УДК 631.871: 631.811: 633.491

4.1.1. Общее земледелие, растениеводство (сельскохозяйственные науки)

ПРИМЕНЕНИЕ РЕГУЛЯТОРОВ РОСТА В ПОВЫШЕНИИ БИОЛОГИЧЕСКОГО ПОТЕНЦИАЛА КАРТОФЕЛЯ В ЛЕСОСТЕПНОЙ ЗОНЕ ЧЕЧЕНСКОЙ РЕСПУБЛИКИ

Магомадов Анди Султанович
Чеченский государственный университет им. А.А. Кадырова, Грозный, Россия
magomadov-andi@mail.ru

Оказова Зарина Петровна
Чеченский государственный университет им. А.А. Кадырова, Грозный, Россия; Чеченский государственный педагогический университет, Грозный, Россия
okazarina73@mail.ru

Титова Лариса Анатолиевна
Чеченский государственный университет им. А.А. Кадырова, Грозный, Россия
larisa-titova-1976@mail.ru

Цель исследования – изучение возможности применения регуляторов роста в повышении биологического потенциала сортов картофеля, районированных на территории Чеченской Республики. Исследования проводились в 2024-2025 гг. в условиях лесостепной зоны Чеченской Республики, в Гудермесском районе. Использованы отечественные столовые раннеспелые сорта картофеля, районированные в Чеченской Республике Королева Анна и Гулливер. В качестве регулятора роста в опыте использован препарат на основе природных производных гуминовых веществ Гумат+7. Применение регулятора роста для предпосадочной обработки клубней способствовало значительному сокращению видового разнообразия и численности нецелевых объектов в его посадках. В ходе проведенного исследования можно установить положительное влияние на повышение конкурентоспособности предпосадочной обработки клубней картофеля 0,1% раствором регулятора роста на основе гуминовых веществ Гумат+7. Исходя из вышеизложенного, целесообразность применения регуляторов роста на основе природных гуминовых веществ Гумат+7 для предпосадочной обработки клубней картофеля не вызывает сомнений

UDC 634.8.07

4.1.1. General agriculture, plant growing (agricultural sciences)

APPLICATION OF GROWTH REGULATORS TO INCREASE THE BIOLOGICAL POTENTIAL OF POTATOES IN THE FOREST-STEPPE ZONE OF THE CHECHEN REPUBLIC

Magomadov Andi Sultanovich
Chechen State University named after. A.A. Kadyrov, Grozny, Russia
magomadov-andi@mail.ru

Okazova Zarina Petrovna
Chechen State University named after AA Kadyrov, Grozny, Russia; Chechen State Pedagogical University, Grozny, Russia
okazarina73@mail.ru

Titova Larisa Anatolyevna
Chechen State University named after. A.A. Kadyrov, Grozny, Russia
larisa-titova-1976@mail.ru

The objective of this study was to investigate the feasibility of using growth regulators to enhance the biological potential of potato varieties zoned for the Chechen Republic. The research was conducted in 2024-2025 in the forest-steppe zone of the Chechen Republic, in the Gudermes district. The early-ripening domestic table potato varieties, Queen Anna and Gulliver, zoned for the Chechen Republic, were used. A preparation based on natural humic derivatives, Humate+7, was used as a growth regulator in the experiment. The use of a growth regulator for pre-planting treatment of tubers contributed to a significant reduction in species diversity and the number of non-target species in its plantings. The study demonstrated a positive effect on the competitiveness of potato tubers treated pre-plant with a 0.1% solution of the humic-based growth regulator, Humate+7. Based on the above, the feasibility of using Humate+7, a natural humic-based growth regulator, for pre-plant treatment of potato tubers is beyond doubt

Ключевые слова: КАРТОФЕЛЬ, РЕГУЛЯТОРЫ РОСТА, ПРОДОВОЛЬСТВЕННАЯ БЕЗОПАСНОСТЬ, ЭКОЛОГИЗАЦИЯ СЕЛЬСКОХОЗЯЙСТВЕННОГО ПРОИЗВОДСТВА, УРОЖАЙНОСТЬ, КОНКУРЕНТОСПОСОБНОСТЬ

Keywords: POTATO, GROWTH REGULATORS, FOOD SECURITY, GREENING OF AGRICULTURAL PRODUCTION, PRODUCTIVITY, COMPETITIVENESS

http://dx.doi.org/10.21515/1990-4665-218-041

Introduction. Today, implementing measures to ensure food security and produce environmentally friendly agricultural products has become a priority. It is essential to fully realize the potential of agrocenoses without disturbing the ecosystem balance. Growth regulators are successfully used to address the challenges facing agricultural scientists [3, 8].

Due to the imposed sanctions, the volume of agrochemicals used has significantly decreased, while the number of non-target crops has increased significantly, as they have become resistant to the effects of existing agrochemicals. Natural growth regulators are designed to ensure the full realization of the biological potential of field crops [4, 6, 9].

The main advantage of using growth regulators is reducing the stress effects of agrochemicals and realizing the crop's biological potential. This is extremely important for smart and environmentally friendly farming [2, 11, 12].

Potato production is highly relevant today, as import substitution has created a demand for potatoes not only as a food product but also as a raw material for the processing industry. The production of planting material for domestic agricultural producers is also crucial. Varieties must be adapted to specific soil and climate conditions and resistant to non-target pests common in Russia [5, 7? 10].

Purpose of the study– study of the possibility of using growth regulators to increase the biological potential of potato varieties zoned in the Chechen Republic.

Place, conditions and methods of the study. The studies were conducted in 2024-2025 in the forest-steppe zone of the Chechen Republic, in the

Gudermes district. The experiment was based on the Guidelines for the Study of Economic Thresholds and Critical Periods of Weed Harmfulness in Agricultural Crops (1985) and the Guidelines for Conducting Experiments with Herbicides. The experiment was repeated four times. The plot area was 25 m2. The number of weeds was modeled by cutting off the above-ground part of excess specimens with scissors every two weeks. Domestic early-ripening table potato varieties Koroleva Anna and Gulliver, zoned in the Chechen Republic, were used. A preparation based on natural derivatives of humic substances, Humate+7 (produced in Irkutsk), was used as a growth regulator in the experiment [6, 8].

Results and discussion. At the first stage of the study, the species composition of non-target objects of plantings of the studied potato varieties was determined (Tables 1-2).

Table 1 – Non-target objects of potato agrocenosis (Gulliver variety), forest-steppe of the Chechen Republic (2024-2025)

Harmful object		Experience options							
		1	2	3	4	5	6	7	8
I.	***Blumeria graminis***	+/-	+/-	-/+	+/-	+/-	-/-	-/+	+/-
	Alternaria spp.	-/+	+/-	+/-	+/-	-/+	+/-	+/-	-/+
	Phytophthora	-/+	+/-	+/-	+/-	-/-	+/-	-/+	+/-
II.	***Aphidoidea***	-/+	+/-	+/-	-/+	-/+	+/-	+/-	+/-
	Nematoda	+/-	-/+	+/-	-/+	-/+	+/-	+/-	+/-
	Leptinotarsa decemlineata	-/+	+/-	+/-	-/+	-/+	-/-	-/-	+/-
III.I	***Melandrium dioicum (Mill.)***	-/-	+/-	+/-	-/+	-/+	+/-	+/-	-/-
	Plantago lanceolata*(L.)*	-/-	-/+	-/+	+/-	+/-	+/-	+/-	+/-
	Rumexacetosa Willd.	-/-	+/-	+/-	-/+	+/-	+/-	+/-	+/-
III.II	***Avena sativa****(L.)*	-/-	-/-	-/-	+/-	+/-	+/+	+/-	-/-
	Allópia convólvulus*(L.)*	-/-	+/-	-/-	+/-	-/+	-/+	+/-	-/-
	Chenopodium album (L.)	-/-	-/+	-/-	+/-	+/-	-/+	+/-	+/-
III.III	***Amaranthus retroflexus (L.)***	-/-	+/-	+/+	+/-	+/-	-/+	+/-	+/-
	Eshinochloa crus-galli (L.)	-/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
	Ambrosia artemisiifolia(L.)	-/-	-/+	+/-	-/+	-/+	+/-	+/-	+/-
	Ambrosia trifida*(L.)*	-/-	+/-	-/+	-/+	-/+	-/+	+/-	-/+
	Setaria viridis*(L.)*	-/-	-/+	-/+	+/-	-/+	+/+	-/+	-/+
	Galinsóga parviflóra (L.)	-/-	-/-	+/-	+/-	+/-	+/-	+/-	+/+
	Chenopodium album*(L.)*	-/-	+/-	-/+	+/-	+/-	+/-	+/-	-/+
III.IV	***Rhaponticum repen(L.)***	-/-	+/-	+/-	+/-	-/+	+/-	+/-	+/-
	***Cirsium arvense* (L.)**	-/-	-/+	-/+	+/-	+/-	+/+	+/-	-/-
	***Cirsium arvense* (L.)**	-/-	-/+	-/+	+/-	-/+	+/+	+/-	+/-
	Convolvulus arvensis (L.)	-/-	-/+	-/+	+/-	-/-	+/-	-/-	+/-
III.V	***Sorghum halepense* (L.)**	-/-	-/+	-/+	-/+	+/-	+/-	-/+	-/+
	Tussilago farfara*(L.)*	-/-	+/-	+/-	-/+	+/-	+/-	+/-	+/-
	Note: numerator – untreated potato tubers; denominator – potato tubers treated with 0.1% solution of Humate+7. Option 1 – weed-free potato plantings; Option 2 – 4 pcs/m2; Option 3 - 8 pcs/m2; Option 4 - 16 pcs/m2; Option 5 - 32 pcs/m2; Option 6 - 64 pcs/m2; Option 7 - 128 pcs/m2; Option 8 - 256 pcs/m2. I – Diseases; II – Pests; III. – Weeds; III.I. – Taproot; III.II. – Early spring; III.III. – Late spring; III.IV. – Root suckers; III.V. – Rhizome.								

As can be seen from Table 1, powdery mildew, a common disease affecting plants of the Solanaceae family, was observed in almost all experimental variants of the Gulliver potato variety. The incidence of Alternaria blight and late blight was somewhat lower. This is explained by the climatic conditions of the study period—precipitation typically occurring in the afternoon and high temperatures in the morning. This explains the relatively high air humidity. A plant growth regulator used for pre-planting treatment of tubers significantly increased the competitiveness of potato plants during the initial period of development—the incidence of pathogenic pathogens was significantly reduced [9].

During the study period, potato pests such as aphids, nematodes, and the Colorado potato beetle were observed, which can be attributed to poor choice of predecessor crops, a common occurrence among agricultural producers. In this particular case (nematodes), the primary cause was high humidity caused by prolonged rainfall.

An assessment of the floristic composition of the weed vegetation revealed a predominance of late spring weeds, which is explained by the biological characteristics of both the studied crop and its predecessor. During the experiment, tomatoes were the predecessor to potatoes, which is unfavorable from the perspective of a scientifically based crop rotation system [1, 2].

Table 2 – Table 1 – Non-target objects of potato agrocenosis (Queen Anna variety), forest-steppe of the Chechen Republic (2024-2025)

Harmful object		Experience options							
		1	2	3	4	5	6	7	8
I.	***Blumeria graminis***	+/-	+/+	-/+	+/-	+/+	-/-	-/+	+/-
	Alternaria spp.	-/+	+/-	+/-	+/-	-/+	+/-	+/-	-/+
	Phytophthora	-/+	+/-	+/-	+/-	-/-	+/-	-/+	+/-
II.	***Aphidoidea***	-/+	+/-	+/-	-/+	-/+	+/-	+/-	+/-
	Nematoda	+/-	-/+	+/-	-/+	-/+	+/-	+/-	+/-
	Leptinotarsa decemlineata	-/+	+/-	+/-	-/+	-/+	-/-	-/-	+/-
III.I	***Melandrium dioicum (Mill.)***	-/+	+/-	+/-	+/-	-/+	-/+	+/-	-/+
	Plantago lanceolata*(L.)*	-/-	-/+	-/+	+/+	+/-	+/-	+/-	+/-
	Rumex acetosa Willd.	-/-	+/-	+/-	-/+	+/+	+/-	+/-	+/-
III.II	***Avena sativa****(L.)*	-/-	-/-	-/+	+/-	+/-	-/+	+/-	+/+
	Allópia convólvulus*(L.)*	-/-	+/-	+/+	+/-	-/+	-/+	+/-	-/-
	Chenopodium album (L.)	-/-	-/+	+/+	+/+	+/-	-/+	+/-	+/-
III.III	***Amaranthus retroflexus (L.)***	-/-	+/-	+/+	+/-	+/-	-/+	+/-	+/-
	Eshinochloa crus-galli (L.)	-/-	+/-	+/-	+/+	+/-	+/-	+/-	+/-
	Ambrosia artemisiifolia(L.)	-/-	-/+	+/-	-/+	-/+	+/-	+/-	+/-
	Ambrosia trifida*(L.)*	-/-	+/-	-/+	-/+	-/+	+/-	+/-	-/+
	Setaria viridis*(L.)*	-/-	-/+	-/+	+/-	-/+	+/-	-/+	-/+
	Galinsóga parviflóra (L.)	-/-	-/-	+/-	+/-	+/-	-/+	+/-	+/+
	Chenopodium album*(L.)*	-/-	+/-	-/+	+/-	+/-	-/+	+/-	-/+
III.IV	***Rhaponticum repen(L.)***	-/-	+/-	+/-	+/-	-/+	+/-	+/-	+/-
	Cirsium arvense(L.)	-/-	-/+	-/+	+/+	+/-	+/-	+/-	-/-
	***Cirsium arvense*(L.)**	-/-	-/+	-/+	+/-	-/+	+/-	+/-	+/-
	Convolvulus arvensis (L.)	-/-	-/+	-/+	+/-	-/-	-/+	-/-	+/-
III.V	***Sorghum halepense(L.)***	-/-	-/+	-/+	-/+	+/-	-/+	-/+	-/+
	Tussilago farfara*(L.)*	-/-	+/-	+/-	-/+	+/-	+/-	+/-	+/-
	Note: numerator – untreated potato tubers; denominator – potato tubers treated with 0.1% solution of Humate+7. Option 1 – weed-free potato plantings; Option 2 – 4 pcs/m2; Option 3 - 8 pcs/m2; Option 4 - 16 pcs/m2; Option 5 - 32 pcs/m2; Option 6 - 64 pcs/m2; Option 7 - 128 pcs/m2; Option 8 - 256 pcs/m2. I – Diseases; II – Pests; III. – Weeds; III.I. – Taproot; III.II. – Early spring; III.III. – Late spring; III.IV. – Root suckers; III.V. – Rhizome.								

As can be seen from Table 2, powdery mildew was detected on the Queen Anna potato plants in almost all experimental conditions, while late blight and early blight were significantly less common. Queen Anna potato plants demonstrated greater sensitivity to pre-planting treatment of tubers with a growth regulator solution, and, as a result, greater competitiveness.

Aphids, nematodes and Colorado potato beetles have become widespread on the potato variety under study (Queen Anne).

Thus, it can be concluded that the use of a growth regulator for pre-planting treatment of tubers contributed to a significant reduction in species diversity and the number of non-target objects in its plantings [6, 10].

The next step was to determine the pigment content in the leaves of the main weed in potato crops—amaranth. Pigment content, specifically chlorophylls a and b, was determined photometrically.

As weed numbers increased, pigment content in the leaves of pigweed (variety Gulliver) decreased. Compared to minimal weed infestation, pigment content in a field with 256 weeds per square meter decreased as follows: chlorophyll a by 1.65 times, chlorophyll b by 2.1 times, and carotene by 1.45 times.

The use of a plant growth regulator helped reduce the rate of pigment decline in the leaves of a weed planted in the Gulliver potato variety. Pre-planting treatment of tubers with the growth regulator resulted in a 2.03-fold decrease in chlorophyll a, a 3.0-fold decrease in chlorophyll b, and a 1.57-fold decrease in carotene. Chlorophyll b was found to be the most significant decrease.

The pigment content of the leaves of the retroflexus amaranth grown in early potato crops (the Queen Anna variety) was slightly lower than that of the Gulliver variety. For example, with the highest weed density, the chlorophyll a content was 1.6 times lower than in the minimally weedy variant; chlorophyll b was 1.9 times lower; and carotene was 1.5 times lower.

Applying a natural growth regulator to the pre-planting treatment of Queen Anna potato tubers resulted in a more significant reduction in pigment

content in the weed's leaves. Compared to the minimum and maximum infestations (256 pcs/m²), chlorophyll a content decreased by 2.1 times, chlorophyll b by 2.6 times, and carotene by 1.8 times. Consequently, the early Queen Anna potato variety is more responsive to the growth regulator, resulting in increased plant competitiveness.

The influence of the number of weeds per 1 m2 on the accumulation of biomass of the weed component is shown in Table 3.

Table 3. - The influence of the number of weeds on the development and accumulation of their biomass in plantings of different varieties of early potatoes (2024-2025)

Number of weeds in sowing, pcs/m2 (artificial background)	Weight of 1 weed, g/piece	Reduced masses weeds, %	Δ from min blockage, %
Gulliver variety			
4	18.34/17.68	100.00	-/-
8	15.96/15.00	87.00/84.84	13.00/15.16
16	14.95/14.05	81.50/79.46	18.50/20.54
32	13.79/13.08	75.20/73.98	24.80/26.02
64	11.85/11.10	64.61/62.78	35.39/37.22
128	9.80/9.00	53.43/50.90	46.57/49.10
256	8.00/7.32	43.62/41.40	56.38/58.60
$НСР_{0,5}$, г/м^2	50,24		
Queen Anne variety			
4	18.98/15.30	100.00	-/-
8	17.29/13.87	91.10/90.65	8.90/9.35
16	16.18/12.90	85.24/84.31	14.76/15.69
32	15.35/11.15	80.87/72.87	19.13/27.13
64	13.86/8.65	73.00/56.53	27.00/43.47
128	10.17/6.24	53.58/40.78	46.42/59.22
256	7.75/5.15	40.83/33.66	59.17/66.34
$НСР_{0,5}$, г/м^2	56,45		

Note: the numerator is the mass of weeds in the agrocenosis without the growth regulator; the denominator is the mass of weeds in the agrocenosis with the growth regulator Humate+7.

As can be seen from Table 3, the weight of one weed specimen growing in early potato plantings, the Gulliver variety, with minimal infestation (4 pcs/m2) is 18.34 g. With an increase in the number of weeds to 256 pcs/m2, the indicator decreases to 8.00 g, or by 56.38%. The use of a growth regulator for pre-planting treatment of potato tubers due to the activation of growth processes in cultivated plants ensured a decrease in the weight of one weed plant to 7.32 g, which amounted to 41.00% compared to the minimal (4 pcs/m2) infestation.

The weight of one weed plant with minimal infestation in early potato plantings of the Queen Anna variety was 18.98 g. With maximum infestation, the weight decreased and was 7.75 g, or by 59.17%.

In the correlation between the number of weeds per unit area of the Gulliver variety and the weight of 1 weed plant, the correlation coefficient was 0.8984, a strong inverse correlation is observed ($r>0.7$). The regression equation: $Y = 0.0126x+1.5478$; for the Queen Anna variety - 0.7458, also a strong inverse correlation. The regression equation: $Y = 0.0132x+1.6439$.

The use of a growth regulator reduced the weight of each weed to 5.15 g at minimum infestation and 15.30 g at maximum infestation. The weight reduction per plant was 66.34% and 59.17%, respectively.

Thus, we can conclude that there is intraspecific and interspecific competition in the agrocenosis of different early potato varieties. An inverse correlation was established between the weight of a single weed plant and the number of weeds per square meter. The reduction in the weight of a single weed plant in the agrocenosis of the early potato variety Queen Anna is more pronounced, indicating a greater responsiveness of potato plants to the application of the growth regulator.

Conclusion. The study demonstrated a positive effect on the competitiveness of potato tubers treated pre-plant with a 0.1% solution of the humic-based growth regulator, Humate+7. Based on the above, the feasibility of using Humate+7, a natural humic-based growth regulator, for pre-plant treatment of potato tubers is beyond doubt.

Bibliography

1. Adaev, N. L. Ways to green potato cultivation technology / N. L. Adaev, Z. P. Okazova, A. G. Amaeva // International Agricultural Journal. - 2024. - No. 5 (401). - P. 624-626.

2. Adaev N.L., Okazova Z.P., Amaeva A.G., Magomadov A.S., Daulakova A.Sh. Register of weeds in row crops of the Chechen Republic. Database registration certificate 2024621030, 05.03.2024. Application No. 2024620167 dated 22.01.2024.

3. Anikina, I. N. Aspects of regulation of potato plant development / I. N. Anikina // Scientific works on agronomy. - 2022. - No. 4. - P. 5-15.

4. Ikoeva, L. P. Efficiency of using growth regulators in potato cultivation in the foothill zone of the Republic of North Ossetia - Alania / L. P. Ikoeva // Trends in the development of science and education. - 2023. - No. 96-10. - P. 176-179.

5. Ikoeva, L. P. Treatment of seed tubers and potato plants with protective and stimulating preparations / L. P. Ikoeva // Scientific Life. - 2024. - Vol. 19, No. 3 (135). - P. 404-410.

6. Zeyruk, V.N. Adaptive-ecological aspects of potato protection / V.N. Zeyruk, S.V. Vasilyeva, G.L. Belov [et al.] // Plant protection and quarantine. - 2021. - No. 3. - P. 30-34.

7. Magomadov, A. S. Development of an algorithm for creating regional registers of agricultural technologies in the Chechen Republic / A. S. Magomadov, N. L. Adaev, A. G. Amaeva // Electrical technologies and electrical equipment in the agro-industrial complex. - 2022. - Vol. 69, No. 4 (49). - P. 76-83.

8. Magomadov, A. S. Influence of growth regulators based on natural humic substances on the competitiveness of plants of different potato varieties in the forest-steppe zone of the Chechen Republic / A. S. Magomadov, Z. P. Okazova, L. A. Titova // International Agricultural Journal. - 2025. - No. 6 (408). - P. 811-815.

9. Magomedov, R. M. Productivity of early potato varieties in the western Caspian region of Dagestan / R. M. Magomedov, A. A. Magomedova, Z. M. Musaeva // Bulletin of the Dagestan State Agrarian University. - 2020. - No. 1 (5). - P. 81-86.

10. Okazova, Z. P. Weed infestation of potato plantings in the steppe zone of the North Caucasus / Z. P. Okazova // In the world of scientific discoveries. - 2015. - No. 8-2 (68). - P. 808-818.

11. Cao, Zh. Effect of Plant Growth Regulators on Cotton Seedling Root Growth Parameters and Enzyme Activity / Zh. Cao, X. Wang, Ya. Gao // Plants. – 2022. – Vol. 11, No. 21. – P. 2964.

12. Lakshmi, G. Ja. Effect of Plant Growth Regulators on Growth and Yield of Tomato (Lycopersicon esculentum L.) / G. Ja. Lakshmi, D. Singh, G. Raja // International Journal of Plant and Soil Science. – 2022. – P. 709-713.