

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Responsiveness Of Potatoes To The Use Of Mineral Fertilizers Depending On The Cultivation Conditions.

Sergey Evgenievich Geist*, Yuliya Ivanovna Grechishkina, Yulia Alexandrovna Bezgina, Olga Yuryevna Lobankova, Alla Anatolievna Belovolova, and Natal'ya Viktorovna Gromova.

Stavropol State Agrarian University, Zootekhnicheskiiy lane 12, Stavropol 355017, Russia.

ABSTRACT

The article presents the results of experiments on the effect of calculated doses of mineral fertilizers for the planned crop of potato tubers of 20 and 30 t / ha on leached chernozem under conditions of the SSAU experimental station and on the influence of water-soluble forms of complex fertilizers on the productivity of potatoes grown on drip irrigation on the black soil of the Stavropol Territory.

Keywords: potatoes, mineral fertilizers, productivity, leached chernozem, ordinary chernozem, fertilizer dose, drip irrigation.

**Corresponding author*

INTRODUCTION

One of the major crops of great food importance for Russia is potatoes. Obtaining planned potato yields largely depends on the level of nutrition of the plant, the most important source of which is fertilizer. Among the agrotechnical techniques aimed at increasing the yield of potatoes, a large role belongs to their rational use. Fertilizers play a crucial role in the intensification of potato growing, ensuring high yields and good quality of tubers in specific soil and climatic conditions. This requires compliance with the optimal standards, timing and methods of application, the use of the most suitable types and forms of fertilizers, which are determined for each farm depending on the particle size distribution and soil fertility, the planned yield and characteristics of fertilizers.

The method of feeding the mineral elements in the dissolved form directly into the root zone is called fertigation. It was first introduced in the 70s of the last century and since then it has become widespread in the world practice of plant growing [1, 5].

Nutrients supplied to the soil in a dissolved form are more easily absorbed by the root system. The plant does not expend energy on the release of elements bound in sparingly soluble compounds or adsorbed by soil colloids [2, 3, 4, 5].

During the growing season, a nutritional regime is formed with uniform provision of cultivated crops, in which they do not experience a deficit or an excess of mineral elements [6, 7, 8]

Today, traditional fertilizers are being replaced by complex water-soluble fertilizers with a balanced set of macro and microelements for each crop. They are great for root dressing, including by applying through drip irrigation. In addition, some of them may contain special acidifying solutions, which prevent the formation of lime scale and help clean the walls of the system [9, 10, 11, 12].

MATERIAL AND METHODS

The aim of our work was to study the reaction of potatoes to the use of mineral fertilizers in various growing conditions.

Experience 1. It was aimed at optimizing the mineral nutrition of potatoes for obtaining planned yields of potato tubers at 20 and 30 t / ha, was laid on the territory of the agricultural experimental station of Stavropol State Agrarian University.

According to long-term data, the territory of the experimental station belongs to the fourth agro-climatic region. The average long-term amount of precipitation is 551 mm; during the growing season, approximately 386 mm fall out. The average monthly temperature of the warmest month of July is + 21.8 °C. The average monthly temperature of the coldest month of January is 3.4 °C.

The soil of the experimental plot is leached chernozem, powerful, low-humus heavy loamy, which is characterized by an average content of humus (5.2-5.3%) and mobile phosphorus (24 mg / kg according to Machigin), average nitrification capacity (16-30 mg / kg) and a high content of exchangeable potassium (250 mg / kg). The reaction of the soil solution in the upper soil horizons is neutral, the pH is in the range of 6.3-6.5.

The main goal of the research is to study the effect of calculated doses of mineral fertilizers on potato productivity in the conditions of the Stavropol Upland.

Research methodology: plots are placed according to the method of systematic repetitions, the repetition of the experiment is 3 times. Width - 2.8 m, length 10 m, plot area - 28 m², total test area - 406.7 m², test area - 336 m². Doses of mineral fertilizers were calculated in accordance with the level of programmed yield.

Experience options:

1. control (without fertilizers);

2. N₆₀P₉₀P₆₀O (recommended dose);
3. N₄₀P₉₀K₄₈ (estimated dose per 20 t / ha according to the method of V.V. Ageev);
4. N₆₀P₁₄₀K₇₂ (estimated dose per 30 t / ha according to the method of V.V. Ageev).

Field experiments were accompanied by the following analyzes, counts, and observations: the content of nitrate nitrogen using an ion-selective electrode (GOST 26951-86), mobile forms of phosphorus and exchange potassium according to Machigin in the TsINAO modification (GOST 26205-91), pH in an aqueous suspension (GOST 26423-85).

RESULTS AND DISCUSSION

The selection of soil samples and their analysis is timed to the following phases: before planting, germination, flowering, tuberization, full ripeness. The depth of sampling of soil samples for humidity and for the content of agrochemical indices is 0–20 cm.

Based on the data obtained, it can be argued that the application of mineral fertilizers in the spring for planting potatoes always increases the content of nitrate nitrogen, mobile phosphorus and exchangeable potassium in the 0-20 cm soil layer. It also follows that the dynamics of agrochemical processes during the growth and development of potato plants did not change regardless of the type of experience.

So at the beginning of the growing season in the variant with the introduction of the smallest amount of nitrogen and potassium N₄₀P₉₀K₄₈ relative to the control (without fertilizers), the content of nitrate nitrogen in the 0-20 cm soil layer increased by 2.1 mg / kg, mobile phosphorus by 12 mg / kg of exchangeable potassium at 4 mg / kg. And for the harvest period, the content of mobile phosphorus and exchangeable potassium increased by 6 mg / kg and 2 mg / kg. But the content of nitrate nitrogen was almost equal to the control option.

And in the variant of making N₆₀P₁₄₀K₇₂, the content of nitrate nitrogen, mobile phosphorus and exchangeable potassium in the 0–20 cm soil layer to sprouting was increased by 3.7 mg / kg, 17 mg / kg, and 15 mg / kg compared to the control. By harvesting, phosphorus and potassium exceeded the control (without fertilizers) by 7 mg / kg and 28 mg / kg, and nitrogen was even less than in the control variant, by 0.1 mg / kg of soil.

The dynamics of the soil solution during the growing season of potatoes, regardless of the variant, had a generally general direction - a decrease in pH from the beginning of the growing season to the flowering phase, and its further restoration to previous values at the end of the growing season. The application of acid fertilizers increased this indicator at the beginning of the growing season by 0.05-0.21 units and 0.02-0.08 units in the end.

Table 1: Effect of calculated doses of mineral fertilizers on potato productivity, t / ha

| Variant | | Yield | |
|--|--|-------|------|
| | | t/ha | +/- |
| Control | (without fertilizer) | 18,4 | - |
| N ₆₀ P ₉₀ K ₆₀ | recommended dose | 24,6 | 6,2 |
| N ₄₀ P ₉₀ K ₄₈ | estimated dose of 20 t / ha according to the method of V. V. Ageev | 36,7 | 18,3 |
| N ₆₀ P ₁₄₀ K ₇₂ | estimated dose of 30 t / ha according to the method of V. V. Ageev | 42,8 | 24,4 |

It follows from the above that the introduction option N₆₀P₁₄₀K₇₂ has the greatest effectiveness on the agrochemical indicators of chernozem leached on plantings of potatoes under the conditions of the experimental station of Stavropol State Agrarian University and provides the highest yield both with respect to control and other options in the experiment. The crop yield corresponding to the planned yield was obtained on the variants with calculated fertilizer doses.

Experience 2. On the study of new water-soluble chelated forms of complex fertilizers in the cultivation of potato varieties Colette grown on drip irrigation in conditions of ordinary chernozem in the zone

of unstable moistening of the Central Ciscaucasia.

To achieve this goal the following tasks were solved:

- to assess the impact of new water-soluble forms of mineral fertilizers on the biometric indicators of the development of potato plants;
- to study the effect of new water-soluble forms of mineral fertilizers on the biochemical composition of potato tubers (on wet weight) in connection with the use of various water-soluble fertilizers;
- to assess the yield of potatoes in connection with the use of new water-soluble forms of mineral fertilizers in drip irrigation.

To maintain soil moisture not lower than 80% NH in the variant with differentiation according to the phases of growth and development of potatoes (to a depth of wetting of 0.3 m to the flowering phase and 0.6 m to the subsequent phases of growth and development of potato plants) irrigation rate from 800 up to 1600 m³ / ha. Despite the shorter duration of the second period, from flowering to harvesting potatoes, compared with the period from planting to flowering, as a result of intensive water consumption, potato plants formed by this time under high average daily air temperatures the need for irrigation water in this period was 200 m³ / ha more than the first. 7 irrigations were carried out, of which 4 were irrigation rates of 200 and 3 - 400 m³ / ha. For all the years of research under this irrigation regime, watering was carried out during the budding period - flowering and the last watering - in the phase of the beginning of yellowing of the lower leaves before harvesting.

In our experience, water-soluble fertilizers often used by agricultural producers of the Stavropol Territory in drip irrigation in the form of dressings were used: Rexolin ABS, SpeedFol, Novalon, Lebazol.

The use of various water-soluble fertilizers changed the morphological characteristics of potato plants (Table 2).

Table 2: Changes in the morphological characteristics of potato plants due to the use of various water-soluble fertilizers (2015–2017)

| Fertilizer | Biometric indicators of plant development in the flowering phase | | | |
|---|--|---------------------------|-------------------|--------------------------|
| | height, cm | number of main stems, pcs | weight of tops, g | number of leaves, pieces |
| Control (Background N ₆₀ P ₆₀ K ₆₀) | 46,9 | 3,0 | 335,0 | 39,0 |
| Background + Rexolin | 55,4 | 3,7 | 420,6 | 40,2 |
| Background + Speedfol | 40,3 | 3,1 | 338,4 | 32,2 |
| Background + Novalon | 43,9 | 3,3 | 343,8 | 38,8 |
| Background + Lebazol | 62,1 | 3,9 | 432,9 | 41,6 |

According to the variants of the experiment, a change in the morphological features of potato plants was observed due to the use of various water-soluble fertilizers. All studied options compared with the control increased the value of the indicators. The maximum effect was noted on the variants using Lebazol: the height of plants on these variants was higher than the control by 15.2 cm, the number of main stems was 0.9, the weight of the leaves was 97 g, the number of leaves was 2.6.

The biochemical composition of potato tubers was also directly dependent on the fertilizer used (Table 3).

Table 3: Biochemical composition of potato tubers (for wet weight) in connection with the use of various water-soluble fertilizers (2015–2017)

| Fertilizer | Dry matter, % | Starch, % | Amount of sugars, % | Ascorbic acid, % | Nitrates, mg / kg |
|---|---------------|-----------|---------------------|------------------|-------------------|
| Control (Background N ₆₀ P ₆₀ K ₆₀) | 17,3 | 9,7 | 0,5 | 13 | 91,2 |
| Background + Rexolin | 19,2 | 10,8 | 0,6 | 15 | 92,4 |
| Background + Speedfol | 17,1 | 9,4 | 0,5 | 12 | 93,8 |
| Background + Novalon | 17,5 | 9,6 | 0,5 | 13 | 96,0 |
| Background + Lebazol | 18,9 | 10,5 | 0,6 | 16 | 94,5 |

The use of water-soluble fertilizer Rexolin had the best effect on the effect on the biochemical composition of potato tubers. Indicators of dry matter, starch content, sugars were the best. The variants with Lebazol also showed a significant difference compared with the control and revealed good indicators of the quality of tubers. The nitrate content in potato tubers did not exceed 100 mg / kg.

Table 4: Potato yield due to the use of various water-soluble fertilizers (2015–2017)

| Fertilizer | Productivity, t / ha | | | Average yield, t / ha |
|---|----------------------|------|------|-----------------------|
| | 2015 | 2016 | 2017 | |
| Control (Background N ₆₀ P ₆₀ K ₆₀) | 42,6 | 40,2 | 44,4 | 42,4 |
| Background + Rexolin | 42,3 | 45,5 | 44,5 | 44,1 |
| Background + Speedfol | 43,2 | 45,0 | 42,3 | 43,5 |
| Background + Novalon | 41,5 | 43,1 | 46,5 | 43,0 |
| Background + Lebazol | 44,1 | 42,8 | 46,6 | 44,5 |

The yield of potatoes in connection with the use of various water-soluble fertilizers on the full mineral background varied by variants of the experiment from 43.0 to 44.5 t / ha. The maximum indicators are marked on the variants with the use of Rexolin and Lebazol with a slight difference between them.

CONCLUSION

Thus, the use of drip irrigation under the conditions of unstable wetting of the Stavropol Territory on the full mineral background N₆₀P₆₀K₆₀ using Rexolin and Lebazol as a supplement of complex water-soluble fertilizers allows to obtain high yields of potatoes 44.1-44.5 t / ha.

ACKNOWLEDGEMENT

The study was carried out with the support of the Ministry of Agriculture of the Stavropol Territory on the implementation of research, development and technological work to meet the state needs of the Stavropol GC 194/18.

REFERENCES

- [1] Agrochemical Principles of Targetting Winter Wheat Yield on Leached Chernozem of the Stavropol Elevation / A.N. Esaulko, E.A. Salenko, M.S. Sigida, S.A. Korostylev, E.V. Golosnoy // Biosciences Biotechnology Research Asia – 2015. V.12. №1. P.301-309.
- [2] Document Changing population by aerobic nitrogen-fixing bacteria in natural and anthropogenically transformed chernozems biogeocenoses Central Ciscaucasia / V.S. Tskhovrebov, V.I. Faizova, A.N. Mar'in, D.V. Kalugin, A.A. Novikov // Source of the Document Research Journal of Pharmaceutical,

- Biological and Chemical Sciences. 2016. 7 (4), P. 2178-2182.
- [3] Influence of fertilizers and methods of soil cultivation on the dynamics of mobile sulphurchernozem leached to the winter wheat crops in the zone of an unreliable moistening of Stavropol territory / A. N. Esaulko, A. Y. Fursova, Y. I. Grechishkina, A. A. Belovolova, L. S. Gorbatko // Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2016. № 7(3) P. 2578–2581.
- [4] The influence of fertilizer systems on the content of various forms of potassium and nutrition mode of humus / A. N. Esaulko, Y. I. Grechishkina, M. S. Sigida, S. A. Korostilev, E. V. Golosnoi // Oriental journal of chemistry. 2016. Vol. 32, No. (6): P. 3189-3199.
- [5] Optimization Of Mineral Nutrition Of Winter Wheat In Leached Chernozem Conditions / Esaulko A. N., Salenko E.A., Lobankova O. Yu., Golosnoy E. V., Gromova N. V. // Research journal of pharmaceutical biological and chemical sciences. 2018. Vol. 9. Is. 4. P. 565-570.
- [6] "Healthy" Food Products Based On Natural Plant Material / Romanenko E. S., Sosyura E. A., Esaulko N. A., Selivanova M. V., Aysanov T. S. // Research journal of pharmaceutical biological and chemical sciences. 2018. Vol. 9. Is. 4. P. 1095-1104.
- [7] Biologization Of Fertilizer Systems: A Step Towards Organic Farming / Baibekov R. F., Esaulko A. N., Lobankova O. Yu., Golosnoy, E. V., Ozheredova A. Yu. // Research journal of pharmaceutical biological and chemical sciences. 2018. Vol. 9. Is. 4. Pp. 1694 – 1701.
- [8] Introduction of Calculated Doses of Mineral Fertilizers to Achieve Maximum Productivity of Winter Wheat Varieties on Chernozem Leached Stavropol Upland / Esaulko A. N., Ozheredova A. Yu., Sigida M. S., Voskoboynikov A. V., Podkolzin O. A. // Research journal of pharmaceutical biological and chemical sciences. 2017. Vol. 8. Is. 6. P. 778-781.
- [9] Accumulation Ions of Salts and Nutrients in Plants Due to Soil Salinity and Changes in Mineral Nutrition / Belovolova A. A., Gromova N. V., Salenko E. A., Ageev V. V., Podkolzin A. I. // Research journal of pharmaceutical biological and chemical sciences. 2017. Vol. 8. Is. 6. P. 800-804.
- [10] Effect of Fertilization Systems on the Dynamics of Ca²⁺ In Crops of Winter Wheat / Esaulko A. N., Aysanov T. S., Sigida M. S., Salenko E. A., Voskoboynikov A. V. // Research journal of pharmaceutical biological and chemical sciences. 2016. Vol. 7. Is. 3. P. 2370 – 2373.
- [11] The Influence of Fertilizer Systems on the Content of Various Forms of Potassium and Nutrition Mode of Humus / Esaulko, Aleksandr Nicolaevich; Grechishkina, Ylia Ivanovna; Sigida, Maksim Sergeevich; Korostilev S. A., Golosnoi E. V. ORIENTAL JOURNAL OF CHEMISTRY: Vol: 6 P.: 3189-3199: 2016.