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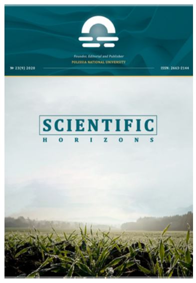

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Optimisation of Nutrition of Early-Maturing Potato Varieties on Drip Irrigation in the South of Ukraine

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Abstract. Potatoes are an extremely important crop for the nutrition of the population in Ukraine. Its potential is high-up to 100 t/ha of tubers, but the average yield reaches 14-16 t/ha. To obtain significantly higher productivity, it is necessary to improve the main elements of cultivation technology. The main factor of potato production on drip irrigation is the optimisation of plant nutrition, which the authors have taken to study with three varieties of early maturing potatoes. Studies have established that providing plants with nutrients with the selection of varieties can increase the productivity of tubers up to 37-39 t/ha, or increase its level compared to the control to 64.7%. It was determined that the maximum yield is provided by the main application from autumn $N_{32}P_{32}K_{32}$, before planting $N_{48}P_{48}K_{48}$ and carrying out three top dressings during the growing season simultaneously with watering with a total rate of N_{33} and Plantafol 6 kg/ha, starting from the beginning of budding with an interval of 8-10 days. At the same time, tubers are formed with high-quality indicators as they contain a sufficient number of dry substances, ascorbic acid (vitamin C), and starch. It should be noted that when optimising nutrition, the intake of all the main indicators of potato tubers compared to the control slightly decreased, namely dry substances and starch. On the contrary, the amount of ascorbic acid increased, especially with top dressing with Plantafol. Varietal features regarding the impact on the quality of tubers are also determined. Significantly more dry substances were found in tubers of the Riviera and Prada varieties, and more starch content was found in Prada and Minerva varieties. Slightly less dry matter and ascorbic acid were detected in Minerva potato tubers compared to other varieties. From the grown crop of tubers of the studied potato varieties, it is possible to obtain up to 4.0 t/ha of bioethanol or alcohol if they are processed

Keywords: yield, quality of potato tubers, fertiliser system, Plantafol, bioethanol, alcohol

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INTRODUCTION

As of November 1, 2020, potato production in Ukraine amounted to 21.7 million tons with an average yield of tubers at the level of 10-14 t/ha. In some countries and in some advanced farms, due to the introduction of scientific and technological progress into production, the productivity of this crop reaches 30-40 t/ha. Its potential yield exceeds 100 t/ha, and the collection of dry matter is up to 25 t/ha [1; 2]. That is, now in Ukraine, the potential of biological and economic productivity of potatoes is used only by 10-12%. The difference in these data is because industrial production occupies only a small part of the potato market of Ukraine. Almost 95% of the total potato volume is grown by the population in the private sector.

According to the Ukrainian Association of potato producers, about 3 million tons of potatoes are sold through supermarkets per year, and the population needs twice as much to feed – at least 6 million tons (120-128 kg per person), part of the crop is used for animal feed and processing. Therefore, potato cultivation is an urgent problem aimed at expanding planting areas, increasing yields due to properly selected varieties, and applying mineral fertilisers.

Potatoes are a valuable food, technical, and fodder crop. The main food component of potatoes is carbohydrates in the form of starch. Different varieties of potatoes contain from 17 up to 30% of dry substances in tubers, of which 70-80% is starch and up to 3% is protein substances. Tubers contain vitamins A, B1, B2, PP, etc. Potatoes are an essential raw material for the starch and alcohol industries. Tubers are used for livestock feed both in fresh and processed form, as well as for the production of bioethanol [3-6]. Recently, on the irrigated lands of the south of Ukraine, the technology of growing potatoes improved by the Institute of irrigated agriculture of the National Academy of Sciences, in which tubers are planted in pre-cut ridges, is increasingly used. This, of course, with other elements and measures, contributes to improving the physical condition of the soil, warming it up faster [7].

When applying mineral fertilisers in the optimal amount for plant nutrition, the irrigation regime becomes particularly important in the conditions of the steppe zone of Ukraine. Due to the insufficient amount of moisture for plants, an increase in potato productivity during watering is associated with optimising the moisture supply during the growing season of the crop, which contributes to an intensive increase in above-ground biomass and tubers. In recent years, the area of use of drip irrigation has been constantly growing.

The relevance of the topic of this study is determined by the fact that an important direction for accelerating scientific and technological progress in potato growing is the creation and introduction into production of highly productive varieties and hybrids adapted to the appropriate soil and climatic conditions of the growing zone. For them, it is necessary to develop conditions for the most complete disclosure of genetic potential based on improved seed production, the development of zonal intensive technologies, in particular fertiliser systems.

Therefore, as a result of the study, it was planned to determine the influence of the background of nutrition on the yield and quality of tubers of three varieties of early ripening potatoes when grown on drip irrigation in the conditions of the Southern steppe of Ukraine.

LITERATURE REVIEW

Each agricultural crop, and even its individual varieties or hybrids, have certain features and requirements for the level of nutrition, differ in the removal of nutrients from the soil and their optimal ratio. Potatoes are quite picky about providing the soil with nutrients. So, at the average yield level (18.0 t/ha of tubers and 8.0 t/ha of tops), it removes nitrogen from the soil – 95-105 kg, phosphorus – 40-50 kg, potassium – 110-120 kg/ha. Regarding 1 ton of tubers, this use is 5.6, 2.2, and 6.4 kg, respectively. Potatoes absorb the maximum amount of phosphorus during budding and flowering, and they absorb nitrogen and potassium in the second half of the growing season during the increased growth of tubers and tops [8].

Potatoes also show a significant need for nutrition relating to trace elements, their lack from the very first periods of vegetation disrupts growth processes and normal metabolism. After all, to obtain stable potato yields with high-quality tubers, plants require not only nitrogen, phosphorus, and potassium, but also calcium, magnesium, iron, boron, sulfur, manganese, and other elements. Therefore, the rate of mineral fertilisers should be such as to ensure sufficient nutrition of potato plants throughout the growing season [9].

In particular, to combat scab, it is advisable to replace part of mineral fertilisers with physiologically acidic forms (superphosphate, ammonium sulfate). In fields where scab is very common, it is advisable to feed potatoes with manganese sulfate or ammonium sulfate as 60 kg/ha during mass tying of tubers [10].

The authors recommend applying 30-50 kg/ha of magnesium and 30-60 kg/ha of sulfur to potatoes in addition to the main fertiliser before planting or during the growing season applying micro fertilisers by foliar top dressing. The absorption of nutrients by plants depends on the stage of crop development. So, during the period of early spring growth, there is a need for a significant amount of trace elements, and to achieve high yields, it is essential to have all the nutrients available to plants in an accessible form. Both potassium and nitrogen are necessary for potatoes during vegetative growth, the ovary of tubers and during tuber formation [8].

To obtain high yields of tubers, potato plants need enhanced potassium nutrition, potassium is also vital for the starchiness of tubers. Therefore, its consumption in significant quantities is typical for potato culture. For the growth of leaves, above-ground biomass, and tubers, nitrogen application is crucial. In general, in the conditions of irrigation in the south of Ukraine, nitrogen nutrition is at the first minimum for most agricultural crops. It is the availability of plants with this element of nutrition that affects the level of yield and product quality. Like potassium, a significant amount of nitrogen is distributed from the leaves to the tubers during their formation. For better rooting and tuber formation, potatoes use phosphorus in fairly large quantities, especially at the beginning of plant growth, as well as at the end of the growing season, for the intensity of tuber growth. This is established on different types of soils and in many countries [11-15].

Balanced nutrition is vital, despite the significantly lower removal of trace elements. In the nutrition of plants, it is necessary to adhere to their optimal content, since they, like trace elements, are a necessary factor in obtaining high yields. The trace elements, boron, copper, manganese, and zinc are the most important for potatoes. The importance of trace elements in the formation of stable yield levels and their quality is determined on many agricultural crops in the conditions of the southern steppe zone of Ukraine [16]. The authors point out the significant influence of trace elements in increasing the yield of potato tubers and the main indicators of their biochemical composition after conducting a study in Polesie [17]. In general, the use of trace elements for vegetable crops and potatoes significantly improves their quality, products with a balanced diet meet the requirements of environmentally friendly standards [18].

Many studies have proved that with the optimisation of humidification conditions, the productivity of any crop increases significantly under the influence of plant nutrition. Fertilisers have the greatest impact, and they are a decisive factor in increasing yields due to their rational use, crop yields increase by an average of 40-50%, and on irrigated land, they increase by 75% or more. In addition, fertilisers significantly affect not only the levels of potato yield but also the biochemical composition, nutritional value, taste qualities of tubers, their shelf life, etc. [19].

Currently, due to a sharp decrease in the number of animals, the use of organic fertilisers has significantly decreased, so it is necessary to search for alternative sources of organic mass in the soil, which is determined by many studies. For example, in the Polesie region, it was found that the use of various crops as green manure for potatoes is equal in efficiency to 30-40 tons of manure per hectare [20].

Mineral fertilisers are highly expensive and should be used with the greatest efficiency and payback. One way may be to apply them locally. With this method of application, it is possible to get significantly higher returns from a significantly (halved) reduced dose of fertilisers. Definitely, the local method of applying mineral fertilisers affects physiological processes from the early stages of plant development and continues until the period of formation of spare substances, that is, it significantly affects the yield and the main indicators of its quality. The high efficiency of mineral fertilisers for potatoes has been determined by many researchers [21-24].

According to the generalised data of researchers, the coefficient of use of nutrients by plants using the local method of fertilisation increases in comparison with the scattered one by 10-15% for nitrogen and potassium, and by 5-10% for phosphorus.

Therefore, according to the generalisation of scientific literature, it can be seen that the use of the correct system of plant nutrition (potatoes in particular) is an extremely important element of the technology of growing agricultural crops. The issue of the nutrient regime optimising has become particularly significant recently when the application of fertilisers is insufficient and soil fertility is deteriorating [25].

MATERIALS AND METHODS

Field experiments were conducted during 2018-2020 in the Educational, Scientific and Practical Center of the Mykolaiv National Agrarian University. The soil of the experimental site – southern chernozem – in the arable layer on average contained 3.02-3.21% humus, 20.7-32.0 mg/kg of soil nitrates, 26-45 mg/kg of mobile phosphorus, and 326-472 mg/kg of exchange potassium, pH of water extract was 7.0-7.2.

The source of irrigation of the experimental site was the central main channel of the Ingulets irrigation system, the water of which was characterised by satisfactory quality and belongs to the 2nd class regarding the level of saltwater hazard. According to irrigation indicators, the water was suitable for irrigation and would not lead to salinisation of the soil.

The experiment scheme included the following variants:

Factor A – Variety: 1 – Minerva; 2 – Riviera; 3 – Prada.

Factor B – nutrition variant:

1. Control - without fertilisers;
2. $N_{32}P_{32}K_{32}$ (autumn) – background;
3. background + $N_{48}P_{48}K_{48}$ (when planting);
4. background + $N_{48}P_{48}K_{48}$ (when planting)+N_{33}+Plantafol, 6 kg/ha (in three top dressing with vegetative irrigation).

The area of the experimental plot was 90 m^2, the accounting plot was 50 m^2. The experiment was repeated three times. The research was carried out in accordance with the requirements of the research methodology [26; 27]. Agrotechnics of growing potatoes on drip irrigation, in addition to the factors taken for study, were recommended for the southern steppe zone of Ukraine [7].

The predecessor of potatoes was winter wheat. In autumn, $N_{32}P_{32}K_{32}$ (2 centners/ha of nitroammofos) was applied for the main tillage. Before planting, $N_{48}P_{48}K_{48}$ (3 centners/ha of nitroammofos) was applied according to the experiment scheme. The planting material was treated with the growth stimulator Poteitin (5 ml/t) together with the mordant Commander extra (0.2 l/t) for water consumption of 20 l/t.

Tubers were planted in late March – early April in the ridge to a depth of 6-8 cm, the nutrition area was 70×15-20 cm.

During the growing season, starting from the beginning of budding, the top dressing was carried out with a general norm of N_{33} and Plantafol 20:20:20 6 kg/ha. The specified fertiliser and Plantafol were applied three times with an interval of 8-10 days simultaneously with irrigation according to N_{11} and Plantafol 2 kg/ha, respectively.

In a layer of 0-20 cm, before the appearance of sprouts on tubers, soil moisture was maintained at 70-75% HB, and in the subsequent growing season – 80-85% HB by drip irrigation.

The yield of alcohol and bioethanol from potato tubers was determined by the calculation method recommended by the Institute of Potato NAAS of Ukraine 100.4 liters, and the yield of bioethanol from 1 ton of raw materials – 100.4 liters, and the yield of absolute alcohol from 100 kg of raw materials – potato tubers (medium starch) – 11.2 kg.

RESULTS AND DISCUSSIONS

Field germination of tubers of the studied potato varieties was formed at the level of 95.8-97.5%. The beginning of budding in all variants of the experiment and in all varieties began on the 53-59 day after planting. The duration of the interphase budding – flowering period, depending on the variety and background of nutrition, ranged from 5 to 9 days. Fertilisers, regardless of the application period, slightly restrained the onset of budding and flowering phases – on average, for 1-2 days compared to the control in all varieties. The Minerva potato variety ripened by 4-7 days earlier than the Riviera and Prada varieties. Fertilisation slightly affected the overall duration of the growing season.

In 2019, all the studied potato varieties formed the lowest yield of commercial tubers, which was caused by the cold spring. Considering the yield within varieties, Minerva was determined to be less productive, the yield of its tubers on average over the years of research in the control was 17.4 t/ha, while in the Riviera and Prada varieties, respectively, their yields were 21.6 t/ha and 22.2 t/ha.

The yield of potato tubers, depending on weather conditions, the variety, and the current nutrition background, ranged from 15.7-39.0 t/ha. On average, over the years of cultivation, the highest yield of tubers of the studied potato varieties was formed at the level of 30.5-35.5 t/ha when applied in autumn $N_{32}P_{32}K_{32}$, before planting $N_{48}P_{48}K_{48}$ and carrying out three top dressing N_{33} and Plantafol 6 kg/ha simultaneously with fertigation, (respectively for N11 and Plantafol 2 kg/ha), which exceeded the control without fertilisers depending on the varietal characteristics of potatoes by 13.1-13.3 t/ha (Table 1).

***Table 1**. Yield of commercial tubers of potato varieties under the influence of nutrition optimisation in research years, t/ha*

Year	Variety (factor A)	Nutrition background (factor B)			
		Control (without fertilisers)	$N_{32}P_{32}K_{32}$ (in autumn) – background	Background + $N_{48}P_{48}K_{48}$ (when planting)	Background + $N_{48}P_{48}K_{48}$ (when planting) + N_{33} + Plantafol
2018	Minerva	17.9	19.8	26.9	31.2
	Riviera	22.0	26.5	31.9	37.6
	Prada	22.5	27.2	32.4	37.9
2019	Minerva	15.7	18.8	22.8	26.7
	Riviera	20.1	22.5	25.7	28.8
	Prada	21.1	23.4	26.4	29.6
2020	Minerva	18.5	20.0	28.4	33.7
	Riviera	22.7	28.3	33.7	38.2
	Prada	22.9	28.9	34.4	39.0
Average for 3 years	Minerva	17.4	19.5	26.0	30.5
	Riviera	21.6	25.8	30.4	34.9
	Prada	22.2	26.5	31.1	35.5
HIP_{05}			2018 yr.	2019 yr.	2020 yr.
	By factor A		1.3	0.8	1.1
	By factor B		1.6	1.2	1.5
	By factors AB		1.9	1.7	2.3

The importance of nutrition optimisation in potato productivity is clearly illustrated in Figure 1, namely, the increase in yield of tubers from background application of $N_{32}P_{32}K_{32}$ averaged 17.2% for three varieties over the years of research, the use of $N_{48}P_{48}K_{48}$ for planting on this background fertilisers – by 43.1%, and fertilisation with watering during the growing season (general norm N_{33} and Plantafol 6 kg/ha) provided a maximum increase in yield by 64.7%. In general, from foliar fertilisation with Plantafol 2 kg/ha three times during the growing season, the yield of tubers increased by 4.4 t/ha on average during the years of cultivation in all varieties (by 21.6% compared to the control).

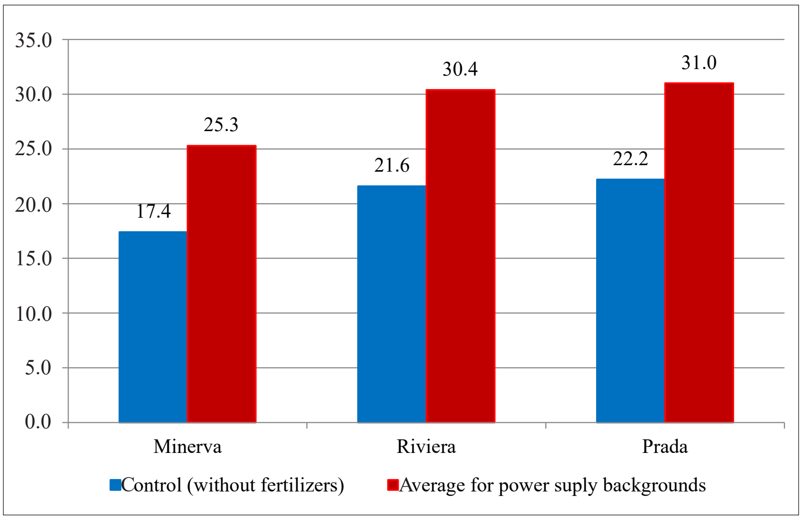

Figure 1*. Influence of potato varietal characteristics and nutrition optimisation on tuber yield (average for 2018-2020), t/ha*

Of the potato varieties taken for research, the highest level of yield in all the years of cultivation was provided by the Prada variety. The Riviera variety was characterised by similar yield values, and the lowest yield of tubers in this study was provided by the Minerva potato variety. However, all varieties reacted significantly to the optimisation of nutrition by increasing the yield of tubers. On average, for three varieties, the maximum productivity was provided by the cultivation of their use for top dressing with Plantafol on the background of $N_{48}P_{48}K_{48}$ (Fig. 2). The positive effect of growth-regulating substances containing trace elements on the yield of potato tubers was determined in studies conducted at the Institute of irrigated agriculture, that is, in the conditions of the Southern steppe of Ukraine on drip irrigation [28-30]. Note that despite the lowest yield of tubers, which is formed by the potato variety Minerva, this variety significantly increased it with optimisation of nutrition: the increase in all variants of fertilisers to control in this variety was 45.4%, while in the Riviera variety – 40.7%, and Prada – 39.6%.

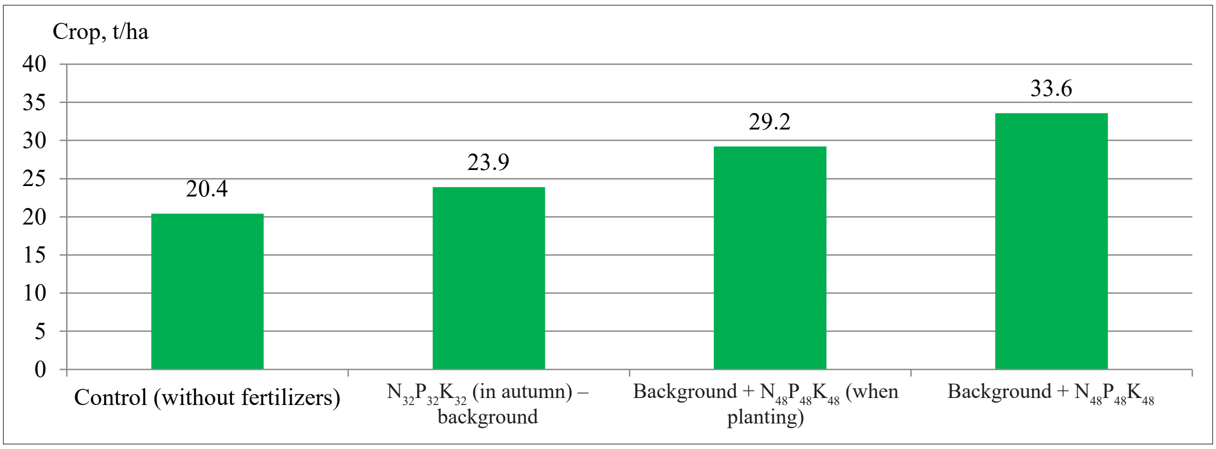

Figure 2*. The Importance of nutrition optimisation in the productivity of potato tubers (average by varieties for 2018-2020), t/ha*

During this period, potato producers are subject to serious requirements regarding product quality criteria. That is why the cultivation of potatoes, including the quality of tubers, significantly depends on the selection of the variety, the planting scheme, and agricultural technology, the conditions of harvesting, drying, and storage, it is aimed at obtaining not only a high yield but also, accordingly, high quality.

The background of nutrition, as determined by studies, influenced the main indicators of the quality of potato tubers (Table 2).

***Table 2**. Impact of nutrition optimisation on the main quality indicators of potato tubers depending on the variety (average for 2018-2020)*

Nutrition background (factor B)	Variety (factor A)								
	Minerva			Riviera			Prada		
	1	2	3	1	2	3	1	2	3
Control (without fertilisers)	18.5	22.8	14.9	21.5	23.5	13.7	21.0	23.7	14.4
$N_{32}P_{32}K_{32}$ (in autumn)	18.3	23.3	14.5	21.0	24.5	13.4	20.8	24.7	14.2
$N_{32}P_{32}K_{32}$ (in autumn) + $N_{48}P_{48}K_{48}$ (when planting)	18.1	25.5	14.3	20.5	26.2	13.2	20.5	26.2	14.0
$N_{32}P_{32}K_{32}$ (in autumn) + $N_{48}P_{48}K_{48}$ (when planting) + N_{33} and Plantafol, 6 kg/ha	18.0	25.8	14.1	20.3	26.6	12.8	20.2	26.5	13.9

***Note**: 1 – dry matter content, %; 2 – vitamin C (Ascorbic acid) content, mg%/100 g; 3 – starch content, %*

The content of dry matter and starch in potato tubers varied depending on the background of nutrition (application of mineral fertilisers and top dressing with Plantafol) and on varietal characteristics. So, for the period of harvesting in potato tubers of the Minerva Variety, the minimum dry matter content was determined, in the variant without fertilisation it was 18.5%. With an increase in the dose of mineral fertilisers, this indicator decreased. Tubers of the Riviera and Prada varieties contained more dry matter: in the control variants, they contained 21.5 and 21.0%, respectively, and depending on the background of nutrition, from 20.2% to 21.5%. Similar data and their changes were obtained from determining the quality of tubers of different potato varieties by optimising crop nutrition, in particular using biologics [24; 25]. This is also determined by the previous studies conducted with three varieties of summer-planted potatoes for growing on drip irrigation, as was noted [19].

With a similar dependence, the improvement of nutritional conditions also contributed to a decrease in the starch content in the tubers of all the studied potato varieties compared to tubers grown in the control non-fertilised versions. That is, with an increase in the doses of mineral fertilisers, the yield of tubers increases, but in most cases their use leads to a decrease in the content of dry substances and starch in tubers. The starch content is lowest in tubers of the early maturing Riviera variety, and the highest one is in the Minerva variety. It should be noted that in the tubers of potato varieties taken for study, the content of vitamin C or ascorbic acid did not differ significantly. Among the variants of nutrition backgrounds and fertiliser application methods, the most vitamin C in potato tubers was due to the combination of $N_{32}P_{32}K_{32}$ (in autumn) + $N_{48}P_{48}K_{48}$ (when planting) + 1C saltpeter + Plantafol (6 kg/ha) with fertigation. The content of vitamin C in tubers of the Minerva variety on average for three years of cultivation was 25.8 mg%, slightly higher indicators were determined in tubers of the Riviera and Prada varieties – 26.5 mg% and 26.4 mg% respectively, which exceeded the content in tubers grown without fertilisation, by 3.0, 2.9 and 2.8 mg% per raw mass respectively.

By calculation, the authors also determined the possibility of obtaining a conditional yield of bioethanol and alcohol from grown potato tubers in the context of varieties and nutrition variants. For these purposes, tubers are used if they need to be processed, as well as in case of damage or formation of small, non-standard ones, non-commercial tubers and the like.

The highest yield of bioethanol and alcohol from grown potato tubers is provided by the Prada variety, the Riviera variety is close to it in terms of indicators, and the Minerva variety is the smallest because these values are conditional, calculated, and depend on the levels of the formed tuber yield (Table 3).

Table 3. Possible conditional yield of alcohol or bioethanol from the potato crop (average for 2018-2020), t/ha

Nutrition background (factor B)	Possible conditional yield variety (factor A)					
	Minerva		Riviera		Prada	
	Bioethanol	Alcohol	Bioethanol	Alcohol	Bioethanol	Alcohol
Control (without fertilisers)	1.75	1.95	2.17	2.42	2.23	2.49
$N_{32}P_{32}K_{32}$ (in autumn)	1.96	2.18	2.59	2.89	2.66	2.97
$N_{32}P_{32}K_{32}$ (in autumn) + $N_{48}P_{48}K_{48}$ (when planting)	2.61	2.91	3.05	3.40	3.12	3.48
$N_{32}P_{32}K_{32}$ (in autumn) + $N_{48}P_{48}K_{48}$ (when planting) + N_{33} + Plantafol, 6 kg/ha	3.06	3.42	3.50	3.91	3.56	3.98

Under the influence of optimising the nutrition of potato plants, they increase significantly in comparison with the control and background application under the main tillage $N_{32}P_{32}K_{32}$ (autumn). To process tubers into starch is appropriate, and it is widely used by potato growers. Therefore, the production of large volumes of potato tubers and their partial processing to obtain starch, bioethanol, alcohol, chips and other products will significantly increase the profitability of growing this crop and its waste-free production.

CONCLUSIONS

Studies conducted on Southern chernozem with three early maturing potato varieties grown on drip irrigation during 2018-2020 determined that this crop responded significantly to nutrition optimisation. The yield of tubers under the influence of the use of mineral fertilisers in autumn, before planting, and N_{33} and Plantafol 6 kg/ha in top dressing increases to 64.7%. Positively, this element of cultivation technology affects the main indicators of the quality of tubers, the conditional collection of bioethanol and alcohol from the formed crop. The authors have identified Prada as the most productive of the studied varieties, the early maturing Riviera variety forms a slightly lower yield of tubers, and the Minerva variety forms the lowest. However, the latter potato variety is characterised by more favorable indicators for the starch content in tubers.

All potato varieties taken for the study in all years of cultivation reached the maximum yield level with the main background application of $N_{32}P_{32}K_{32}$ in autumn, $N_{48}P_{48}K_{48}$ in spring during planting, and three top dressings with ammonium nitrate (N_{33}) and Plantafol (2 kg/ha) at intervals of 8-10 days simultaneously with watering, starting from the budding phase. In these cultivation variants, with conditional processing of tubers for bioethanol or alcohol, it is possible to get their yield up to 3.0-3.6 and 3.4-4.0 t/ha, respectively.

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Оптимізація живлення ранньостиглих сортів картоплі на краплинному зрошенні Півдня України

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Анотація. Картопля є виключно важливою культурою харчування населення в Україні. Потенційні можливості її високі – до 100 т/га бульб, проте середня врожайність сягає 14–16 т/га. Для отримання значно вищої продуктивності необхідно удосконалювати основні елементи технології вирощування. Головним із факторів виробництва картоплі на краплинному зрошенні є оптимізація живлення рослин, саме цей захід нами взято на вивчення з трьома сортами ранньостиглої картоплі. Дослідженнями встановлено, що забезпечення рослин елементами живлення з добором сортів дозволяє збільшити продуктивність бульб до 37–39 т/га, або підвищити її рівень порівняно з контролем до 64,7 %. Визначено, що максимальну врожайність забезпечує основне внесення з осені $N_{32}P_{32}K_{32}$, перед садінням $N_{48}P_{48}K_{48}$ та проведення трьох підживлень упродовж вегетації одночасно з поливами загальною нормою N_{33} і Плантафолу 6 кг/га, починаючи з початку бутонізації з інтервалом 8–10 днів. При цьому формуються бульби з високими показниками якості – в них міститься достатня кількість сухих речовин, аскорбінової кислоти (вітаміну С) і крохмалю. Зазначимо, що за оптимізації живлення вступ усіх основних показників бульб картоплі порівняно до контролю, дещо знижувався, а саме сухих речовин та крохмалю. Кількість аскорбінової кислоти, навпаки, зростала й особливо за підживлень Плантафолом. Визначено і сортові особливості щодо впливу на якість бульб. Значно більше сухих речовин міститься в бульбах сортів Рів'єра і Прада, а крохмалю – Прада та Мінерва. Дещо менше, порівняно з іншими сортами сухої речовини і аскорбінової кислоти, визначено в бульбах картоплі сорту Мінерва. З вирощеного врожаю бульб досліджуваних сортів картоплі за умови їх переробки можливо отримувати до 4,0 т/га біоетанолу чи спирту

Ключові слова: урожайність, якість бульб картоплі, система удобрення, Плантафол, біоетанол, спирт