Features of growing chickpea in the foothill zone of the Kabardino-Balkarian Republic

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Abstract. In the foothill zone of the Kabardino-Balkarian Republic in 2013-2015, studies were carried out in order to study the effect of growth regulators and rhizotorfin on the formation of elements of the structure of the chickpea crop. The objects of research were the varieties of chickpeas "Golden Jubilee" and "Privo 1". The background for testing biological preparations was pre-sowing inoculation of seeds with rhizotorphin based on nitrogen-fixing bacteria and their treatment with microelements (P120K60MoV). The following drugs were used: Albit, Alfastim, Potassium / sodium humate with microelements. The use of growth regulators and rhizotorfin has a positive effect on field germination, the duration of the growing season and the yield of chickpea. The analysis of the data in our studies showed that the cultivation of the chickpea variety "Golden Jubilee" in the foothill zone of the Kabardino-Balkarian Republic is more profitable.

1 Introduction

Of all cultivated agricultural crops, the most high-protein crops are legumes - peas, soybeans, lentils, chickpeas. They affect soil fertility, reduce the use of mineral nitrogen fertilizers, and contribute to the production of environmentally friendly products.

The cultivation of various grain legumes makes it possible to increase their production in years of different moisture availability due to bioclimatic interaction. The introduction of new crops into crop rotation that are suitable for growing in the foothill zone of the Kabardino-Balkarian Republic is a promising direction. Chickpea is one such crop.

Chickpeas, mutton peas (Cicer arietinum L.) are the most drought tolerant legume crops that are resistant to lodging, disease and pest damage, to which other legumes are susceptible. Chickpea seeds contain thiamine (B1), riboflavin (B2), adermin (B6), retinol (A), vitamin PP1, E; trace elements: cobalt (Co), copper (Cu), iron (Fe), ascorbic acid and lecithin. 1 centner of chickpea seeds contains 1.22 centners of feed units, 0.19 centners of digestible protein. When introduced into the diet of animals, chickpeas significantly exceed the digestibility of other feeds rich in carbohydrates.

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Peas are considered the main source of vegetable protein in the conditions of the Kabardino-Balkarian Republic. This culture is hygrophilous, to a large extent damaged by pests and diseases, besides, peas lodge a lot, so harvesting it is difficult.

For the climatic conditions of the Kabardino-Balkarian Republic, chickpea can represent a worthy alternative to peas among leguminous crops, which is highly resistant to drought, lodging and damage by diseases and pests.

In terms of nutritional value and economic activity, chickpeas are not inferior to peas, and chickpea seeds are distinguished by a high content of essential amino acids in protein. In terms of biological composition, chickpea protein is closer to animal protein, since chickpea protein contains all the essential amino acids.

However, despite all the advantages, this leguminous crop has not yet been cultivated in the Kabardino-Balkarian Republic. The main reason is the lack of cultivation technologies adapted to local conditions, and a properly selected variety. According to foreign researchers Kurhade, N.G C.A.Deshpande, K.T. Nagre (1994), the selection of a suitable variety is of great importance in the cultivation of chickpea. In the course of our research, the main problems were insufficient information about the studied crop, a small amount of pesticides registered for use on chickpea crops.

2 Materials and methods

In the conditions of the foothill zone of the Kabardino-Balkarian Republic on the territory of the educational and experimental field of the FSBEI HE “Kabardino-Balkarian State Agrarian University named after V.M. Kokov ”in 2013-2015, the experimental part of the research was carried out.

The purpose of the research is the development of effective technological methods for the cultivation of chickpea in the conditions of the foothill zone of Kabardino-Balkaria.

Research objectives:

– to study the agrobiological features and productivity of chickpea varieties in the conditions of the foothill zone of the Kabardino-Balkarian Republic;

– to study the influence of growth regulators on the formation of elements of the structure of the harvest of chickpea in the conditions of the foothill zone of the Kabardino-Balkarian Republic;

– to determine the economic efficiency of technological methods for growing chickpeas in the conditions of the foothill zone of the Kabardino-Balkarian Republic.

Field experiments were laid according to the scheme:

1. Control (water)
2. FON - (Rizotorfin and their processing with microelements (P120K60MoV)
3. FON + Albit;
4. FON + Alfastim;
5. FON + Potassium / sodium humate with trace elements.

The background for testing biological preparations was pre-sowing inoculation of seeds with rhizotorphin based on nitrogen-fixing bacteria Mesorhizobium ciceri (strain 527) and their treatment with microelements (P120K60MoV).

The objects of the study were chickpea varieties of domestic selection "Golden Jubilee" and "Privo 1". The studied drugs were used in the following dosages: Albit - 40 ml / t, Alfastim - 10 L / t, Potassium / sodium humate with microelements - 0.5 L / t. The area of the accounting plot is 25 square meters, the replication is four times, the placement of variants is randomized. The chickpeas were sown by an ordinary sowing method with a row spacing of 15 cm and a seeding rate of 650 thousand germinable seeds per 1 hectare.

3 Results and discussion

One of the important ways to increase the productivity of chickpea is the treatment of seeds with biologically active substances that regulate the growth and development of plants. In agricultural production, biological products are used for: improving fruit set, accelerating ripening, increasing the yield and quality of the grown crop. The duration of the period from sowing to germination in our studies was different for the control variant, variants with the use of rhizotorfin and microelements "FON - (Inoculation + P120K60MoB)" and with the combined use of growth-regulating drugs against the background of the use of rhizotorfin and microelements (table 1).

Table 1. Influence of growth regulators on the duration of the "sowing-emergence" period in the studied varieties of chickpea (Cicer arietinum L.) for 2013-2015 research years, days

Experience Option	Years of research			The average in 3 years
	2013 year	2014 year	2015 year	
"Golden Jubilee"				
Control (water)	15	14	13	14
FON - (In. + P120K60MoV)	13	13	12	12
FON + Albit	11	12	11	11
FON + Alfastim	10	9	10	9
FON+ Potassium / sodium humate with trace elements	11	12	10	11
"Privo 1"				
Control (water)	14	13	15	14
FON - (In. + P120K60MoV)	12	13	14	13
FON + Albit	12	11	13	12
FON + Alfastim	12	9	10	10
FON+ Potassium / sodium humate with trace elements	13	11	12	12

Analysis of the data in the experiment showed that the duration of the "sowing-seedling" period in the control variant for the studied chickpea varieties "Golden Jubilee" and "Privo 1" was 14 days. on average over 3 years of research. On the variant with the use of "FON - (Inoculation + P120K60MoB)" this period was 12 days for the variety "Golden Jubilee", and 13 days for the variety "Privo 1". In variants with the combined use of growth-regulating drugs against the background of the use of rhizotorfin and microelements, this period was the shortest with the combined use of the drug Alfastim against the background of the use of rhizotorfin and microelements "FON + Alfastim", which was 9 days in the variety "Golden Jubilee", and in the variety Privo 1 - 10 days.

The period from germination to flowering according to morphophysiological and biological processes has a number of features. This is leaf formation, the formation of the apparatus of symbiotic nitrogen fixation of molecular nitrogen, the formation of generative organs and the synthesis of organic substances. This period for chickpeas is critical in terms of heat, moisture, light, because during this period one can often observe an increase in air temperature and a decrease in the moisture reserve in the soil. In our studies, the duration of the "seedling-flowering" period on average for 2013-2015 ranged from 29 to 34 days. The shortest period was in 2015, the duration was 33 days, and the longest period was in 2013 - 35 days.

Our observations showed that, on average, over 3 years of research, the duration of the "shoots-flowering" period in the control variant for the studied varieties of chickpea was 34 days for the variety "Golden Jubilee", and 32 days for the variety "Privo 1". On the variant with the use of "FON - (Inoculation + P120K60MoB)" this period was 33 days for the variety "Golden Jubilee", and 31 days for the variety "Privo 1".

On variants with the combined use of growth-regulating drugs against the background of the use of rhizotorfin and microelements, this period was the shortest with the combined use of the drug Alfastim against the background of the use of rhizotorfin and the microelements "FON + Alfastim" Privo 1 - 30 days.

The "flowering-maturation" phase is the final stage in the formation of yield, accumulation of biomass, synthesis and redistribution of protein in plant parts. During this period, a decrease in the moisture content in the vegetative organs is observed in chickpeas, the lower leaves gradually dry out, beans develop from the ovaries, the process of formation, filling and ripening of beans and seeds of chickpea is underway.

Basically, the potential yield of chickpea determines the period from germination to flowering, and the quality and quantity of the harvest of chickpea determines the period from flowering to ripening. The length of the flowering-ripening period may depend on the weather and the variety. Higher air temperatures and low rainfall can lead to a shorter flowering to ripening period, while an increase in flowering to ripening occurs with frequent precipitation. At the same time, the yield and quality of seeds decreases, and the weight of 1000 seeds decreases.

In our studies, the duration of the "flowering-ripening" period varied depending on the treatment option for chickpea seeds and meteorological conditions during the years of research.

On average, over three years of research, the duration of the "flowering-ripening" period in the control variant for the studied varieties of chickpea was 53 days for the variety "Golden Jubilee", and 52 days for the variety "Privo 1".

On the variant with the use of "FON - (Inoculation + P120K60MoB)" this period was 52 days for the variety "Golden Jubilee", and 51 days for the variety "Privo 1".In variants with the combined use of growth-regulating drugs against the background of the use of rhizotorfin and microelements, this period was the shortest with the combined use of the drug Alfastim against the background of the use of rhizotorfin and microelements "FON + Alfastim", which was 49 days for the variety "Golden Jubilee", and for the variety Privo 1 - 50 days.

In the conditions of the foothill zone of the Kabardino-Balkarian Republic, the length of the growing season is very important. In our studies, the length of the growing season for all variants largely varied depending on the variant with the treatment with growth regulators and on the weather conditions that were in the years of the research (Table 2).

Table 2. Influence of growth regulators on the duration of the growing season studied varieties of chickpea, days

Experience Option	Years of research			The average in 3 years
	2013 year	2014 year	2015 year	
"Golden Jubilee"				
Control (water)	90	87	84	87
FON - (In. + P120K60MoV)	86	85	83	84
FON + Albit	85	83	81	83
FON + Alfastim	80	78	77	78
FON+ Potassium / sodium humate with trace elements	86	85	81	84
"Privo 1"				
Control (water)	85	85	82	84
FON - (In. + P120K60MoV)	84	81	81	82
FON + Albit	85	83	80	82
FON + Alfastim	82	80	80	80
FON+ Potassium / sodium humate with trace elements	80	82	82	81

On average, for 2013-2015 years of research, the duration of the period "seedlings-full ripeness" in the control variant in the studied varieties of chickpea (Cicer arietinum L.) was: in the variety "Golden Jubilee" 87 days, and in the variety "Privo 1" 84 days ...

On the variant with the use of "FON - (Inoculation + P120K60MoB)" this period was 85 days for the variety "Golden Jubilee", and 82 days for the variety "Privo 1".

In variants with the combined use of growth-regulating drugs against the background of the use of rhizotorfin and microelements, this period was the shortest with the combined use of the drug Alfastim against the background of the use of rhizotorfin and the microelements "FON + Alfastim", which was 78 days for the variety "Golden Jubilee", and grades "Privo 1" - 80 days.

Our experimental studies carried out in 2013-2015. it was found that the combined use of growth regulators against the background of the use of rhizotorfin and microelements has a significant effect on the completeness of seedlings. Over the years of research, the average value of field germination in the control variant for the "Golden Jubilee" variety was 88.3%, and for the "Privo 1" variety - 86.5%.

On the variant with the use of "FON - (Inoculation + P120K60MoB)", the field germination capacity was 90.5% for the variety "Golden Jubilee", and 89.7% for the variety "Privo 1". On the variants with the combined use of growth-regulating drugs against the background of the use of rhizotorfin and microelements, the highest field germination was with the combined use of the drug Alfastim against the background of the use of rhizotorfin

and the microelements "FON + Alfastim" and was 94.2% for the variety "Golden Jubilee", and grades "Privo 1" - 92.1%.

The indicators of plant safety for harvesting had a small scatter of values for the options. The safety of chickpea plants for harvesting in the control variant was 87.2% for the Zolotoy Yubilei variety, and 85.7% for the Privo 1 variety.

On the variant with the use of "FON - (Inoculation + P120K60MoV)" the safety of chickpea plants for harvesting was 87.5% in the Zolotoy Yubilei variety, and 85.9% in the Privo 1 variety.

In variants with the combined use of growth-regulating drugs against the background of the use of rhizotorfin and microelements, the maximum safety of chickpea plants for harvesting was noted with the combined use of the drug Alfastim against the background of the use of rhizotorfin and the microelements "FON + Alfastim" and was 88.4% in the variety "Golden Jubilee" , and the variety "Privo 1" - 87.4%.

By biological characteristics, chickpeas are a more technologically advanced crop when cultivated in comparison with other cereals and legumes. Chickpeas do not lie down, when they ripen, the beans do not crack, they ripen together, so it is possible to cultivate chickpeas using a set of machines. But a more laborious and responsible stage in the process of growing chickpeas is harvesting. Harvesting at the optimum time reduces crop loss.

Chickpeas have strong, non-sticking stems and this facilitates mechanized harvesting. But this crop is mainly cultivated in areas where wet years change with very dry years, which affects the total plant height and the attachment height of the lower pod.

In our experiments, in the studied chickpea varieties, the plant height and attachment height of the lower beans changed depending on the weather conditions that developed during the years of research and on the biological characteristics of the varieties.

For the rapid growth of plants, the presence of moisture and nutrients in the soil, the optimum temperature of the soil and air are necessary. But if during the growth of chickpea plants, the "Shoots - flowering" phase, high air temperature and little precipitation, the plants remain low in growth, and the setting of beans occurs at a low height. If the attachment height of the lower beans is less than 30 centimeters, then this makes mechanized harvesting very difficult, thereby placing special demands on the harvesters to provide a low cut.

The studies carried out showed that the height of the plants and the height of the attachment of the lower pod varied depending on the variants of the experiment. The variants with joint treatment with Alfastim against the background of the use of rhizotorfin and microelements "FON + Alfastim" turned out to be the tallest. Plants in the variety "Golden Jubilee" were on average 8.5 cm higher than in the control variant. All variants where the joint processing of rhizotorfin and microelements was studied, as well as the joint treatment with growth regulators against the background of the use of rhizotorfin and microelements, exceeded the control in this indicator. The height of plants in the control variant averaged 40.0 cm for the variety "Golden Jubilee" and 39.2 cm for the cultivar "Privo 1".

The main thing for chickpeas is not the overall height of the plants, but the attachment height of the lower pod, because the quality of the harvest depends on this. In our experiments on the variants with the maximum attachment height of the lower bean was the variant with joint treatment with Alfastim against the background of the use of rhizotorfin and microelements "FON + Alfastim" and averaged 36.3 cm for the variety "Golden Jubilee" and for the variety "Privo 1 "- 32.7 cm.

The analysis of the conducted studies showed that in our experiments the number of beans per plant varied depending on the application of growth regulators (table 3).

Table 3. Influence of growth regulators on the number of beans and seeds per plant in the studied chickpea varieties (on average for 2013-2015 years of research)

Chickpea variety (Cicer arietinum L.)	Option	The number of beans per plant, pcs.	The number of grains per plant, pcs.
"Golden Jubilee"	Control (water)	16,6	19,9
	FON - (In. + P120K60MoV)	17,9	21,3
	FON + Albit	18,5	21,7
	FON + Alfastim	21,7	25,0
	FON + Potassium / sodium humate with trace elements	18,2	21,5
"Privo 1"	Control (water)	15,8	18,6
	FON - (In. + P120K60MoV)	16,7	19,1
	FON + Albit	17,2	19,7
	FON + Alfastim	20,0	22,5
	FON + Potassium / sodium humate with trace elements	17,0	19,6

So, on average for 2013-2015 years of research on variants with joint treatment with Alfastim against the background of the use of rhizotorfin and microelements "FON + Alfastim", both varieties produced more beans. Plants formed the least number of beans in the control variant.

The number of grains per plant has a positive correlation with plant productivity and the number of beans. This indicator largely depends on the meteorological conditions prevailing during the growing season of chickpea and on the biological characteristics of the variety.

The analysis of the conducted studies showed that the number of grains per plant in all variants depended both on meteorological conditions and on seed treatment with growth regulators. The number of grains per plant depended on the number of set beans per plant. Unlike other legumes, chickpeas have one in one bean, rarely two. More grains per plant in our experiments were formed on variants with joint treatment with Alfastim against the background of the use of rhizotorfin and microelements "FON + Alfastim" - 25.0 and 22.5, respectively, and less on the variant with control. In our experiments, the number of grains in a bean on the studied variants changed insignificantly depending on meteorological conditions and treatment with growth regulators, and basically one bean contained 1 grain.

According to researchers, the weight of 1000 seeds is 70 - 80% determined by the characteristics of the genetics of the plant variety. However, large seeds do not always indicate high yields. The size of the seeds is a very important biological trait, which today determines the cost of chickpea seeds. Compared to small-seeded and medium-seeded varieties, large-seeded chickpea varieties are in increased demand on the world market.

Depending on weather conditions during the growing season of chickpea, the weight of 1000 seeds may change. With the maximum moisture supply, with a sufficient supply of nutrients and good care of plants during the setting and filling of grain, the mass of 1000 seeds reaches the maximum value for a given variety and affects the yield. The mass of 1000 seeds is not very dependent on the rest of the structure of the crop.

In our studies, the formation of the mass of 1000 seeds varied depending on the use of growth regulators against the background of rhizotorfin and microelements (Table 4).

Table 4. Influence of growth regulators on the formation of 1000 grain mass in the studied chickpea varieties during the years of research

Option	Years			The average in 3 years
	2013	2014	2015	
"Golden Jubilee"				
Control (water)	263,7	264,8	263,5	264,0
FON - (In. + P120K60MoV)	265,1	265,6	264,9	265,2
FON + Albit	266,0	266,3	265,1	265,8
FON + Alfastim	268,6	269,0	267,9	268,5
FON + Potassium / sodium humate with trace elements	264,6	266,1	265,5	265,4
"Privo 1"				
Control (water)	245,2	245,8	243,7	244,9
FON - (In. + P120K60MoV)	264,3	246,6	245,4	246,1
FON + Albit	247,0	247,7	245,1	246,6
FON + Alfastim	249,2	251,4	248,5	249,7
FON + Potassium / sodium humate with trace elements	247,1	247,5	244,3	246,3

On average, over the years of research, the maximum weight of 1000 seeds could be observed in the variant with combined treatment with Alfastim against the background of the use of rhizotorfin and microelements "FON + Alfastim" - 268.5 grams for the variety "Golden Jubilee" and 249.7 for the variety "Privo 1 ". The smallest value was noted in the control - 264.0 and 244.9 grams, respectively.

The main role in increasing the yield of leguminous crops is played by high agricultural technology and plant breeding. Agrotechnical (tillage, crop rotation, sowing terms and rates) method of increasing the yield of chickpea allows you to accumulate and use rationally the moisture reserves in the soil. The breeding method of increasing the yield of chickpea allows the creation and use of drought-resistant early maturing varieties that are able to withstand drought.

The analysis of our studies showed that the yield varied within significant limits in different years and according to options (table 5).

Table 5. Influence of growth regulators on grain yield in the studied chickpea varieties during the years of research, c / ha

Option	Years			The average in 3 years
	2013	2014	2015	
"Golden Jubilee"				
Control (water)	16,8	17,1	16,2	16,7
FON - (In. + P120K60MoV)	18,5	18,9	17,2	18,2
FON + Albit	19,2	21,0	18,9	19,7
FON + Alfastim	25,4	26,6	24,5	25,5
FON + Potassium / sodium humate with trace elements	19,0	21,2	18,3	19,5
"Privo 1"				
Control (water)	14,3	14,9	14,0	14,4
FON - (In. + P120K60MoV)	15,7	16,4	15,3	15,8
FON + Albit	16,8	17,0	15,7	16,5
FON + Alfastim	19,6	20,2	17,8	19,2
FON + Potassium / sodium humate with trace elements	16,2	16,8	15,3	16,1

On average, for three years of research, treatment with growth regulators against the background of the use of rhizorfin and microelements provided a significant increase in yield for the options. The largest yield increase was obtained on variants with joint treatment with Alfastim against the background of the use of rhizotorfin and microelements "FON + Alfastim" - 25.5 c / ha for the variety "Golden Jubilee" and 19.2 c / ha for the variety "Privo 1". The smallest value was noted in the control - 16.7 and 14.4 c / ha, respectively.

The energy value of the grain harvest of agricultural crops largely depends on the conditions of crop cultivation. In chickpea, the chemical composition of the grain depends on the weather conditions during the growing season, the biological characteristics of the variety and on the location of the seeds along the stem. In our studies, grain analyzes carried out showed that the variants with the use of growth regulators exceeded the control variant in terms of protein content. The maximum increase in the yield of chickpea was given by variants with the joint treatment of seeds with growth regulators against the background of the use of rhizotorfin and microelements. In our experiments, it was found that in the control variant, the protein content in the chickpea grain (Cicer arietinum L.) averaged 25.3% for the Zolotoy Yubiley variety, and 26.1% for the Privo 1 variety. The highest protein content was observed in variants with joint treatment with Alfastim against the background of the use of rhizotorfin and microelements "FON + Alfastim" and was 28.9% in the variety "Golden Jubilee", and in the variety "Privo 1" - 27.8%.

4 Conclusion

Based on the studies carried out in the conditions of the foothill zone of the Kabardino-Balkarian Republic in 2013-2015, it can be concluded that:

1. On average, for 2013-2015 years of research, the duration of the period "shoots-full ripeness" was the shortest with the combined use of the drug Alfastim against the background of the use of rhizotorfin and microelements "FON + Alfastim", which was 78 days for the variety "Golden Jubilee". , and the variety "Privo 1" - 80 days.

2. In the variants with the combined use of growth-regulating drugs against the background of the use of rhizotorfin and microelements, the highest field germination was also with the combined use of the drug Alfastim against the background of the use of rhizotorfin and the microelements "FON + Alfastim" and was 94.2% in the variety "Golden Jubilee" , and the variety "Privo 1" - 92.1%.

3. The largest yield increase was obtained on variants with joint treatment with Alfastim against the background of the use of rhizotorfin and microelements "FON + Alfastim" - 25.5 c / ha for the variety "Golden Jubilee" and 19.2 c / ha for the variety "Privo 1" ... The smallest value was noted in the control - 16.7 and 14.4 c / ha, respectively.

4. Cultivation of the chickpea variety (Cicer arietinum L.) "Golden Jubilee" in the foothill zone of the Kabardino-Balkarian Republic is more profitable in terms of economic indicators. It is necessary to sow early (April 15) in an ordinary way with a seeding rate of 650 thousand germinable seeds per hectare using the Alfastim drug against the background of the use of rhizotorfin and microelements "FON + Alfastim". The level of profitability was 395.2%, net income per hectare - 95650 rubles.

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