

The influence of growth regulators on the yield of potato tubers of seed material in the conditions of the mountainous zone of the Kabardino-Balkar Republic

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Abstract. With sufficient provision of mineral macro elements of the soil and an optimized fertilizer system, growth regulators contribute to an increase in the number of tubers laid on one bush. The use of growth regulators dampens the influence of the weather conditions of the year on the diet of plants, which contributes to the growth and development of potatoes. The complex application of growth regulators contributes to the production of leveled seed material, to increase the yield of the seed fraction twice. The effectiveness of using Agrovin Mg-Zn-B is higher than Agrovin Ca by 13%, in terms of total productivity, and in terms of seed yield by 7.8%. Agrovin Ca, in comparison with Agrovin Mg-Zn-B, has a more directed effect on increasing the mass of the tuber than on the number of tubers per plant. The complex use of Agrovin Micro 0.5l/t + Agrovin Mg-Zn-B is more suitable in seed plantation technology, and Agrovin Micro 0.5l/t + Agrovin Sa for the production of table potatoes.

1 Introduction

It is necessary to ensure maximum independence in the production of the seed fund as soon as possible, which will make it possible to implement all the tasks of ensuring the country's food security. A rapidly developing processing industry focused on the production of products that cover the needs of both citizens and the food industry, especially in the social sphere. In catering establishments of schools, hospitals, the army and other institutions, the production of potato food should be convenient and safe and provide them with ready-made food. Therefore, breeding work is aimed not only at table varieties, but also at creating special varieties for processing that would meet certain technological requirements for the production of French fries separately, chips separately, and dry puree separately. The work on the selection of varieties and hybrids suitable for processing into starch was updated.

Obtaining high and high-quality potato yields is one of the main tasks of modern potato growing. In this regard, growth regulators play a significant role [4, 8].

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A special role in solving the tasks belongs to seed production, and at the moment to the establishment of high-tech production of seed and commercial potatoes of popular domestic varieties.

The scientific novelty of this work is the development of regulations for the use of growth regulators in the technological system of growing seed potatoes in combination with microbiological chemicals in the conditions of the high-altitude zone of the Kabardino-Balkar Republic. [5].

The range of growth regulators recommended for use in potato seed production is large, but this range calls for improving both functional and technological parameters of use for cultivation conditions and varieties.

The existing recommendations on the use of growth regulators in potato production technology issued by the Agricultural University of Kazan state that "to increase the profitability of potato production, it is necessary to process the planting material with Zircon 10ml/t (10l/t working solution consumption) or its mixture with Prestige (0.75 l/t), or Maxim (0.4 l/tt), for late potato varieties. the Prestige consumption rate is at least 1L/t. During budding-the beginning of flowering, spray vegetative plants with Zircon 10ml / ha or a mixture of it with understated pesticide consumption rates (by 20-50%)" [3].

The main task in the field of developing regulations for the use of growth regulators is to increase adaptability to changing conditions of biotic and abiotic factors that could stimulate the growth and development of seed potatoes. It is important to note that high importance is attached to improving the quality parameters of the potato seed tuber and its functional characteristics.

Biological growth regulators with multifunctional physiological properties can have different phyto regulatory activity under different conditions of use and for different varieties. Therefore, our research seems to be very relevant [5].

The purpose and objectives of the research. Determination of the influence of growth regulators on the level of productivity and quality indicators of potato seed fraction tubers in the highlands of the central part of the North Caucasus.

To develop scientific recommendations on the regulation of the use of growth regulators in potato cultivation in the highlands of the Kabardino-Balkarian Republic.

The task of the study was to determine the characteristics of the growth and development of the Zhukovsky early potato variety, optimal parameters of the assimilation surface, agricultural biological, development of optimal regulations for the use of growth regulators in combination with microbiological preparations

2 Conditions and methods of research

Research work to identify the effectiveness of plant growth regulators is carried out within the framework of the plan of a comprehensive scientific and technical project in the fields of LLC "Zolskiy Potato".

Agrotechnics of growing seed potatoes in the nursery is designed to use advanced technology with the use of high-class tools and machines. In the research, elite seed tubers of domestic varieties with an average weight of 65g were used for planting. The predecessor in the crop rotation was winter barley. The planting scheme provided for the distribution of 60 thousand tubers per hectare, the planting depth was 10-15cm, when creating a ridge, its height was 18-20cm. The working area of the plot is 72 m², the accounting area is 60m²[5].

Field experiments, observations, and laboratory analyses were carried out according to generally accepted methods. Mathematical processing of yields was carried out using computer programs for statistical data processing.

During the growing season of potatoes, observations, analyses, and records were carried out in accordance with generally accepted methods. Phenological observations were carried out in accordance with the "Potato Culture Research Methodology". Cleaning is done manually. Mandatory accounting procedures are carried out for diseases: late blight, ring rot, blackleg, scab, rhizoctoniosis and viral diseases. For all varieties of the same ripening period, the level of starch content in potato tubers is determined [2].

The area of the assimilation surface was determined using a modified method of accelerated calculation of the area of the leaf surface of agricultural crops using a scanner.

Analysis of the structure of the potato crop; plant resistance to diseases and pests was evaluated before harvesting according to the "Reference scale for accounting for damage to the surface of tubers by diseases" [1, 5].

The qualitative indicators of the harvest were determined by the content of dry matter in it – starch, nitrogen, ash content, vitamin content. The yield of dry matter in tubers was determined by drying at a temperature of 105 ° C, starch – by washing and further drying the crushed mass of tubers, nitrate nitrogen – using a pH meter by an electrode method, protein – according to State Standard 134964-84. ash content – was found by tubers burned in a muffle furnace, previously well washed, dried and weighed (according to State Standard 26226-84). The yield data of the varieties were analyzed by variance on a computer [5].

The scheme of research work on the development of regulations for the use of growth regulators and microbiological preparations on potato seed plantings looked as follows.

Table 1. Technological scheme of PP application in experimental conditions, 20219-2021.

1. Control variant	water
2. Tekamin Max	Treatment (spraying) at plant height of 15-20 cm+ in the budding phase – the beginning of flowering + in the end of flowering phase
3. Agrovin Micro 0,5 l/t	Spraying tubers before planting
4. Agrovin Micro 0,5 l/t + Agrovin Ca (0,25 - 1,0 kg/ha)	Spraying tubers before planting + Budding phase
5. + Agrovin Micro 0,5 l/t Agrovin Mg-Zn-B (0,2; 0,4; 0,6)	Spraying tubers before planting + Budding phase

3 Research results

Potato productivity expresses an integral indicator of the effectiveness of the use of growth regulators. Therefore, the independent or complex use of growth regulators, the impact on the qualitative and quantitative indicators of a particular variety are of great scientific interest.

The analysis of the data in Table 2 shows that the use of the growth regulator Tekamin Max under experimental conditions by three-fold processing in certain phases of plant development gives an increase in potato productivity by an average of 18.9%.

In the variant of seed treatment three days before planting in the ground with Agrovin Micro 0.5 l / t leads to an increase in potato yield by an average of 19%.

And the combined use of two growth regulators Agrovin Micro 0.5 l / t + Agrovin Mg-Zn-B in the 5th variant allows to significantly increase the regime of mineral nutrition of potato plants by phases of development and generally increase the effectiveness of growth regulators. In the fifth variant, the yield increases by 17.4% compared to the control variant.

According to the results of his research, Petrukhin writes that "the use of bio-compost and growth regulators in a complex contributed to a more sustainable increase in potato plant productivity during the years of research [6, pp.94-100].

In our studies, with integrated use of Agrovin Micro Agrovin Mg-Zn-B, the average productivity of the Zhukovsky early variety for three years of research exceeds 31t/ha of tubers. This is 87.6% higher than the control variant.

Table 2. Yield of the early-ripening potato variety Zhukovsky early on the variants of the experiment using PP, 2019-2021.

Experience options	Yield, t/ha			
	2019	2020	2021	Average
1. Control variant	16,39	15,09	18,38	16,6
2. Tekamin Max	28,19	19,29	30,37	26,0
3. Agrovin Micro 0,5 l/t	28,89	19,78	32,49	27,2
4. Agrovin micro 0,5 l/t + Agrovin Ca (0,25 -1,0 kg/ha)	31,39	22,48	35,27	29,7
5. Agrovin micro 0,5 l/t + Agrovin Mg-Zn-B (0,2; 0,4; 0,6)	32,66	23,08	37,57	31,1
The smallest significant difference ₀₅	0,7	0,8	1,2	

It should be noted here that the increase in seed productivity was provided, first of all, by increasing the amount of seed fraction of tubers and their average increase in the weight of tubers in one bush.

Table 3 shows the indicators of the analysis of the crop structure. The processing of tubers before planting and the introduction of growth regulators on the safety of the planting rate of 45 thousand tubers per hectare according to the variants of a significant impact, the introduction of growth regulators did not affect the number of bushes preserved for harvesting. In the best fourth variant, Potato yield is determined by the following structural components - the number and mass of tubers per 1 bush, which depended on the use of growth regulators. With sufficient provision of mineral macronutrients of the soil and an optimized fertilizer system, growth regulators contribute to an increase in the number of tubers laid on one bush. In the fifth variant, the complex use of Agrovin Micro Agrovin Mg-Zn-B gives an increase in the number of tubers by an average of 8.6, which is twice as much as the control variant. At the same time, the average mass of tubers decreases by 5 g, but the mass of tubers from one bush increases by 82%.

In other variants of using growth regulators, this indicator is at the same level on average 618g/bush, which is 57% higher than the control variant. The number of bushes is 3.8% higher than the control variant.

At the same time, the number of tubers on one bush increases symmetrically with respect to the mass of tubers in the bush. The average tuber weight varied depending on the number of tubers.

In the fourth and fifth variants, the use of growth regulators allows not only to achieve an increase in the number of tubers, but also to significantly increase the proportion of the mass of the seed fraction.

Table 3. Potato crop structure depending on growth regulators

Experience options	Number of plants, thousand pcs./ha	Tuber weight, g./bush	Number of tubers, pcs./bush	Average tuber weight, g
Zhukovsky early				
1. Control variant	42,48	389,3	8,19	47,38
2. Tekamin max	43,19	602,2	12,37	48,46
3. Agrovin Micro 0,5 l/t	43,5	625,4	13,08	47,78
4. Agrovin micro 0,5 l/t + Agrovin Ca (0,25 -1,0	44,09	628,1	15,18	41,29

kg/ha)				
5. Agrovin micro 0,5 l/t + Agrovin Mg-Zn-B (0,2; 0,4; 0,6)	43,78	710,2	16,79	42,26

The amount of the optimal seed fraction of 50-80g in the fifth variant is 68.2% of the total number of tubers. This is achieved by increasing the growth rate and the number of tubers. At the same time, it is important to catch the time of mowing the tops to prevent them from overgrowing.

When using Tecamin Max and Agrovin Micro, the number of tubers and the dynamics of their mass increase are lower (Table 4). On average, there are 11% more tubers of the 30-50 fraction than in the fourth and fifth variants. At the same time, the overgrown tubers in these variants are 2 times less. Therefore, if we take the total volume of the seed fraction 30-50 and 50-80 in the control and second variants, the amount exceeds 80% of the total mass of the crop. In other variants, the food part of the crop exceeds 24%, which is undesirable for seed planting. If we take the number of tubers, the best result in the fifth option is an average of 12.8 pcs., which is 6.4 pcs. more control option. In other variants, the use of growth regulators, the average amount of seed tuber was more than 10 pieces of tubers from one bush.

The complex use of Agrovin Micro 0.5l / t + Agrovin Mg-Zn- contributes to an increase in the yield of seed material by 6.4 pcs / bush, while as a percentage in the control version its amount is 2.5% higher than this option. The average weight of tubers from one bush of the seed fraction in the fifth variant increases by 184g / bush.

The analysis of these results suggests that the complex application of growth regulators contributes in the fifth variant to obtaining leveled seed material twice as much in quantitative and qualitative aspects. At the same time, the mass of the food fraction is 2.6 times higher than the control variant and 14-18% higher when used separately. The effectiveness of using Agrovin Mg-Zn-B in the complex is higher than Agrovin Ca by 13%, in terms of total productivity, and in terms of seed yield by 7.8%.

Table 4. Crop structure in early-ripening potato varieties, on average for 2018-2021.

Experience options	Fractions by mass of tubers								Total tubers pcs
	30-50g.		50-80g.		80-120g		> 120 g.		
	t		t		t		t		
Zhukovsky early									
1. Control variant	2,69	33,19	3,68	45,29	1,49	18,1	0,29	3,47	8,2
2. Tekamin max	3,09	24,58	7,2	56,38	1,39	11,37	0,91	7,62	12,4
3. Agrovin Micro 0,5 l/t	3,08	23,28	6,71	51,40	2,58	20,29	0,71	5,1	13,1
4. Agrovin micro 0,5 l/t + Agrovin Ca (0,25 -1,0 kg/ha)	1,8	11,8	8,6	56,4	3,6	23,9	1,2	7,9	15,2
5. Agrovin micro 0,5 l/t + Agrovin Mg-Zn-B (0,2; 0,4; 0,6)	1,3	7,8	11,5	68,2	3,7	22,1	0,3	1,9	16,8

The yield of the food part is higher on the option of complex use of Agrovin Micro 0.5l / t + Agrovin Ca 475g /bush. Which, in our opinion, suggests that Agrovin Ca, in comparison with Agrovin Mg-Zn-B, has a more directed effect on increasing the mass of the tuber than on the number of tubers per plant. And in the fifth variant, there is a more uniform effect on increasing the quantitative and weight parameter of the total mass of all

tubers. Therefore, the complex use of Agrovin Micro 0.5l/t + Agrovin Mg-Zn-B is more suitable in seed plantation technology, and Agrovin Micro 0.5l/t + Agrovin Sa for the production of food potatoes.

4 Conclusion

With sufficient provision of mineral macronutrients of the soil and an optimized fertilizer system, growth regulators contribute to an increase in the number of tubers laid on one bush.

The use of growth regulators dampens the effect of unfavorable soil and climatic conditions on the nutritional regime, growth and development of potato plants.

The complex application of growth regulators contributes to the production of leveled seed material, to increase the yield of the seed fraction twice. The effectiveness of using Agrovin Mg-Zn-B in the complex is higher than Agrovin Ca by 13%, in terms of total productivity, and in terms of seed yield by 7.8%. Agrovin Ca, in comparison with Agrovin Mg-Zn-B, has a more directed effect on increasing the mass of the tuber than on the number of tubers per plant.

The complex use of Agrovin Micro 0.5l/t + Agrovin Mg-Zn-B is more suitable in seed plantation technology, and Agrovin Micro 0.5l/t + Agrovin Ca for the production of table potatoes.

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