RESEARCHES REGARDING THE MEASURES APPLIED FOR REDUCING THE WEEDS INFESTATION AT SEED HEMP CROPS UNDER THE CONDITION OF CENTRAL OF MOLDOVA

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Abstract

The hemp is one of the crops susceptible at weed infestation, weed appearance in the first vegetations phenophases lead at compromising the crop. Chemical intervention through herbicide application represents one method to control the weed appearance and spreading over the seed hemp crop. In this moment for seed hemp crop there is a limited range of approved herbicides. At A.R.D.S. Secuieni Neamț, for controling the weeds from seed hemp crop were experimentated a series of herbicides with different active substance to assess the product selectivity for the crop plant and efficacy under the climatic conditions of the years 2018 - 2019. During two years, the weeds identified from hemp crop was composed from 13 species, 11 from *Dicotyledonate* class and two from *Monocotyledonate* class. From *Dicotyledonate* class, the weed species which recorded the highest average density were *Atriplex patula* with 21.50 specimens /sqm and *Polygonum persicaria* with 15.05 specimens/sqm. *Setaria glauca*, the most representative species from *Monocotyledons* class recorded an average density of 5.88 specimens/sqm. By the weeds number/sqm, the species from *Dicotyledonate* class register a 89.20% share meaning a average density of 53.59 specimens/sqm and from the *Monocotyledons* class belong 6.49 specimens/sqm representing a share of 10.80% from the all the specimens identified. From all the 12 herbicides experimentated, two were applyed in preemergence and the rest of herbicides were applied to control the weeds after plant emergence. Regarding the hemp plant selectivity, the commercial products Lentagran 45 WP, Galera Super and Challenge 600 provoked different symptoms of phytotoxicity, but the hemp recovered after 30 days from applying the herbicides. The weeds control highest efficacy was obtained at the variant treated with Challenge 600 and it was 72%. For the herbicides Stratos Ultra, Fusilade Forte, Frontier Forte, Lontrel 300, Leopard Super și Select Super the efficacy had values between 62 and 67%.

Key words: weeds, seed hemp crop, herbicide

The competition between crops and weeds for nutritive elements, water and light in the first weeks from emergence in not favorable for seed hemp because of slow vegetation phenophase development. (Corbett *et al,* 2004; Prade T., 2011). Chemical intervention through herbicide application represents one method to control the weed appearance and spreading over the seed hemp crop. In this moment for seed hemp crop there is a limited range of approved herbicides.

Jankauskiene *et al,* (2014) study the weeds spectrum since the hemp emergence until harvesting without using any classical method to prevent weeds appearance. They found that weeds density was high in the first vegetation phenophases reaching 202 specimens/sqm, the climatic condition characterized by high temperatures and moderate rainfall contributed to the increase weeds appearance. Researchers identify 31 weeds species, the most frequent were register at plant emergence. Thereby in 2010 the most numerous species was *Chenopodium album L.*, in 2011 *Veronica arvensis* L. and in 2012 the species *Lamium purpureum L.*, *Thlaspi arvense L*., *Veronica arvensis* and *Poa annua L.*

The results obtained by Jankauskienė *et al,* (2015) support the important influence of hemp sowed at high seed density over the plant density at plant emergence and at harvesting and also that rainy periods are favorable to crops development and for weeds appearance too. The rainy periods are favorable to crops and weeds, the weeds average density varied depending on seed density from 166 specimens/sqm at variants sowed with 45 kg/ha to 140 specimens /sqm at 70 kg/ha.

In this paper are presented the results obtained within a seed hemp experience for establish the efficacy of some herbicides in the prevention and control of weeds, crop selectivity and influence on seed production.

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The data presented in this paper are the results of the observations and determinations made in the years 2018 and 2019 within the complex project PN III - P1 - 1.2 - PCCDI - 2017 - 0566 "Complex system of integral valorisation of some agricultural species with energy and food potential".

MATERIAL AND METHOD

The research was carried out at A.R.D.S SECUIENI - NEAMȚ between the years 2018 and 2019, the experience was located in the experimental field of the Plant Protection Laboratory, on a typical cambic chernozem soil, with pH in water 6.29, humus content 2.3, nitrogen index 2.1, P_2O_5 mobile 39 ppm, K_2O 161ppm. The experience was placed in the experimental field following the randomized blocks method in three repetitions. The variety used was Zenit created at SCDA Secuieni. Pre-plants were wheat (2018) and sunflower (2019). Soil works, fertilization, germination bed preparation work were performed according to the framework technology for cultivating hemp for seed (Trotuș et al, 1992, 2008, 2011, 2015).

The seed hemp was sowed in the optimum time, in the first decade of April. Immediately after sowing, pre-emergent herbicides were applied and the herbicides experienced in post-emergence were applied in the phenophases corresponding to the crop plants and weeds (*Table* 1).

From plant emergence to harvesting, maintenance work was carried out on specific crops of seed hemp, observations and determinations were made regarding the efficacy and selectivity of the herbicides experienced. The data obtained were statistically processed according to the method of analysis of variance, the effectiveness of herbicides was calculated using the Abott formula and the selectivity was evaluated according to the EWRS scale with grades from 1 to 9, in which 1 represents an unaffected plant and 9 affected plant as a percentage of 80 - 100%.

The climatic conditions recorded during the two years were very varied, the two years were characterized as thermally warm and under the rainfall aspect the first year (2017/2018) was characterized as normal and the second (2018/ 2019) as dry.

Regarding the recorded temperatures, in 2018, the months of April and May were hot compared to the same period of 2019 when the recorded temperatures were similar to the multiannual average (*figure 1*).

The distribution of precipitations during the vegetation period of the hemp was irregular, the precipitations being insignificant in April (14.8 mm) and May (23.4 mm) of 2018 compared to the same period of 2019 when in April and May it was recorded 38 mm and 95 mm respectively (*figure 2*).

Under the conditions of 2018, the germination of the seeds, the emergence and growth of the plants was slowed down, and the weed growth was quite staggered, their density was lower compared to the one registered in the years with normal precipitation and the weeds were more resistant to herbicides action.

Although the highest amounts of rainfall fell at the end of June in 2018, causing a late weeds appearance, the situation of 2019 with the more uniform distribution of rainfall in May and in the first decade of June caused a late weed appearance and plants who showed symptoms of phytotoxicity recovered after 30 days .

Therefore, the two very different climatic years influenced the weed appearance, the emergence of the crop, the crop selectivity and the effectiveness of the herbicides.

RESULTS AND DISCUSSIONS

During the two years the weeds identified match to 13 species of monocotyledonous and dicotyledonous weeds belonging to 10 botanical families.

The highest average density was recorded by *Atriplex patula* species of 21.52 specimens/sqm, and *Polygonum persicaria* of 15.05 specimens/sqm, and the lowest by the species *Cirsium arvense* - 0.17 specimens/sqm, *Sonchus arvensis* - 0.33 specimens/sqm and *Echinochloa crus - galli* - 0.61 specimens/sqm (*Table 2*).

According to the number of species divided by taxonomic classes, the 11 species of *Dicotyledonous* weeds have a weight of 84.62% of the total and the *Monocotyledons* - 15.38% (*figure 3*).

According to the number of weeds, the highest weight belongs to the class of *Dicotyledonate*, which represents 89.20% of the total collected specimens/sqm totaling 53.59 specimens/sqm. *Monocotyledonous* weed species recorded a weight of 10.80% with an average density of 6.49 specimens/sqm (*figure 4*).

Analyzing the weight of the weed species belonging to the *Dicotyledonata* class, we find that the species: *Atriplex patula* L. (40.16%), *Polygonum persicaria* L (28.08%) and *Galinsoga parviflora* Cav. (19.78%) have the highest values and the lowest share had the species *Cirsium arvense* (0.32%) and *Sonchus arvensis* (0.62%). The rest of the species identified *Abutilon theophrasti* Medik., *Amaranthus retroflexus* L., *Brassica rapae* L., *Convolvulus arvensis*, *Solanum nigrum* L., *Taraxanum officinale* L. recorded values between 1.23% and 2.80% (*figure 5*).

Table 1

Herbicides experienced at seed hemp crops between 2018-2019 at A.R.D.S. SECUIENI Neamț

No	Experimental variant (Commercial product)	Dose l/ha p.c.	Active substance	Application time	Weeds
1	Dual Gold (std.)	1.5	S-metolaclor 960 g/l	Preemergent	Monocotyledonous and some dicotyledonous weeds
2	Dual Gold – Stratos Ultra	1.5 – 2.0	S-metolaclor 960 g/l – cicloxidim 100 g/l	Pre-emergent - postemergent	Annual and perennial weeds grasses
3	Dual Gold – Fusilade Forte	1.5 – 2.0	S-metolaclor 960 g/l - fluazifop-p-butil 150 g/l	Pre-emergent - postemergent	Annual and perennial grass weeds
4	Dual Gold - Frontier	1.5 – 1.4	S-metolaclor 960 g/l - S-dimetenamid 720 g/l	Pre-emergent - postemergent	Annual monocotyledonous weeds and some annual dicotyledonous weeds
5	Dual Gold - Lontrel	1.5 – 0.3	S-metolaclor 960 g/l - clopiralid 300 g/l	Pre-emergent - postemergent	Dicotyledonous weeds
6	Dual Gold - Lontrel	1.5 – 0.5	S-metolaclor 960 g/l - clopiralid 300 g/l	Pre-emergent - postemergent	Dicotyledonous weeds
7	Dual Gold - Leopard Super	1.5 – 1.5	S-metolaclor 960 g/l - quizalofop-p-etil 5 g/l	Pre-emergent - postemergent	Monocotyledonous weeds
8	Dual Gold – Select Super	1.5 – 1.5	S-metolaclor 960 g/l – cletodim 120 g/l	Pre-emergent - postemergent	Monocotyledonous weeds
9	Dual Gold - Galera Super	1.5 – 0.25	S-metolaclor 960 g/l - aminopiralid 40g/l + clopiralid 240 g/l + picloram 80 g/l	Pre-emergent - postemergent	Dicotyledonous weeds
10	Dual Gold – Lentagran	1.5 – 2.0	S-metolaclor 960 g/l – piridat 450g/l kg	Pre-emergent - postemergent	Dicotyledonous weeds
11	Challenge	3.0	Aclonifen 600 g/l	Pre-emergent	The dicotyledonous and monocotyledonous weeds
12	Challenge	2.5	Aclonifen 600g/l	Postemergent	The dicotyledonous and monocotyledonous weeds

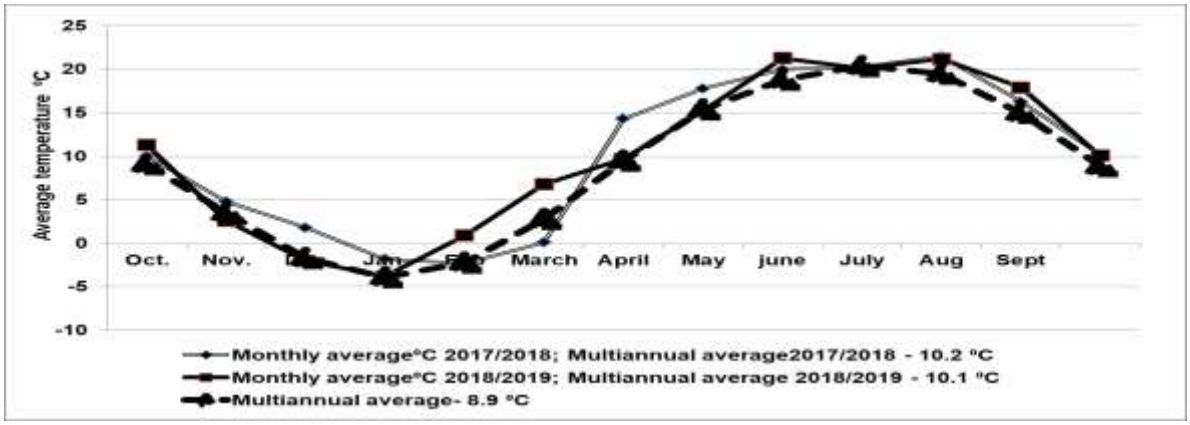

Figure 1 **The temperatures recorded at Secuieni - Neamț in the period 2018-2019**

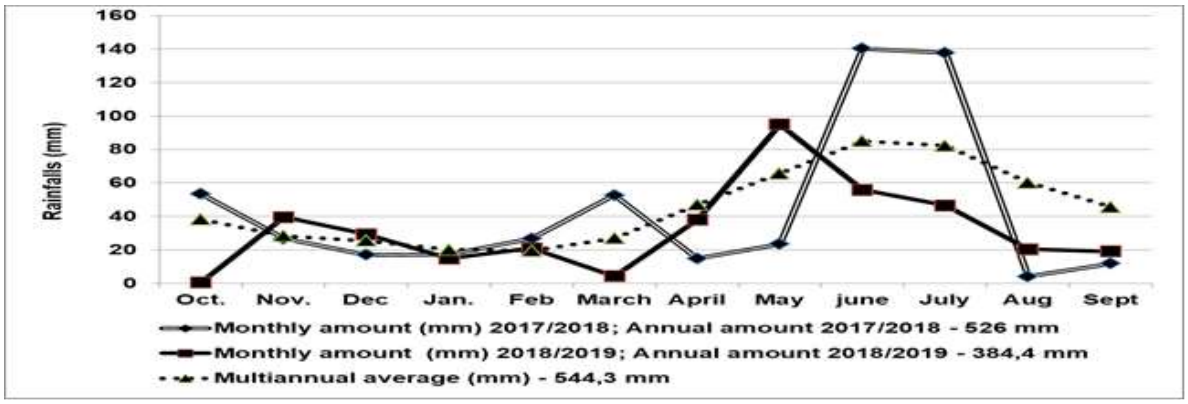

Figure 2 **Precipitation recorded at Secuieni - Neamț in the period 2018-2019**

Table 2

Weeds register at seed hemp crops located in the conditions of the Center of Moldova, Secuieni 2018 -2019

No	Species	Class	Family	Weeds density /sqm		
				Maxim	Minim	Average
1	*Abutilon theophrasti* Medik.	*Dicotyledonous*	*Malvaceae*	1.50	1.00	0.66
2	*Amaranthus retroflexus* L.	*Dicotyledonous*	*Amaranthaceae*	1.00	1.00	1.00
3	*Atriplex patula* L.	*Dicotyledonous*	*Chenopodiaceae*	59.00	1.00	21.52
4	*Brassica rapae* L.	*Dicotyledonous*	*Cruciferae*	2.00	1.00	1.50
5	*Cirsium arvense* L.	*Dicotyledonous*	*Asteraceae*	5.00	1.00	0.17
6	*Convolvulus arvensis* L.	*dicotyledonous*	*Convolvulaceae*	2.50	1.00	0.95
7	*Galinsoga parviflora* Cav.	*Dicotyledonous*	*Compositae*	32.00	2.00	10.60
8	*Polygonum persicaria* L.	*Dicotyledonous*	*Polygonaceae*	1.50	1.00	15.05
9	*Sonchus arvensis* L.	*Dicotyledonous*	*Compositae*	1.00	1.00	0.33
10	*Solanum nigrum* L.	*Dicotyledonous*	*Solanaceae*	3.50	1.50	0.81
11	*Taraxacum officinale* L.	*Dicotyledonous*	*Asteraceae*	1.00	1.00	1.00
12	*Echinochloa crus – galli* L.	*Monocotyledonous*	*Gramineae*	8.00	1.00	0.61
13	*Setaria glauca* L.	*Monocotyledonous*	*Gramineae*	53.00	1.00	5.88
Total	13	*Dicotyledonous:* 11 *Monocotyledonous:* 2	9 1	171.00	14.50	60.08

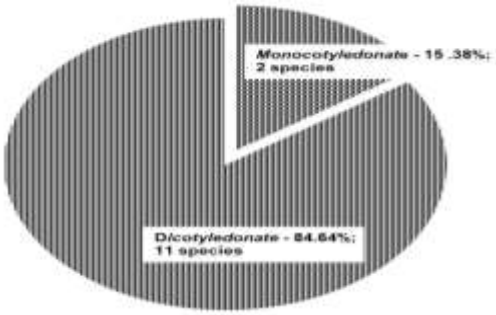

Figure 3 **Share of classes by number of species**

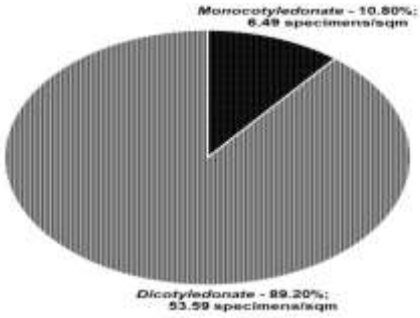

Figure 4 **Share of classes by number specimens /sqm**

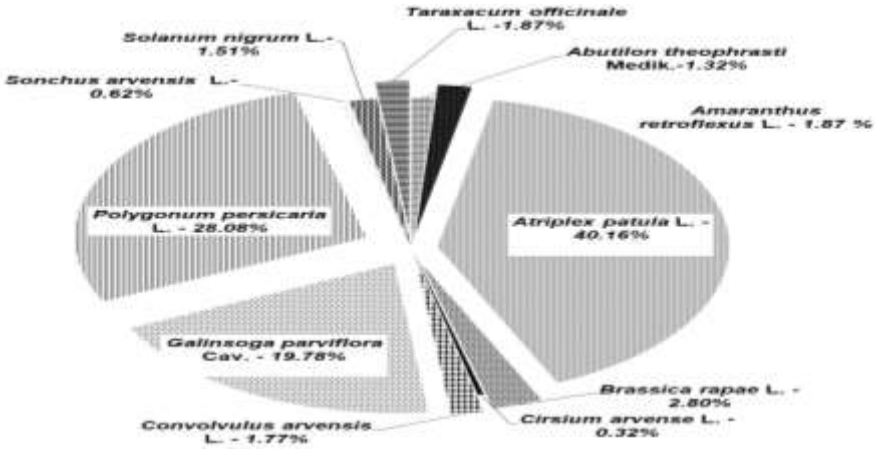

Figure 5 ***Dicotyledonate* class share of weeds species**

Of the 12 herbicides experienced, two were applied in pre-emergence - Dual Gold - 1.5 l / ha, which can use standard and Challenge 600 3.0 l / ha, and the rest in post-emergence.

The commercial products Lentagran 45 WP, Galera Super and Challenge 600 have caused various symptoms of phytotoxicity (leaf emboli, basal leaf necrosis, plant growth slow down) and the crop plant recovers after approximately 30 days from the application of herbicides (*Table* 3). The efficacy of herbicides applied in pre-emergence ranged from 48% (Dual Gold) to 72% (Challenge 600).

The herbicides Stratos Ultra, Fusilade Forte, Frontier Forte, Lontrel 300, Leopard Super and Select Super have efficacy values ranging from 62% to 67% (*table* 3).

The production of hemp was 558 kg / ha in the non-herbicide control and between 997 kg / ha and 1225 kg / ha in the herbicide variants, between the herbicide variants and the non-herbicide control, there were very significant production differences (*table 4*).

Table 3

Pre-emergent and postemergent herbicides efficacy applied to combat weeds from seed hemp crops, Secuieni-Neamț 2018-2019

No.	Experimental variant (Commercial product)	Dose l/ha c.p.	Active substance	Application time	Efficacy %	Selectivity EWRS Scale
1	Control	-	-	-	-	-
2	Dual Gold (std.)	1.5	S-metolaclor 960 g/l	Preemergent	48	1
3	Dual Gold – Stratos Ultra	1.5 – 2.0	S-metolaclor 960 g/l – cicloxidim 100 g/l	Pre-emergent - postemergent	65	1
4	Dual Gold – Fusilade Forte	1.5 – 2.0	S-metolaclor 960 g/l - fluazifop-p-butil 150 g/l	Pre-emergent - postemergent	67	1
5	Dual Gold - Frontier	1.5 – 1.4	S-metolaclor 960 g/l - S-dimetenamid 720 g/l	Pre-emergent - postemergent	62	1
6	Dual Gold - Lontrel	1.5 – 0.3	S-metolaclor 960 g/l - clopiralid 300 g/l	Pre-emergent - postemergent	67	1
7	Dual Gold - Lontrel	1.5 – 0.5	S-metolaclor 960 g/l - clopiralid 300 g/l	Pre-emergent - postemergent	65	1
8	Dual Gold – Leopard Super	1.5 – 1.5	S-metolaclor 960 g/l - quizalofop-p-etil 5 g/l	Pre-emergent - postemergent	67	1
9	Dual Gold – Select Super	1.5 – 1.5	S-metolaclor 960 g/l – cletodim 120 g/l	Pre-emergent - postemergent	62	1
10	Dual Gold – Galera Super	1.5 – 0.25	S-metolaclor 960 g/l - aminopiralid 40g/l + clopiralid 240 g/l + picloram 80 g/l	Pre-emergent - postemergent	72	3
11	Dual Gold – Lentagran	1.5 – 2.0	S-metolaclor 960 g/l – piridat 450g/l kg	Pre-emergent - postemergent	92	3
12	Challenge	3.0	Aclonifen 600 g/l	Pre-emergent	72	1
13	Challenge	2.5	Aclonifen 600g/l	Postemergent	86	6

Table 4

The influence of some herbicides applied for weed control on the production of seed hemp at A.R.D.S. SECUIENI, NEAMȚ, 2018-2019

No.	Experimental variant (Commercial product)	Dose l/ha c.p.	Application time	Seed production kg/ha	% compared to control	Diff. control kg/ha	Signif.	Diff. std. kg/ha	Signif. std.
1	Control	-	-	558	mt	Mt	mt	-439	000
2	Dual Gold(std.)	1.5	Preemergent	997	179	439	***	std	-
3	Dual Gold – Stratos Ultra	1.5 – 2.0	Pre-emergent - postemergent	1155	207	597	***	158	***
4	Dual Gold – Fusilade Forte	1.5 – 2.0	Pre-emergent - postemergent	1023	183	465	***	26	
5	Dual Gold - Frontier	1.5 – 1.4	Pre-emergent - postemergent	1068	191	510	***	71	**
6	Dual Gold - Lontrel	1.5 – 0.3	Pre-emergent - postemergent	1126	202	568	***	129	***
7	Dual Gold - Lontrel	1.5 – 0.5	Pre-emergent - postemergent	1225	220	667	***	228	***
8	Dual Gold - Leopard Super	1.5 – 1.5	Pre-emergent - postemergent	1080	194	522	***	83	***
9	Dual Gold – Select Super	1.5 – 1.5	Pre-emergent - postemergent	1007	180	449	***	10	
10	Dual Gold - Galera Super	1.5 – 0.25	Pre-emergent - postemergent	1037	185	479	***	40	
11	Dual Gold – Lentagran	1.5 – 2.0	Pre-emergent - postemergent	825	148	267	***	-172	ooo
12	Challenge	3.0	Pre-emergent	1008	181	450	***	11	
13	Challenge	2.5	Postemergent	622	111	64	**	-375	ooo
			DL 5%	40.9 kg/ha					
			DL 1%	55.6 kg/ha					
			DL 0.1%	74.5 kg/ha					

CONCLUSIONS

The weeds identified from the seed hemp culture totaled 13 species belonging to 10 botanical families.

According to the number of species, the 11 *Dicotyledonous* weed species account for 84.62% of the total and the *Monocotyledons* 15.38%.

According to the number of weeds, the highest share belongs to the class of *Dicotyledons* that participate with 89.20%, and *Monocotyledons* -10.80%.

The species *Atriplex patula* L. (40.16%), *Polygonum persicaria* L. (28.08%) and *Galinsoga parviflora* Cav. (19.78%) belonging to the *Dicotyledonata* class had the highest weights and the lowest were recorded at the species *Cirsium arvense* L. (0.32%) and *Sonchus arvense* L. (0.62%).

The commercial products Lentagran 45 WP, Galera Super and Challenge 600 have caused various symptoms of phytotoxicity (leaf emboli, basal leaf necrosis, plant growth slowdown) and the crop plant recovers after approximately 30 days from the application of herbicides.

The efficacy of herbicides applied in pre-emergence ranged from 48% (Dual Gold) to 72% (Challenge 600).

The herbicides Stratos Ultra, Fusilade Forte, Frontier Forte, Lontrel 300, Leopard Super and Select Super have efficacy values ranging from 62% to 67%.

The production of hemp was 558 kg / ha in the non-herbicide control and between 997 kg / ha and 1225 kg / ha in the herbicide variants, between the herbicide variants and the non-herbicide control, there were very significant production differences.

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