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The Nutrition Effect on the Quantity and Quality of the Potato Yield in the Irrigated Conditions of Askeran Region in the Artsakh Republic

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ABSTRACT

The effect of nitrogen nutrition with different doses and application methods on the quantity and quality of potato yield in the irrigated conditions of the Askeran region of NKR was studied throughout 2018-2019. Four fertilization variants have been studied: manure 25 t/ha+P₉₀ – background (control), background+N₃₀₊₍₃₅₊₃₅₎ – pre-sowing and split nutrition, background+N₁₀₀ – single nutrition, background+N₁₂₀ – single nutrition.

As a result of conducted studies and estimations of economic efficiency, it has been disclosed that among the tested variants the highest gross and commercial yield was provided by the variant of background+ N₃₀₊₍₃₅₊₃₅₎, which amounted to 321.5 c/ha and 250.5 c/ha respectively. Meanwhile, 2.6 mln AMD profit has been resulted from the sale of marketable product.

Introduction

In the contemporary conditions the most urgent issue in the horticultural production is to meet the gradually rising requirements of the population towards the high-quality agricultural food supply. The solution of the food provision issue has an extremely important strategic significance for poverty elimination and for the improvement of human living standards. So, the key to its solution can be found in the enhancement of the cultivation efficiency for such agricultural crops as, for example, potato, which is factually considered to be “the second bread”. From this perspective the increase of the potato production sizes together with the development of cereal crop production sector can greatly promote the comprehensive

solution of the problems in agri-food system.

Among the applied agro-technical events the establishment of scientifically justified fertilization system has an invaluable role in the increase of the potato yield capacity and its cultivation efficiency. Thus, the establishment of the abovementioned fertilization system is considered to be one of the extremely urgent tasks for the development of agriculture and increase of its production sizes in the Republic of Artsakh. Despite the fact that fertilization process is vital in the agro-technical measures of potato cultivation, the doses of the nurtured nitrogen shouldn't be abused, which can cause a number of undesired consequences as it has been already proved by numerous research experiments of different scientists (Matevosyan,

Gyulkhasyan, 2000, Grigoryan, 1999, Vavilov, 1986).

A number of authors believe (Pfeffer, 1999) that in irrigated conditions high potato yield can be ensured only by applying 40 t/ha manure through the main fertilization method.

The trials conducted by B.V. Anisimov have testified that the highest efficiency of potato cultivation in the irrigated conditions of the Poltava region is provided upon the fertilization variant of $N_{120}P_{100}K_{90}$ (Anisimov, 2005).

Materials and methods

In the irrigated conditions of the Askeran region at the Artsakh republic we have studied the effect of various nutrition doses of nitrogen on the quantity and quality of the “Latino” potato variety. The studies were carried out within 2018-2019 and based on the agro-chemical indicators characteristic to the soils of the mentioned region the following fertilization variants have been tested:

1. Manure- 25 t/ha+ P_{90} , which has been accepted as a background and taken as a control variant.
2. Background+ $N_{30+(35+35)}$, out of which N_{30} had been introduced before the tubers planting, while the nutrition with 35 kg nitrogen was implemented twice during the vegetation period in two different time periods.
3. Background+ N_{100} - with single nutrition.
4. Background+ N_{120} - with single nutrition.

The experiments were set up with 4 repetitions in 4 variants upon the randomization principle and the estimated size of each experimental bed was 50 m², while the whole experimental plot was 800 m². During the vegetation period the treatment and harvesting activities in all experimental beds of each variant were carried out

simultaneously and with the same principle, except for the nutritional doses of the nitrogen, which were provided according to the specifics of experimental variant selected by our research group.

Sturdy, undamaged 70 g-80 g potato tubers of “Latino” variety of the first reproduction have been selected as a planting material, which have been subjected to light germination for 28 days, the sprouts being amounted to 0.7-0.8 cm length (light germination was carried out under the 12 °C heating conditions and 70 % relative humidity). Planting was implemented in the third ten days of March (20.03 and 23.03 per study years) with the scheme of 70x30 and the study results are introduced in average indices.

Results and discussions

To study the efficiency of the recommended nutrition doses for the irrigated conditions of the Askeran region in the Artsakh republic and to identify the best variant, a number of phenological observations, measurements and weighing were conducted during the plants vegetation period. Based on the results of the aforementioned activities estimations on the economic efficiency were performed and the beneficial, as well as the most effective variant was identified. Particularly, the effect of nitrogen nutrition on the morphological indicators of the potato bush (plant height, the number of stems and leaves, leaf surface, etc.) was investigated, which alters significantly per variants (Table 1).

The table data testify that the bush height has increased together with the increase of nitrogen doses and exceeded the control variant by 9.7 cm-18.6 cm, besides the highest stem indicator has been recorded in N_{120} variant, which is quite an expected result, anyhow the similar growing

Table 1. The effect of nitrogen nutrition on a number of growing indicators in the surface parts of potato and its leaf surface (2018-2019)*

Variant	Bush height, cm	Ground-level stem diameter, mm	For one potato bush			Leaf surface in 1 ha, 1000 m ²
			Stems number, n	Leaves		
				Number, n	Leaf surface, cm ²	
Manure 25 t/ha+ P_{90} -background	53.7	7.8	2.7	107.2	4150.5	197.5
Background + $N_{30+(35+35)}$	63.4	12.4	3.3	138.2	5880.7	279.8
Background + N_{100}	64.2	11.0	3.0	140.3	5907.4	281.2
Background + N_{120}	72.3	10.2	3.1	151.4	6875.4	327.3

*Composed by the author.

rate is absent in the stem diameter and its number. On the ground-level part the largest diameter and the greatest stem numbers per a plant have been recorded in the first experimented variant (Background+N₃₀₊₍₃₅₊₃₅₎), where the nutrition was carried out through split fertilization method by the end of sprouting phase and at the end of budding phase. In the second experimented variant (Background+N₁₀₀) the plant height is almost close to that of the previous variant exceeding only by 0.8 cm (64.2 cm), while regarding the stem diameter it lags behind the former variant by 1.4 cm. Despite the fact that in both variants N₁₀₀ dose of fertilizer was totally introduced into the soil the significant differences in the mentioned indicators should be related only to the application times and methods of the fertilization in the soil.

The pre-sowing application of N₃₀ promotes the intensive growth of the newly formed plant and the bush formation, while by the end of sprouting stage the nutrition with N demonstrates its beneficial effect on the stems growth and the increase of their number (3.3 stems). Regarding the other indicator (leaf number and leaf surface) the variant of N₁₂₀ is unrivalled and such a high dose has promoted the plants stretching capacity and the increase in the leaf number and surface. The experimental doses of the nitrogen applied in the nutritional form have exerted their impact on the plants growth and on the duration of their

developmental phase transitions, the results of which are introduced in Table 2.

According to the two-year average data of the experiments the planting of the tubers was implemented on March 21 and the germination in all variants was observed 19 days after planting, since the planting material had been subjected to the light germination beforehand, nevertheless starting from the budding phase, prolongation in the duration of the developmental phases together with the increase of nitrogen doses was observed. For example, if in the variant of the background+N₃₀₊₍₃₅₊₃₅₎ the transition phase between the tubers planting period up to the budding stage was prolonged by 11 days as compared to the same period observed in the control variant and up to the flowering phase-by 4 days against the control variant, then in the variant of background+N₁₂₀ this difference was even more evident - by 14 and 13 days respectively, amounting to 92 and 99 days respectively. So, in accordance to these indicators the whole vegetation period of the plants was prolonged against that of the control variant by 6-15 days, totally amounting to 157-166 days.

The nutrition methods and doses of the nitrogen fertilizer have had a significant effect not only on the potato yield, but also on its quality and the quantity of the marketable tubers (Table 3).

Table 2. The effect of nitrogen nutrition on the potato growth, the duration times of developmental phase transition and on the vegetation period (2018-2019)*

Variant	Planting time	The duration of developmental phase transition (in days) from planting up to			
		Germination	Budding	Flowering	Natural death of haulms
Manure 25 t/ha+P ₉₀ -Background	21.03	19	78	86	151
Background +N ₃₀₊₍₃₅₊₃₅₎	21.03	19	89	90	157
Background +N ₁₀₀	21.03	19	88	91	158
Background +N ₁₂₀	21.03	19	92	99	166

Table 3. The effect of nitrogen nutrition on the structural elements and yield capacity indicators in a potato bush (2018-2019)*

Variant	For a potato bush					
	Tubers number, n	Tubers weight, g				Tuber gross yield
		Total	Marketability			
			Large	Medium	Small	
Manure 25 t/ha+P ₉₀ -Background	5.7	505.7	131.3	198.7	175.7	240.2
Background +N ₃₀₊₍₃₅₊₃₅₎	9.8	680.3	383.1	141.4	155.8	321.5
Background +N ₁₀₀	8.2	631.2	311.7	139.2	180.3	298.8
Background +N ₁₂₀	7.1	602.4	280.3	129.8	192.3	284.4

*Composed by the author.

Table 4. The economic efficiency of nitrogen nutrition in the potato sowings (2018-2019)*

Variants	Tubers' yield, c/ha		Commercial yield cost, thousand AMD	Sale price of 1c tuber, thousand AMD	Costs needed per 1 ha, thousand AMD	Profit per 1 ha, thousand AMD
	Gross	Commercial				
Manure 25 t/ha+P ₉₀ -Background	240.2	157.1	2043	13.0	574.0	1469
Background +N ₃₀₊₍₃₅₊₃₅₎	321.5	250.5	3250	13.0	642.0	2608
Background +N ₁₀₀	298.8	210.4	2730	13.0	634.0	2096
Background +N ₁₂₀	284.4	190.7	2480	13.0	672.0	1808

*Composed by the author.

Regarding the number and weight of tubers formed per a potato bush the variant of background+N₃₀₊₍₃₅₊₃₅₎ is unrivalled, which has surpassed the control variant by 4.1 tubers and 174.6 g, while the other experimented variants stay behind the mentioned variant by 1.6-2.7 tubers and 49.1 g - 77.9 g respectively. Despite the fact that in the first and second experimental variants the doses of nitrogen are equal (N₁₀₀), they significantly differ by the resulted yield quantity and its marketability, the main reason of which is the time and method of fertilizer's application. In the variant of background+N₃₀₊₍₃₅₊₃₅₎, the fertilizer introduced with N₃₅ dose in nutritional form at the end of germination phase, has had its positive impact on the intensive stem formation and further stolon formation processes. The remaining part of the nitrogen (N₃₅) introduced in the budding phase promotes the process of tuber formation and the emergence of the large tubers, which is clearly shown by the data of Table 3. Thus, in the best variant the lowest weight of small tubers formed per a bush is recorded which makes 155.8 g. In case of single nutrition with the dose of N₁₀₀ not only a decrease in the resulted yield but also an increase in the weight of small tubers by 24.5 g (180.3 g) is recorded, meanwhile the weight of the large tubers have decreased by 71.4 g (311.7 g).

The further increase of the nitrogen dose (N₁₂₀) introduced into the soil in the single nutritional form leads not only to the decrease of the tuber yield, but also to the increase of the number and weight of the small tubers. Regarding the last indicator it has exceeded the best variant by 36.5 g and the control variant by 16.6 g.

To make sure that among all the tested variants background+N₃₀₊₍₃₅₊₃₅₎ is the most efficient and practical fertilization variant for agricultural production, an estimation for its economic efficiency has been also conducted and the size of the received profit has been determined, the results of which are summed up in Table 4.

The distinguished variant (background+N₃₀₊₍₃₅₊₃₅₎) exceeded all variants both in the gross yield and commercial yield quantity providing 321.5 c/ha and 250.5 c/ha yield respectively. Accepting that the sale price for one centner tuber is 13 thousand AMD, the cost of the marketable yield and the size of the received profit have been estimated as a result of which it has been revealed that the mentioned variant has provided 2.6 mln AMD profit. This number has surpassed that of the control variant by 1.2 mln AMD and the experimented variants - by 0.5-0.8 mln AMD.

Conclusion

Upon the results of the conducted research experiments it becomes clear that in the irrigated conditions of the Askeran region the variant of background+N₃₀₊₍₃₅₊₃₅₎ is considered to be the most efficient fertilization method for potato. It provides an unprecedentedly high profit per hectare and hence, is recommended to the farmers engaged in potato cultivation. So, as the potato yield grows up in case of applying the mentioned cultivation method the import sizes of potato from abroad can be significantly reduced as well.

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