>Agropyron repens</i>
2.	<i>Convolvulus arvensis</i>	<i>Chenopodium album</i>	<i>Digitaria sanguinalis</i>	
3.	<i>Lathyrus tuberosus</i>	<i>Raphanus raphanistrum</i>	<i>Setaria glauca</i>	
4.	<i>Rumex crispus</i>	<i>Sinapis arvensis</i>	<i>Setaria viridis</i>	
5.	<i>Sonchus arvensis</i>	<i>Centaurea cyanus</i>	<i>Lolium</i> ssp.	
6.	<i>Taraxacum officinale</i>	<i>Xanthium italicum</i>	<i>Poa annua</i>	
7.		<i>Ambrosia artemisiifolia</i>		
8.		<i>Polygonum hydropiper</i>		
9.		<i>Sonchus asper</i>		
10.		<i>Hibiscus trionum</i>		
11.		<i>Polygonum persicaria</i>		
12.		<i>Scleranthus annuus</i>		
13.		<i>Matricaria inodora</i>		

Xanthium italicum, weed-problem



Figure 1. *Ambrosia artemisiifolia* competition



Figure 2. *Centaurea cyanus* competition

After completion of the vegetation period, metric frame samples were collected for all weed species. After weighing them, they were separated into large botanical groups: DP- perennial dicots, DA- annual dicots, MA- annual monocots and MP- perennial monocots. Their quantitative evolution from the untreated and unseeded control was specific (Table 2). The behavior of the sunflower plants in the naturally weeded control was specific, in the last

12 years (Figure 3). Three groups of data can be seen from the graph. In the first, the sunflower plants produced seeds between 1.2 and 1.5 t/ha, due to somewhat less competition. In a single year, the cultivated plants produced 1.8 t/ha of seeds under these conditions. The third group placed seed productions between 0.7 and 1.2 t/ha. From the graph it can be seen that in most years the sunflower plants were strongly competed for, on the one hand, and on the other

hand there were also years with somewhat less close competition in which the crop plants were less competed for.

Table 2. Weed evolution (t/ha biomass) by botanical gruoups from untreated plot

Years/form	Total t/ha	PD	AD	AM
1	9.9	0.5	4.2	5.2
2	13.7	0.8	3.3	9.6
3	13.0	1.7	0.2	11.1
Mean	12.2	1.0	2.6	8.6
Participation, %	100	8	21	71

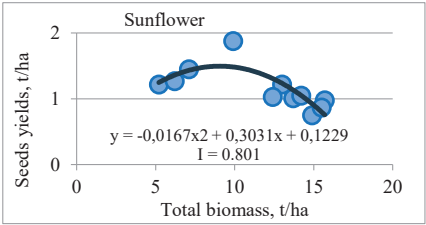


Figure 3. Corelation between weed biomass x sunflower seeds yields from untreated plot (Ionescu, 2014)

Competition between weeds and sunflower plants. The weeding that occurred in the unmaintained sunflower crop (no herbicides, uncultivated) caused significant damage to it (Figure 4).

And in sunflower, the average rate of accumulation (Kandel et al., 2019), of both total and grain biomass, with and without the presence of weeds, showed delays by natural weeding (Figure 4 - 1.A). The deposition of

useful substances in the grains was at a level considered low. Thus, through weeding the accumulation of total biomass reached a maximum level at 760 g/m², compared to the clean weed culture with a maximum level of 1500 g/m². Dry matter accumulation rates of both weeds and sunflower followed specific sinusoidal curves (Figure 4 - 1.B). Sunflower plants without weed competition accumulated a maximum of 48 g/m²/day. In the presence of weeds, this rate had a slight deviation towards maturity, and the maximum value was 20 g/m²/day. The respective deviations were followed by the submission of active ingredients in sunflower plants.

The respective curves were influenced by the presence of weeds. The unwanted weed biomass obtained separately experienced a similar rate, but at much higher values, namely by a maximum of 35 g/m²/day.

Regarding the rate of accumulation (deposition) of active ingredients in sunflower seeds, a differentiation by weeding was found. From the graph (Figure 5), it can be seen that weeding was also harmful for sunflowers, with great repercussions on the formation of production. In the conditions of competition, the rate of accumulation was low and diverted towards the beginning of the deposit process of active ingredients in seeds. As a value, this rhythm had a maximum of 4 g/m²/day, after which it decreased. Sunflower free by weeds had a maximum accumulation of 9.8 g/m²/day.

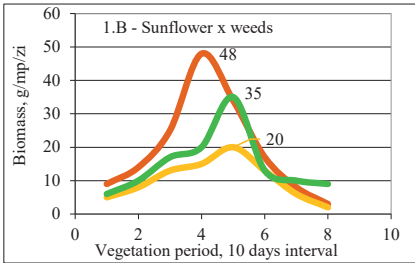
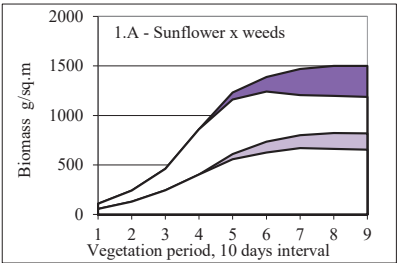


Figure 4. The evolution of biomass- total biomass and grain yield formation (1.A) and weeds biomass, sunflower total biomass and seeds filling rates (1.B), as affected by weeds encroachment or not (brown- sunflower without weeds, yellow- sunflower with weeds, green- weeds. The axis represent consecutive observations with time- intervals of 10 days (after Ionescu, 2005 - 1.A, and Ionescu, 2001 - 1.B)

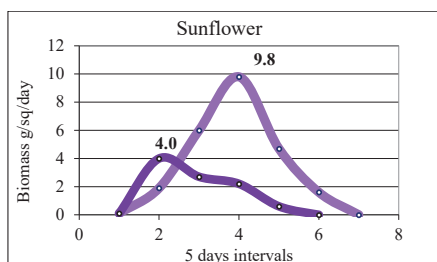


Figure 5. The seeds rate of accumulation, in weed-free and weedy sunflower (after Ionescu, 2012)

Herbicide of the sunflower crop. Among the new rules for weed control in the sunflower culture, three very important directions have been realized: i) competition with sunflower plants, ii) cultivation and iii) the rational use of herbicides. The first two rules have already been presented in the paper. The third direction refers to the use of herbicides.

Today, in the case of the sunflower, single active substances and in more complex formulations are available, sufficient to cover the entire range of weeding situations in this cultivated plant as well. Absolutely all herbicides recommended for sunflowers have both a high degree of effectiveness and a selective protection for crop plants. At the moment, both companies in the field and research have and can recommend the best weed control options in sunflower culture. Recently,

Table 3. Efficacy of weeding control (hoed type)

Hoeing type	Seeds yields levels	
	kg/ha	%
Mechanical + manual	3043	100.0
Mechanical	2922	96.0
Manual	2069	68.0
Not hoed	1366	44.9
LSD (5 %)	548	18.0
LSD (1 %)	726	23.9
LSD (0.1%)	936	30.8

due to the need to emphasize the protection of the agricultural environment, it is recommended to reduce as much as possible the use of herbicides, or exclusively with herbicides (Bostrom., & Fogelfors, 2001). Moreover, the products that have a dangerous residual effect on the agricultural environment were taken out of use and the friendliest ones were promoted.

Today's practice aims to make the best possible use of decisions regarding weeding, with reference to both climatic factors and the spectrum of weeds existing on the respective areas. Considering these two aspects, in practice sometimes herbicides with unilateral application are used. The high level of effectiveness is obtained with the help of herbicides in combination (tank mix), or those associated (Table 4).

Table 4. The efficacy of herbicides in sunflower crop

No.	Herbicides	Doses/ha	WCD, %	Selectivity (notes)	Production increase, kg/ha
Single applied herbicides					
1.	Acetochlor 820-840 g	1.75	16	1.0	1070
2.	Alachlor 480 g	6.0	37	1.0	510
3.	Bifenox 480 g	1.5	58	1.3	213
4.	Oxyfluorfen 240 g	1.0	15	1.0	1150
5.	Linuron 475 g	2.5	67	1.0	260
6.	Pendimethalin 330 g	5.0	36	1.0	1060
7.	Promethryn 500 g	5.0	26	1.0	1235
	Mean	36.4			785
Combined (tank mixed) and associated herbicides					
1.	Alachlor 480 g + promethryn 500 g	6+4	14	1.0	1307
2.	Alachlor 480 g + oxyfluorfen 240 g	6+1	10	1.0	1329
3.	Alachlor 480 g + fluorochloridon 250 g	6+1.5	25	1.0	990
4.	Butylat 800 g + oxyfluorfen 240 g	6+1	15	1.0	1465
5.	Metolachlor 960 g + linuron 475 g	1.5+2.5	15	1.0	1200
6.	Metolachlor 960 g + fluorochloridon 250 g	1.5+1.5	11	1.0	1330
7.	Metolachlor 960 g+fluorochloridon 250 g + imazamox 40 g	1.5+1.5+1.2	5	1.3	1428
8.	Pendimethalin 330 g + bifenox 480 g	5+1.5	31	1.3	1100
	Mean	15.8			1270

*WCD- weeds covered degrees

Experiments with the reduction of herbicide doses in crop plants is relatively new (Ionescu, 2011). Recently, the European recommendations also invite to find ways to reduce the normal, recommended doses (Zhang et al.,

2000). In the present example from the paper, the effectiveness of three treatments is presented, in different doses: 20%, 40%, 60%, 80% and 100%, of the normal, recommended doses (Figure 6).

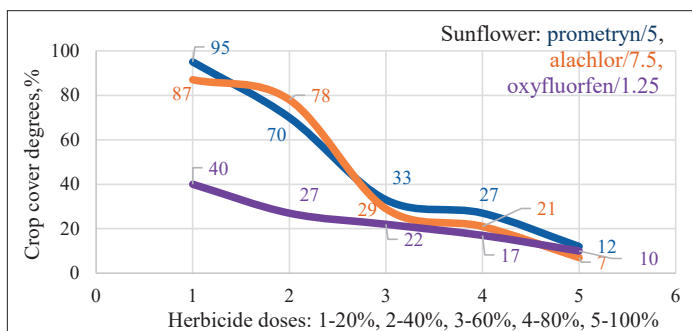


Figure 6. The influence of different doses of herbicides in reducing the weed levels from sunflower crop (Ionescu, 2011)

The evolution of the effectiveness expressed by the degree of weed coverage (GA) left uncontrolled in these different doses demonstrates characteristic situations. Two products: promethryn and alachlor reduced weed cover to acceptable levels only at 60-100% doses. At 60% promethryn reduced WCD to 30-31%, virtually on target of 30%, below which weeds no longer produce significant losses in sunflower production. Alachlor reduced the WCD by an additional 2-3% at 60% dose, demonstrating an additional benefit. The third herbicide, oxyfluorfen reduced WCG the most, even from doses of 20% of normal. In some favorable years, this product can be recommended to be applied in doses of 40-60% of the normal, due to the expression of much increased effectiveness. Research of this kind should be promoted in as many centers as possible with different ecological conditions (Kudsk, 2002). Their purpose is to be able to recommend, at a certain time and crop condition, herbicide products in the lowest possible doses.

On the selectivity of some herbicides applied in sunflower crop. In most sunflower herbicide situations, phytotoxic effects are not produced, as they are selective in their action. However, in a sunflower crop there may be times when a herbicide, usually with post-emergence application, with or without repeating that treatment, can show some symptoms on the

plant foliage. In other situations of treatment in too early seedling vegetation, the phenomenon of growth arrest may occur. These phenomena may be favored by less favorable climatic conditions for cultivation, but usually the symptoms disappear after a short period of time (Inoue et al, 2019). Examples of sunflower-induced phytotoxicity can be found in Table 4, for bifenox products with a selectivity grade of 1.3 and imazamox also with a grade of 1.3. In both cases the plants recovered in a short time and developed normally.

CONCLUSIONS

And the sunflower is one of the field plants that get massively weeded in some years. Depending on the area, here too the causes can be: the specific reserve of seeds in the forest soil, along with the equally reduced competition of the seedlings from the moment of emergence.

From the practical point of view of weed control in the sunflower culture, the information about: the competition between sunflower plants and weeds, the effectiveness of cultivation works in reducing this competition, this being considered by Europe to be mild compared to the culture environment, becomes important and using the recommended herbicides as correctly as possible.

From a study it was shown that on average the average level of weeding was 12.2 t/ha of total

biomass, of which annual dicot species (DA) represented 21%, DP 8%, and the largest proportion, 71% were MA.

The production of naturally weeded sunflowers was between the limits of 720 and 1810 kg/ha. The other data fell within these limits. This study demonstrates the fact that in some years the crop can show a certain degree of competitiveness with the weeds present in the crop.

Specific competition between sunflower plants and weeds demonstrated distortions in plant biological performance. Certainly, in the first period of vegetation, the sunflower plants showed a rather strong fight with the weeds, after which it gave way, but not completely.

Manual and mechanical weeding had very high efficacies in sunflower culture. The differences through mechanical weeding were 68.0% of the ideal, and manual weeding 96.0% of the completely clean culture.

Chemical control of sunflower weed species achieves that lack of competition for a sufficient period of time for the plants to grow and develop as normally as possible. Among the control strategies used, single herbicides give good results, but the best solutions were found with associated treatments. Tank-mix treatments can often be used separately, but only in relation to the concrete situations of existing weeding levels.

Reducing herbicide rates requires several years of research, and the resulting recommendations will be advised with caution.

The phenomenon of phytotoxicity can appear on young plants, following treatments carried out with some herbicide products. Climatic conditions can contribute to intensifying the phenomena, but usually they last only a few days, after which the sunflower plants continue their normal growth and development.

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