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RESEARCH REGARDING THE INFLUENCE OF SOME HERBICIDES ON THE STRUCTURE OF SEGETAL FLORA AND NODOSITIES IN CHICKPEAS CULTURE, AT A.R.D.S. TELEORMAN

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Abstract

Chickpeas are a small plant with slow growth rates, the passage of phenophases falls within time intervals, which can be influenced by soil and climate conditions. The research took place in the years 2019-2020, at A.R.D.S. Teleorman, being studied the combinations and associations of herbicides applied to chickpea culture. The experiment was placed on a fertile chernozem vertric soil with good fertility (more than 3,1% humus, clay content more than 42% on the horizon 0-24 cm, pH-> 5.9), using the Burnas chickpea variety. The forerunner was autumn wheat. Chickpea plants are very easily competed by weeds within the first days of emergence. The influence of weeding in the first 2-3 weeks after emergence has an influence on production even if the culture can be kept clean later on. To achieve good effectiveness in weed control in chickpeas culture, herbicides must be applied correctly taking into account their mechanism of action and control spectrum. Biometric determinations performed on nodes highlight the difference in bacterialization between the experimental variants and productivity elements of the chickpea plant.

Key words*: chickpeas, Cicer arietinum L., herbicides, weeds, control, efficacy, nodulation.*

INTRODUCTION

Chickpeas (*Cicer arietinum* L.) is one of the most resistant species of legumes for drought and heat grains, withstanding high heat and strong insolation during fertilization and fruiting, it can be successfully grown in areas with arid climates, where beans and soybeans do not give satisfactory results without water supply through irrigation.

Chickpeas are a sustainable crop, grown on medium, fertile soil with residual moisture, which may not be suitable for other legumes and grains, but is very sensitive to alkaline soils (Fisher and Goldworthy, 1984).

In Romania's conditions, grain legumes find very favorable conditions.

Chickpeas compete poorly with weeds due to their slow growth rate, especially in the early stages of vegetation, and the lack of weed control techniques can produce production losses between 40-87%, it is generally cultivated on slopes, on soils without excess moisture, in areas with lower rainfall (Solh and Pala, 1990).

Increased chickpea production may depend on the proper use of moisture, nutrients, light and sowing density of chickpeas, in the absence of competition with weeds.

The results are corroborated with data supported by (Arya, 2004) and (Patel et. al., 2006).

Simultaneous and rapid growth of weeds in chickpea culture, lead to severe competition for light, moisture, space and nutrients, which leads to a drastic reduction in yield. Production losses ranged from 40 to 94% (Bhan and Kukula, 1987).

The best control of weeds in chickpeas was obtained by applying pendimethalin and trifluralin (Hassan et. al., 1995).

In subsequent studies, (Vaishya et. al., 1999) reported 41-44% loss in chickpeas by increasing weeding.

There is an urgent need to identify more effective herbicides with a broad spectrum of weed control and increased adaptability in chickpea culture (Singh and Sharma 2013).

The reduction of chickpea yield due to the presence of weeds in chickpea culture, in

proportion of 75% was also observed by Chaudhary et. al., 2005.
Chickpeas form nodules, roots that support the biological fixation of N (BNF) and host symbiotic bacteria that fix N. These findings suggest that variety selection can improve (PNF) with a wide variety of symbionts, leading to higher yields, higher protein content and/or more residual N for subsequent crops (Rita Abi-Ghanem et al., 2012) .
The findings reveal a unique opportunity to improve N-fixation by cross-breeding and genetic selection. Nitrogen (N) is the most limited nutrient in crops worldwide. N industrially produced has grown in recent years and is not available in many regions of the world. Biological fixation of N by rhizobic bacteria is a large underutilized resource that this study aims to maximize (Rita Abi-Ghanem et al., 2011).

MATERIALS AND METHODS

The research took place in the years 2019-2020, at A.R.D.S. Teleorman, being studied the combinations and associations of herbicides applied to chickpea culture. The experiment was placed on a fertile chernozem vertric soil with good fertility (more than 3.1% humus, clay content more than 42% on the horizon 0-24 cm, pH > 5.9), using the Burnas chickpea variety. The forerunner was autumn wheat.
The location of the experiment was done according to the method of randomized blocks, with a plot area of 25 m^2, in four repetitions.
The sowing density is provided for 40-46 plants/m^2, the distance between rows 50 cm, the sowing depth 4-5 cm.
In terms of water, in 2019 chickpeas benefited from 376.6 mm of rainfall over the entire vegetation period, with 76.6 mm more than the crop's requirements for humidity, but their distribution was unfavorable to the chickpea culture. Thus, in the first part of the vegetation period the precipitations were quantitatively higher than the multiannual average with (+27.2 mm) in April, (+48.1 mm) in May and (+99.3 mm) in June.
In 2020, there were small excesses of precipitation in May (7.8 mm) and June (11.6 mm), and in April a deficit (21.8 mm), compared to the multiannual averages of the area (Figure 1).

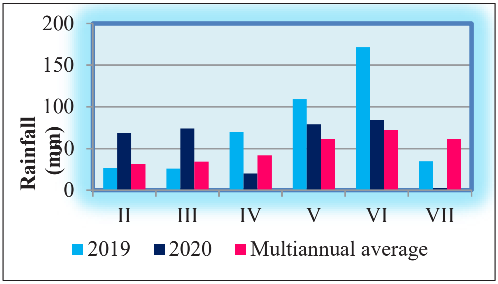

Figure 1. The evolution of precipitations A.R.D.S. Teleorman, 2019-2020.

In July, it can be said that the total drought installed, only 2.8 mm of rainfall was recorded, the rainfall being practically absent, the deficit of the month being (58.6 mm).
The productions made in 2020 for chickpeas were slightly affected by the water deficit, from the first part of the vegetation period (April), and favored by the moderate surpluses of precipitation during the period of intense growth and formation of the elements of productivity May-June (Figure 2).

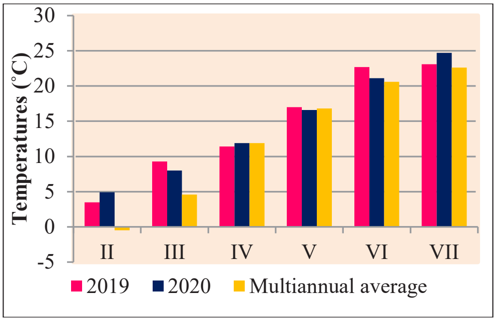

Figure 2. Temperature evolution at A.R D.S. Teleorman, 2019-2020

Chickpeas are a small plant with slow growth rates, the passage of phenophases falls in time intervals, which can be influenced by soil and climate conditions.
Chickpea plants are very easily competed by weeds in the first days of emergence. The influence of weeding in the first 2-3 weeks after emergence is very much felt on the production even if later the crop can be kept clean. Weed control by mechanical plowing between rows can be done, but it requires a lot of labor to weed the weeds by hand.
All these factors can be eliminated by using herbicides and herbicide combinations.

Chemical weed control is an important program and the following key issues need to be considered:

- Knowledge of the dominant weed species that influence the chickpea culture;
- Knowledge of the mechanism of action of herbicides and their control spectrum;
- The most appropriate application technique and the maximum effect in weed control.

In the conditions of our country, weed infestation differs from one area to another (Anghel et al., 1972).

From the determinations performed in the experiment with herbicides at the resort in the two years, it is found a permanent presence of both groups of monocotyledonous and dicotyledonous weeds (Figures 1 and 2).

Due to the fact that in most variants a mixed flora predominates, the application of a single herbicide does not solve the problem of weeds, so satisfactorily that it may require weeding and plowing.

In order to achieve a good effectiveness in controlling chickpea weeds, it is necessary that the herbicides presented in (Table 1) are applied correctly taking into account their mechanism of action, control spectrum and predominant species that occur frequently in the area.

Table 1. Experimental variants in chickpea culture. ARDS Teleorman, 2019-2020

Nr. variant	Active substance content	Dose g.s.a./ha	Herbicide treatment	Age of application
V1	Unprepared	-	Control - untreated	-
V2	2 mechanical plows	-	Untreated control 2 mechanical plows	-
V3	50g/l quizalofop-p-ethyl Isoxaflutole 240 g/l Cyprosulfamide (safener): 240 g/l	1.2 l/ha 0.15 l/ha	Leopard 50EC + Merlin Flex	Postem. Postem.
V4	960 g/l S-metolachlor isoxaflutole 240 g/l Cyprosulfamide (safener): 240 4g/l	1.5 l/ha 0.20 l/ha	Dual Gold 960EC+ Merlin Flex	Preem. Preem.
V5	960 g/l S-metolachlor isoxaflutole 240 g/l Cyprosulfamide (safener): 240 g/l	1.2 l/ha 0.30 l/ha	Dual Gold 960 EC + Merlin Flex	Preem. Preem.
V6	312.5 g/lS-metolachlor 187.5 g/l terbuthylazine	4.0 l/ha	Gardoprim Plus Gold 500 SC	Preem.
V7	312.5 g/lS-metolachlor 187.5 g/l terbuthylazine Isoxaflutole 240 g/l Ciprosulfamide (safener): 240 g/l	4.0 l/ha 0.20 l/ha	Gardoprim Plus Gold 500 SC + Merlin Flex	Preem. Preem.
V8	312.5 g/lS-metolachlor 187.5 g/l terbuthylazine isoxaflutole 240 g/l Ciprosulfamide (safener): 240 g/l	4.0 l/ha 0.30 l/ha	Gardoprim Plus Gold 500 SC + Merlin Flex	Preem Preem
V9	312.5 g/lS-metolachlor 187.5 g/l terbuthylazine pyridate 450 g/kg	4.0 l/ha 1.0 l/ha 1.0 l/ha	Gardoprim Plus Gold 500 SC + Lentagran+ Lentagran	Preem. Post. I Post. II
V10	960 g/l S-metolachlor aclonifen	1.5 l/ha 2.5 l/ha	Dual Gold 960EC + Challenge 600 SC	Preem. Preem.
V11	960 g/l S-metolachlor 40 gr/l imazamox	1.5 l/ha 0.7 l/ha	Dual Gold 960EC+ Pulsar 40	Preem. Post.
V12	960 g/l S-metolachlor metribuzin 700 g/kg	1.5 l/ha 0.3 l/ha	Dual Gold 960EC + Sencor 600 SC	Preem. Preem.

RESULTS AND DISCUSSIONS

If climatic conditions do not allow effective control of weeds in pre-emergence (drought, drafts or inadequately prepared ground, etc.), weed control may be used in post-emergence (V3). With a very good selectivity for the crop plant, without affecting the following crops Table 1.

The effectiveness of herbicide combinations, with pre-emergence application gives results, if the soil is very well prepared, uniform and with an optimal degree of humidity from precipitation. This effectiveness is when about 8-12 mm of precipitation falls, within 8-11 days of application.

The control of diseases and pests in chickpeas culture is an important technological factor, and non-compliance with the conditions of application of phytosanitary treatments can significantly reduce chickpea production.

In the first phases of vegetation of the culture, the emergence of monocotyledonous and dicotyledonous weeds, annual and perennial, can affect to a very large degree the evolution of the culture, both at emergence and in the growth and development stages (Figure 3).

The advances in chemistry are remarkable in terms of herbicides in recent decades.

During the study years, the density, dominance and frequency of weed species in chickpea culture were influenced by the pedoclimatic conditions: the amount of precipitation, their distribution, the recorded temperatures. The frequency of weed species was established by the number of plants/m^2, for each calendar year.

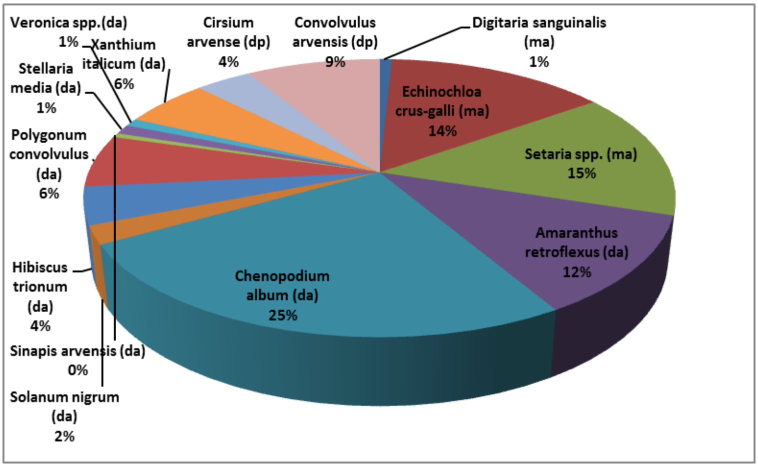

Figure 3. Weed participation in chickpea culture. A.R.D.S. Teleorman, 2019

The most outstanding combined treatments, with average efficacy values, in pre-emergence and early post-emergence, post-emergence, (50 g/l quizalofop-p-ethyl isoxaflutole 240 g/l Cyprosulfamide (safener): 240 g/l (V3); 960 g/l l S-metolachlor isoxaflutole 240 g/l Ciprosulfamide (safener): 240 g/l (V5); 312.5 g/l S-metolachlor 187.5 g/l terbutylazine isoxaflutole 240 g/l Ciprosulfamide (safener): 240 g/l (V8)) .

In soils with a higher level of infestation, in the conditions of practicing integrated control measures, I recommend applying the treatment together with at least one mechanical plow.

Characteristic of each calendar year, the most representative weed species were annual monocotyledons (Figure 4): *Avena fatua, Echinochloa crus-galli, Setaria* spp., and annual dicotyledons: *Amaranthus retroflexus, Chenopodium album, Chenopodium polyspermum, Hibiscus trionum, Polygonum convolvulus, Sinapis arvensis, Stellaria media, Veronica* spp., *Xanthium italicum,* as well as perennials*: Cirsium arvense, Convolvulus arvensis, Sonchus arvensis.*

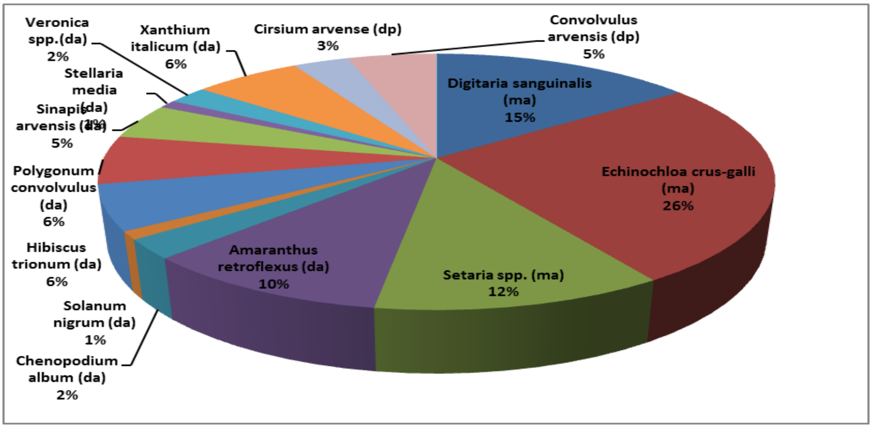

Figure 4. Weed participation in chickpea culture. A.R.D.S. Teleorman, 2020

At the full maturity of the chickpea plants, five typical plants were harvested for biometric determinations and analysis of productivity elements in the laboratory, from each variant, in order to characterize them, in the climatic conditions of the two agricultural years 2019-2020, and the effectiveness of herbicide combinations. The working method was performed by counting and determinations performed in the field, and laboratory analyzes, which were manually processed, centralized, electronically recorded and calculated statistically, being summarized in Table 2.

The height of the plant has as limits of variation 54-69 cm, in 2019 and 62-79 cm, in 2020 with an average character of 67.5 cm. The insertion height of the first pod has an average of 29.2 cm, with variation limits between 29-35 cm in 2019 and 30-36 cm in 2020.

The number of pods formed per plant was between 10-42.8 in 2020, with an average of 27 pods per plant. The total number of grains formed on the pod has an average of 0.92, being between the minimum limits of 0.06 and the maximum of 1.05.

Table 2. Influence of herbicides on the main elements of productivity in chickpea cultivation. A.R.D.S. Teleorman, 2019-2020

No.	Productivity elements of the chickpea plant at harvest											
	The height of the plant		The height of the first pod (cm)		Grain weight/plant (g)		Number of pods/plant		Number grain/pods (g)		TGW (g)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
V1	54	62	29	36	10	13	12	13.5	0.90	1.00	202	279
V2	69	71	27	32	28	36	31	35.2	1.02	1.03	232	265
V3	67	70	27	31	24	38	30	33.5	1.01	1.03	275	320
V4	69	79	26	32	21	32	25	28.0	1.00	1.01	274	300
V5	79	75	27	35	23	31	23	30.4	1.01	1.02	244	285
V6	63	77	24	31	16	29	18	25.0	1.00	1.00	275	288
V7	67	79	23	30	20	37	23	26.1	1.00	1.01	252	297
V8	69	72	24	31	27	40	35	42.8	1.03	1.04	231	301
V9	68	72	26	33	24	33	22	26.6	1.03	1.05	315	335
V10	68	71	26	30	23	34	23	28.2	1.01	1.04	311	325
V11	41	53	35	28	10	15	4	10.0	0.06	0.08	200	203
V12	60	65	23	34	17	29	19	25.3	1.00	1.00	278	311
Average	64.5	70.5	26.4	31.9	20.2	30.5	22.0	27.0	0.90	0.90	257	292

Thousand grain weight (TWG) values varied depending on the climatic conditions of the two experimental years. In 2019, the highest TWG of (315 g) was registered in the variant (V9).

In 2020, distinctly significant increases were recorded by V9 and V10 (335 g and 325 g, respectively).

The weight of the grains per plant has the variation limits between minimum 10 g in 2019 and maximum 40.5 g in 2020, the average being 26.2 g/pl.

The number of pods that showed a fruit caterpillar attack (*Helicoverpa armigera*) was absent (value 0) in the studied variety, Burnas.

When analyzing the productions made in 2020, the highest were obtained by the V8 variant (2010 kg/ha), the V3 variant (1950 kg/ha) and the V7 variant (1880 kg/ha), with very significant production increases, statistically ensured of 1447 kg/ha, 1387 kg/ha and 1316 kg/ha, compared to the untreated, untreated control (Figure 5).

At harvest, the production realized on variants was registered, statistically calculating the limit differences and the significance of the harvest increase brought by each herbicide and herbicide combination/experimental variant.

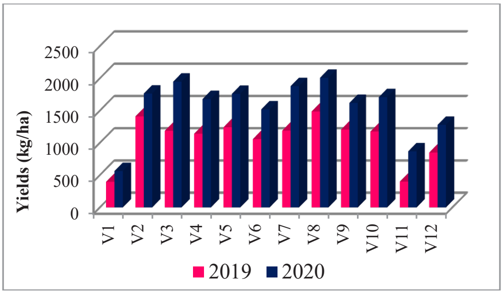

Figure 5. Yields of chickpea cultivation. A.R.D.S. Teleorman, 2019-2020

Table 3. Biometric values of chickpea nodules depending on the treatments applied. A.R.D.S. Teleorman, 2019-2020

No. field	Experimental variant	Volumetry (g/pl în 100 ml water) Frequency of plants with nodules %	Average number of nodules / plant	Of which				Weight of nodules (g/pl.)	
				main root	secundary roots	active nodules	volume for 100 ml water %	green	dry
A. DETERMINATIONS PERFORMED AT 50 DAYS									
Average 2019/2020									
V1	Control - untreated	0.01	4.0	1.0	3.0	4.0	0.1	0.16	0.03
V2	Untreated control 2 mechanical plows	0.20	15.0	13.7	1.7	11.0	0.20	1.13	0.19
V3	Leopard 50EC + Merlin Flex	0.01	9.6	8.3	1.3	9.6	0.05	0.53	0.10
V4	Dual Gold 960EC+ Merlin Flex	0.02	8.6	6.3	2.3	5.6	0.01	0.21	0.02
V5	Dual Gold 960 EC + Merlin Flex	0.05	10.4	9.0	1.4	9.0	0.05	0.38	0.03
V6	Gardoprim Plus Gold 500 SC	0.10	12.0	12.0	-	12.0	0.10	0.59	0.07
V7	Gardoprim Plus Gold 500 SC + Merlin Flex	0.05	10.3	8.3	2.0	8.3	0.05	0.29	0.05
V8	Gardoprim Plus Gold 500 SC + Merlin Flex	0.03	10.0	5.0	5.0	8.0	0.05	0.31	0.05
V9	Gardoprim Plus Gold 500 SC +Lentagran+ Lentagran	0.08	10.0	9.0	1.0	10.0	0.01	0.11	0.02
V10	Dual Gold 960EC + Challenge 600 SC	0.09	12.0	9.3	2.7	12.0	0.01	0.35	0.06
V11	Dual Gold 960EC+ Pulsar 40	0.01	8.0	6.0	2.0	8.0	0.20	0.06	0.01
V12	Dual Gold 960EC + Sencor 600 SC	0.02	11.3	7.0	4.3	9.0	0.01	0.43	0.09

Table 4. Biometric values of chickpea nodules depending on the treatments applied. A.R.D.S. Teleorman, 2019-2020

No. field	Experimental variant	Volumetry (g/pl în 100 ml water) Frequency of plants with nodules %	Average number of nodules / plant	Of which				Weight of nodules (g/pl.)	
				main root	secundary roots	active nodules	volume for 100 ml water %	green	dry
B. DETERMINATIONS MADE AT FLOWERING									
Average 2019/2020									
V1	Control - untreated	0.05	6.3	6.3	-	-	0.05	0.230	0.030
V2	Untreated control 2 mechanical plows	0.01	8.0	6.0	2.0	-	0.01	0.659	0.161
V3	Leopard 50EC + Merlin Flex	0.02	4.5	4.3	0.2	-	0.02	0.593	0.110
V4	Dual Gold 960EC+ Merlin Flex	0.01	4.6	4.6	-	-	0.01	0.291	0.050
V5	Dual Gold 960 EC + Merlin Flex	0.01	4.0	4.0	-	-	0.01	0.114	0.016
V6	Gardoprim Plus Gold 500 SC	0.01	5.0	6.0	-	-	0.01	0.256	0.040
V7	Gardoprim Plus Gold 500 SC + Merlin Flex	0.01	4.0	4.0	-	-	0.02	0.236	0.046
V8	Gardoprim Plus Gold 500 SC + Merlin Flex	0.02	3.6	3.6	-	-	0.01	0.142	0.019
V9	Gardoprim Plus Gold 500 SC+Lentagran+ Lentagran	0.05	6.3	6.3	-	-	0.05	0.787	0.166
V10	Dual Gold 960EC + Challenge 600 SC	0.07	7.3	6.6	0.7	-	0.01	1.186	0.239
V11	Dual Gold 960EC+ Pulsar 40	0	1.5	1.5	-	-	0	0.070	0.009
V12	Dual Gold 960EC + Sencor 600 SC	0.01	3.6	3.3	0.3	-	0.01	0.347	0.068

The results of the determinations regarding the number of nodules (average over the two years) at the two growth phases are presented in Table 3 and Table 4. From the analysis of the obtained data, it is found that the chickpea plant forms nodules with naturalized bacteria existing in the soil, the number of nodules/plant highlights the differentiation of the number of nodules and their weight depending on the experimental variants used in weed control.

The number of nodules was maximum in the control variant (two mechanical plows), respectively, 15 nodules per plant compared to other experimental variants, and 12 nodules per plant in variant V6 and variant V10. The lowest number of nodules was recorded at V11, V4, V5, V7 and V8, respectively. Analyzing the average number of nodules per plant outlines the idea of a phytotoxic, attenuating and inhibiting effect in herbicide combinations, in which isoxaflutole is present, at a dose of 0.300 l/kg with pre-emergent application. In V3, a similar effect is found, even under conditions of dose reduction and early post-emergence application.

The influence of isoxaflutole on the decrease of the weeding degree is evident in all variants, with the specification that at the used doses the process of biological fixation of (N) is inhibited in certain percentages.

The realized productions kept obvious differentiations considering the fertilization based on (N), the dose applied to the preparation of the germination bed. In the variant with obvious phytotoxic effect on chickpea plants (V11), the use of imazamox reduces the number of nodules per plant, given that the degree of weeding is higher and influences the level of production. These determinations will be repeated, in the 3 year of experimentation, anticipating the deregulation of the biological fixation process of (N), as an indicator regarding their degree of selectivity for the chickpea plant.

From a phenotypic point of view, the selectivity was marked with 1, in the associations with isoxaflutole, which will be completed with the criteria on the influence on the biological fixation process.

From the point of view of the weight of the nodules, these observations are confirmed, and they will be observed in the 3 year of experimentation.

Most nodules are found on the main root, and a small percentage is located on the secondary ones (%).

In choosing the weed control strategy, apart from efficacy and selectivity, the effect of compatibility with the process of fixing (N) for chickpea culture will also be followed.

CONCLUSIONS

The results obtained in the studied variants highlight the favorable effect of herbicides and herbicide combinations, in pre-emergence and some in post-emergence on the elements of chickpea productivity, materialized by harvest increases at (V8), (V5), (V9), (V7) and (V3), compared to the two controls, in the years studied. The production of grains does not correlate positively with bacterization, the highest production being recorded in the non-bacterialized version.

Determinations of nodule formation on the main and secondary roots of chickpea plants, by the total number of nodules per plant and the number of active nodules 50 days after application of the herbicide, show that atmospheric nitrogen (N) fixation differs depending on the dose and the combination of treatment, having high physiological indices only, to certain substances and combinations of herbicides.

A good ability to fix atmospheric nitrogen can be determined, first of all, not by the total number of nodules, but by their total mass and the longevity of the symbiosis, expressed in the active bacterialization process in chickpeas culture.

The use of chemicals in chickpeas to control weeds can also affect the metabolic activity of plants through its phytotoxic effect and can therefore reduce grain production if the doses used are not observed.

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