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Agrobiological Assessment of Varieties and Some Methods of Growing Garlic in the Forest-steppe Zone of the Republic of Ingushetia

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Abstract

Increasing production and improving the quality of garlic products is an important production problem. Under the conditions of the vertical zonality of the North Caucasus with varying agroecological conditions, the yield of this crop largely depends on the technology of cultivation and the level of its intensity. Important factors determining the yield and quality of garlic products are varieties adapted to these agro-climatic conditions, quality planting material, cultivation technology that meets the requirements of the crop and the agro-climatic conditions of the region. Currently, the potential productivity of the varieties used in the republic is realized only by 30-40 percent. This is due to the insufficient development of technologies for their cultivation, taking into account the specific environmental conditions of the region. In this regard, research aimed at studying the basic laws of the formation of yield and product quality varieties of garlic is a pressing issue.

Keywords: garlic, fertilizers, planting schemes, variety, planting material, vegetation.

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1. Introduction

Garlic is one of the oldest vegetable crops. The homeland of garlic - the mountainous and submontane areas of Central Asia. Cultivated garlic (Allium sativum L.) belongs to the genus of onions (Allium L) of the lily family (Liliaceae Hall). The type of cultural garlic is divided into two subspecies: bolting and common (nonbolting). Garlic in the annual culture multiplies in the perennial bulbils. The root system of garlic is underdeveloped, fibrous, most of which are located in the upper soil layer at a depth of 25--35 cm [5, 6, 9].

For the cultivation of garlic is needed fertile, processed to a depth of 25--30 cm, with a neutral reaction of the soil solution (pH 6.1--7.0), well-fertilized soil.

Depending on the agro-climatic conditions of the cultivation of garlic, various norms and schemes of fertilizer application, agricultural methods and planting schemes are used [5, 12]. Until recently, garlic in our country was grown in small plots in farms and individual gardens. Only with the transition to a large farm, some agricultural enterprises began to allocate areas of several hectares for sowing garlic [6, 9].

An important feature of garlic is a weak adaptation to new agro-climatic conditions. In connection with which the varieties and growing technologies that have shown themselves well in one growing area, brought to another agro-climatic zone do not adapt well and do not give the desired result [3, 7, 11, 13].

For successful cultivation of garlic, varieties adapted to these agro-climatic conditions, high-quality planting material and its pre-sowing preparation, cultivation technology that meets the requirements of the crop and agro-climatic conditions of the cultivation region are important [9, 13].

The direction of research focuses on the study of agrobiological characteristics of the tested varieties and the development of elements of the adaptive technology of garlic cultivation. In the agro-climatic conditions of the Republic of Ingushetia, such studies have not conducted, so the solution to this issue will be quite relevant.

1.1. Goal of researches

Give an agrobiological assessment of the tested varieties and the improvement of the elements of the technology of growing garlic in the forest-steppe zone of the Republic of Ingushetia.

1.2. Research tasks

1. To give a comparative description of winter and spring varieties of garlic in the agro-climatic conditions of the forest-steppe zone of the Republic of Ingushetia.

2. To study the effect of growth promoters and micronutrients on growth, development and yield of garlic.

3. To study different schemes for planting winter garlic and identify the most optimal for the region;

4. To study the dependence of yield on various combinations and time of mineral fertilizers application.

5. Determine the optimal time for planting winter garlic in the forest-steppe zone of the Republic of Ingushetia.

6. To study the efficiency of removal of scapes of winter bolting garlic, variety Yubileyny Gribovsky.

1.3. The scheme of experiments

Experiment 1. Comparative characteristics of three winter and five spring varieties of garlic in the forest-steppe zone of the Republic of Ingushetia.

Experiment 2. Influence of growth promoters and micronutrients on growth, development and yield of spring garlic, Chinese spring variety.

Experiment 3. Study of different planting schemes for the growth, development and productivity of winter garlic varieties Yubileyny Gribovsky.

Experience variants:

1. Four-line band (30+30+30+50--8) cm;

2. Five-line (20+20+20+20+60--8) cm;

3. Three-line (60+40+40--8) cm.

Experiment 4. Establishing the dependence of yield on various combinations and time of mineral fertilizers application:

1. Application of a full dressing under the main, pre-planting cultivation N90 P100 K110;

2. The introduction of P100 under the main tillage; N90 K110 in the formation of 2--3 true leaves;

3. The introduction of P100 under the main tillage; N90 in the formation of 2--3 true leaves; K110 at the beginning of the bolting.

Experiment 5. Determination of the optimal time for planting winter garlic in the forest-steppe zone of the Republic of Ingushetia, variety Yubileyny Gribovsky:

1. 15th of October;

2. 30th of October;

3. 15th of November;

4. 30th of November.

Experiment 6. The efficiency of removal of scapes of winter bolting garlic, variety Yubileyny Gribovsky.

2. Materials and Methods

Studies were conducted in the forest-steppe zone of the Republic of Ingushetia, on the experimental field of the FSBI Ingush Agricultural Research Institute. The soil of the experimental field is leached chernozem. The thickness of the humus-accumulated horizon is 46--60 cm. For the fields, the humus content was from 4.5 to 4.9 %. The availability of P_2O_5 mobile forms is 22.5--26.0 mg/kg of soil, with potassium from 330 to 345 mg/kg. The target of research is winter and spring varieties of garlic.

Placement of variants in the experiments, randomized, plot area is 15m^2 (5×3), repeated 3 times.

In the course of the experimental work, we carried out the following observations and counts: Phenological -- planting date, the beginning of seedlings (10 %), mass shoots (75 %), the appearance of true leaves, the beginning of bolting, the beginning of opening the wrapper on inflorescences, harvesting. Biometric observations were carried out every 15 days after the emergence of mass shoots. The leaf surface area was determined by the method of A.S. Lahina. The dry matter content was determined by drying at a temperature of 105 degrees to constant weight, the number of sugars (according to Bertrand). Yield accounting was determined by weighing. Mathematical processing was carried out by the method of dispersion analysis.

2.1. Discussion of experimental data and research results

Experiment 1. Comparative characteristics of garlic varieties. Three varieties of winter garlic and five varieties of spring were tested. Winter varieties Yubileyny Gribovsky, Dagestan (local), Komsomolets. Summer varieties Ufimsky 22, Sochinsky 56, Gulliver, Abrek, Chinese spring. Planting dates are recommended for this zone: planting winter varieties on October 15, spring, April 10 [1, 4, 12].

As can be seen from Tables 1 and 2 after the emergence of the seedlings, the leaf area of the Chinese Spring variety was the highest, and by 25.06 the Spring variety Gulliver became the highest. In winter varieties, the largest growth of the leaf surface was observed in the Komsomolets variety, 317.4 m^2, and the smallest in the Yubileiny Gribovsky variety. By the end of the growing season with the death of the lower leaves of all the studied varieties, their total leaf area decreases. During the research, the

Table 1: Growth dynamics of the assimilation surface in different varieties of spring garlic, cm^2.

Date of measurement	30.04	01.05	30.05	01.06	30.06	01.07
Ufimsky 22	196.5	203.6	218.4	226.5	236.5	223.1
Sochinsky 56	201.4	211.2	221.1	238.3	242.6	237.6
Gulliver	244.2	249.3	256.2	283.7	296.4	284.8
Abrek	218.2	223.3	234.1	276.7	279.1	265.4
Chinese spring	249.3	256.1	269.5	282.3	291.2	287.1

Table 2: Growth dynamics of the assimilation surface in winter varieties of garlic, cm^2.

Date of measurement	15.04	30.04	15.05	30.05	15.06
Yubileyny Gribovsky	21.6	54.6	134.1	290.1	282.4
Dagestan (local)	21.8	72.3	183.6	311.2	293.1
Komsomolets	26.5	84.2	184.1	317.4	304.2

highest yield of bulbs was obtained from varieties of spring garlic -- Chinese spring -- 15.8 t/ha and Gulliver -- 16.2t/ha, the lowest in Sochinsky variety, 56--10.05 t/ha. In winter varieties, the highest yield was recorded for the variety Komsomolets 16.7 t/ha, and the lowest for the variety Dagestan (local) -- 13.9 t/ha.

Table 3: Ripening time and yield of different varieties of winter and spring garlic, t/ha.

Variety	Yield, t/ha	Bulb weight, gr.	Ripening time
Sochinsky 56	10.05	20.1	21.06
Ufimsky 22	11.15	22.1	27.06
Chinese spring	15.8	31.6	29.06
Gulliver	16.2	32.5	25.06
Abrek	11.2	23.4	21.06
Yubileyny Gribovsky	14.5	29.1	16.06
Dagestan (local)	13.9	27.8	22.06
Komsomolets	16.7	33.4	22.06

Experiment 2. Influence of growth promoters and microbiological fertilizers on the growth development and yield of spring garlic, Chinese spring variety.

Experience variants:

1. Control (water);

2. Epin-extra 0,03 %;

3. Zircon 0,001 %;

4. Terra Organic 0,002;

5. Terra Organic + Zircon 0,001 %.

Soaking was carried out the day before planting for 6 hours after which they were immediately treated with CMC glue and rolled in peat powder [2, 8].

Table 4: Evaluation of agronomic characters of spring garlic, depending on the planting material treatments.

Variants	Bulbils number in a bulb, pcs	Bulbil weight, gr	Bulb weight, gr	Yield, t/ha	Solid content, %	Sugar content, %
Control (water)	8	3.4	28.1	14.1	35.9	21.7
Epin-extra	9	3.9	35.1	18.45	37.4	23.8
Zircon	8	4.4	35.2	17.6	37.8	24.6
Terra Organic	8	3.6	29.2	14.6	36.6	22.4
Zircon + Terra Organic	9	4.4	38.4	18.7	38.7	24.9

The effect of pre-planting cultivation single-bulbils, as can be seen from table 4, is quite significant. The yield increase in the grown from the bulbils, treated with growth regulator Zircon + Terra Organic was 4.6 tons per hectare compared to the control. Also, the treatment of planting material with a solution of Zircon + Terra Organic accelerated the ripening of garlic for 9 days compared with the control. By the weight of one bulbil, the variant treated with Zircon + Terra Organic was distinguished. The highest content of solid content and sugar was also observed in the variants treated with Zircon and Zircon + Terra Organic.

Experiment 3. Influence of planting on the growth, development and productivity of winter garlic varieties Yubileyny Gribovsky.

The results of our studies on three different schemes of placement of garlic plants showed that the weight of leaves, the amount of wet weight of leaves and the average weight of the bulb of garlic did not have significant differences depending on the pattern of placement of garlic planting [1, 4].

Table 5: Indicators of average bulb weight, the weight of leaves and wet weight of leaves for different schemes of planting garlic in the forest-steppe zone of the Republic of Ingushetia.

Arrangement diagram	The amount of wet weight per m^2 of leaves, kg	Weight of leaves, g/dm	The average weight of one bulb, gr.
four-line	2.2--2.4	6.4	29.1
five-line	2.0-2.2	6.2	27.6
three-line	2.6--2.8	6.4	29.4

Consequently, the layout of planting garlic does not depend on the biological properties of the garlic variety, but on the agro-climatic conditions of the growing region. The largest mass of leaves and the weight of the bulb was observed on a three-line planting scheme, while the maturation period and the mass of the bulb, between the variants, did not have large differences.

Experiment 4. The dependence of yield on the time of the application of mineral fertilizers of winter garlic. Variety Yubileyny Gribovsky, the rate of fertilizer application in all variants N90P100K110.

The optimal doses of mineral fertilizers recommended for our agro-climatic zone are N90P100K110. Analysis of the results of yields and maturity of underground bulbs showed significant differences between the timing of the application of mineral fertilizers.

From the results of our research, it can be seen that the fractional application of mineral fertilizers lengthens the growing season of winter garlic plants and, accordingly, the weight of bulbs increases. The introduction of nitrogen fertilizers in early spring is the most productive, due to the reduction of fertilizer losses, by leaching and evaporation during the autumn-winter and winter-spring vegetation period. From the research results, it can be seen that the introduction of potash fertilizers separately during the beginning of bulbs loading is irrational and does not give the expected yield increase.

Table 6: Dependence of yield and ripening time on various dates of mineral fertilizer application.

Time of fertilizer application	Yield, t/ha	Ripening time
1. NPK under the main tillage	14.5	16th of June
2. PK under the main tillage of N in top dressing.	15.31	22nd of June
3. P under the main processing of N in the formation of 1--2 leaves, K at the beginning of the bolting.	14.7	22nd of June

Experiment 5. Determination of the optimal time for planting winter garlic in the forest-steppe zone of the Republic of Ingushetia.

Having studied many authors' studies on the optimal timing of planting winter garlic in agro-climatic zones similar to the forest-steppe zone of the Republic of Ingushetia, we selected four planting periods for testing.

In this experiment, mineral fertilizers were applied under the main tillage, the planting scheme was four-line (50+30+30+30).

Phenological observations revealed differences in the growth and development of the garlic plant, depending on the time of planting. The leaves of plants, planted in October,

Table 7: Determining the optimal time for planting winter garlic in the forest-steppe zone of the Republic of Ingushetia.

Planting time	15.10	30.10	15.11	30.11
Yield, t/ha	11.5	12.81	14.5	13.7
Ripening time	12.06	12.06	16.06	22.06
The average sheet leave is 03/03/2018, cm	12--14	10--11	6--8	2--4
The amount of wet weight per m^2 of leaves, kg	2.0--2.2	2.2--2.4	2.6--2.8	2.5--2.7

were frozen by 1.4--2.6 cm by spring. The leaves of the plants, planted in November, were frozen by 0.0-0.6 cm. The ripening time of winter garlic in our experiments also varied greatly from June 12 to June 22. The difference in yield, between the first planting on October 15 and the third planting on November 15, was 3.0 t/ha -- 26 %. And the difference between the first and last planting is 2.2 t/ha -- 19.13 %. Also, a significant difference was revealed in terms of the amount of wet weight per m^2 of leaves.

Thus, after analyzing the data obtained, it is possible to draw conclusions: that planting garlic in the early periods leads to a large increase in the green mass of garlic up to 14 cm in the autumn period; leaf freezing to 2.6 cm; sprouting bulbils; poor development of the root system and, as a consequence, a decrease in the yield and quality of the bulbs compared to the later planting dates of November 15 and 30.

Experiment 6. The efficiency of removal of boltings of winter bolting garlic, variety Yubileyny Gribovsky.

In the process of vegetation, after the cessation of growth and the formation of new leaves, the flower-bearing bolting begins to emerge from the sinus of the last leaf. After the start of the release of the bolting, the vegetative processes cease, the weight of the aerial part of the plant begins to decrease, yellowing and wilting of the leaves begin and the onion ripening. At the end of the bolting in the box, the bulbils develop intensively, the flowers do not develop and dry out without forming seeds.

Physiological processes in plants with distant flower-bearing boltings pass faster by 6--8 days than in plants without removal of flower spikes. In plants with distant flower spikes, leaves dry out and the roots die off also occurs 6--8 days earlier than in plants with flower spikes. In plants with flower-bearing boltings removed, the bulb weight was 38g, and the bulb weight with boltings not removed was 32g. This is explained by the fact that the root system and the bulb supply the flower-bearing bolting with nutrients by redistributing them from the bulb to the bulbs. The weight of the bulb holes was 5.5

g, the total weight of the bulb was 37.5 g, which is identical to the weight of the bulb with the flower-bearing boltings removed.

The yield of bulbs with removed peduncles was 12.2 t / ha. The yield of the bulbs without removing the flower spikes was 10.4 t/ha. The yield increase from the removal of flower spikes was 1.8 t/ha. But when leaving the flower spikes, we additionally get a healthy planting material -- bulbils. [2, 8, 10]

Consequences:

1. Comparative characteristics of the five varieties of spring garlic showed that the most productive varieties of both yield and bulb weight are Chinese spring (15.2 t/ha and 34.5 g) and Gulliver (15.5 t/ha and 34.5 g). By early ripening, the Abrek variety turned out to be the most precocious.

2. The use of growth regulators and micronutrients significantly affect the increase in the weight of bulbils, bulbs and yield in general, as well as early ripening in the direction of reducing the vegetative period. The best result was obtained by the treatment of planting material with a mixture of Terra Organic microbiological fertilizer and Zircon growth stimulator, the yield increase was 1.1 tons per hectare compared to the control, while the maturation of the crop accelerated by 9 days, which is also important.

3. In agro-climatic conditions of the Republic of Ingushetia, different planting schemes do not significantly affect the length of the vegetation period and the size of the bulb. The size of the yield affects the number of seats per unit area. Planting garlic on the five-line scheme gives the greatest yield.

4. From the results of the research, it is clear that fractional application of mineral fertilizers is the most productive. The application of nitrogen fertilizers in spring reduces fertilizer losses by leaching into the soil and evaporation, lengthens the growing season, which increases the weight of the bulb, respectively, the overall yield. The yield increase from the use of fractional fertilizer was 1.37 tons/ha compared to the control.

5. Planting garlic at an early date leads to greater growth of green mass up to 14 cm in the autumn, freezing of leaves, poor development of the root system and, as a consequence, a decrease in yield and quality of the bulbs compared to a later planting period in the first decade of November.

6. The analysis of the obtained results showed that physiological processes in plants with distant flower-bearing boltings pass by 6-8 days faster than in plants without removing flower-bearing boltings. The yield increase from the removal of flower-bearing

boltings amounted to 1.8t / ha. Thus, it can be concluded that the use of this cultural practice in the forest-steppe zone of the Republic of Ingushetia is economically beneficial and highly cost-effective.

3. Conclusion

For the agro-climatic conditions of the Republic of Ingushetia, such varieties of winter and spring garlic are promising - Gulliver, Chinese spring, Komsomolets, Dagestan (local).

The use of growth regulators in a mixture with microbiological fertilizers for the treatment of planting material significantly affects the increase in the yield of garlic and is ultimately a highly profitable method in agro-climatic conditions of the Republic of Ingushetia.

For the agro-climatic conditions of the Republic of Ingushetia, three and four-line planting schemes are the most optimal, since they allow for the maximum mechanization of planting, care and harvesting, which ultimately will increase the profitability of garlic production.

For the forest-steppe zone of the Republic of Ingushetia, fractional application of mineral fertilizers is the most productive. The introduction of phosphate and potash fertilizers for the main tillage and nitrogen fertilizer to reduce the loss of nitrogen fertilizers by leaching and evaporation increases the weight of the bulb and, accordingly, the total yield.

For the agro-climatic conditions of the forest-steppe zone of the Republic of Ingushetia, the best time for planting winter garlic is the first decade of November.

The use of such a cultural practice as the removal of flower-bearing boltings in winter bolting garlic in the conditions of the Republic of Ingushetia is economically profitable and cost-effective.

References

[1] Ailyarova, Z.G. (2008). Determining the optimal time for planting garlic. *International Conference of Young Scientists and Postgraduates ``Young Scientists to the Agro-Industrial Complex''*. Vladikavkaz: Gorsky GAU Publishing House, pp. 33--34.

[2] Grinberg, E.G., Susan, V.G. (2007). Growing winter garlic from bulbils is beneficial. *Potatoes and vegetables*, no. 5, p. 19.

[3] Litvinenko, N.V., Susan, V.G. (2007). Efficiency of winter garlic varieties. *International Conference SB RAAS ``Agrarian problems of the Northern Trans-Urals''*, pp. 191--194.

[4] Litvinenko, N.V. (2007). Term of planting winter garlic variety Nazus'', Information package of the regional scientific-practical conference of young scientists and students ``Agrarian policy at the present stage'', pp. 57--58.

[5] N.V. Litvinenko, ``Agrotechnology of winter garlic varieties Nazus'', Agrarian Bulletin of the Urals, no. 5 (41), pp. 24--25, 2007.

[6] Lukyanec, V.N. (1992). To the method of elite seed production of winter garlic, *Improving the production technology of vegetable crops in Kazakhstan*, pp. 52--55.

[7] Kotov, V.P., Xiang, Zh., Li, H.X. (2007). Some methods of growing garlic in the North-West region of the Russian Federation, *News of St. Petersburg State Agrarian University*, no. 6, pp. 15--18.

[8] Xiang, Zh., Kotov, V.P. (2007). The yield of winter garlic, depending on the planting material. *Pages of history and modern areas of research. Collection of scientific papers.* St. Peterburg, pp. 63--65.

[9] Kotov, V.P. (2006). *Garlic.* St. Petersburg.

[10] Kotov, V.P., Xiang, Zh. (2006). The impact of the removal of bolting on the yield of winter garlic. *Scientific support of the development of the agroindustrial complex in the conditions of reforming: Collection of scientific papers*. St. Petersburg, pp. 83--86.

[11] Kotov, V.P., Xiang, Zh. (2007). Selection of varieties of winter garlic for the North-West. *Journal of Potatoes and vegetables*, no. 6, p. 18.

[12] Nikulypin, V.P. (2000). Profitability of winter garlic production. *Introduction of non-traditional and rare agricultural plants. Proceedings of the 3rd International Scientific Production Conferenc*e, vol. 3, p. 8486, Penza.

[13] Nikulypin, V.P. (2006). New varieties of garlic and features of their seed production. *Breeding and seed growing*, no. 3, p. 12--13.