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THE IMPACT OF THE CONTENT OF NUTRIENTS IN POTATO LEAVES ON THE GROWTH AND YIELD OF THE PLANT

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The method of determining the content of nutrients in plant leaves (chemical analysis of plants) is considered to be a method of determining the requirement for fertilization and providing nutrients.

The aim of the study was to find out the relation between NPK content, yield, supply of nutrients and efficiency of using fertilizers in the plant. These studies allow us to determine the content of NPK, the need of usage of fertilizers and their dasages through leaf analysis. The results of these studies are summarized in Tables 4 and 5.

Studies have been carried out on «Impala» sort which is a high-yield, edible and early grown sort. Nitrogen, phosphorus and potassium content in the leaves of the plant was determined by Kieldal method for nitrogen, phosphorus by colorimetric and potassium by the flame photometer method.

Key words: leaf, chemical analyses, nutrients, fetilizer, plant, potato.

Introduction

Determination of the dosage of fertilizers of crops is of major economic and environmental importance. Various methods have been developed to settle this important issue. The method of determining the content of nutrients available to plants in the soil is the most common [1, 2, 4, 6, 18].

An important method of determining the nutrient requirement and fertilization of plants is also the method of determination of nutrients content in the leaves of the plant (method of chemical analysis of plants). It is based on the fact that there is a definite link between the chemical composition of the plant such as nitrogen, phosphorus and potassium (other nutrients as well) and the supply of plant nutrients [3, 7, 8, 9]. It should be noted that the method of chemical analysis of plants is more widely used in European countries, the USA, Japan etc. [3, 7, 8, 17]. In many countries the «optimal» amounts of nutrients of certain crops are determined on the basis of this method. These are those amounts when the plants are considered to be well supplied with nutrients and do not need fertilization [11, 17, 22, 23].

The irreplacable role of each nutrient in plant growth and crop formation is known. In particular, the nitrogen supply of the plant determines the growth and the amount of crops. Phosphorus contributes to the growth of the root system reducing the amount of water consumed to obtain a single harvest. Potassium increases the efficiency of photosynthesis and cellular turgor and increases the viability of tubers. Calcium promotes root growth and wall thickening of plant cell which allows to withstand many diseases and pests. It is established that the plant gets 5,4-6,0 kg N, 2,0-2,4 kg P_2O_5, 9,1-10,5 kg K_2O, 3,5 - 3,6 kg Ca and 2,0-2,1 kg Mg for harvesting 1 tonne of tuber yield. The plant of potato is very sensitive to the deficiency of nitrogen: the haulms turn yellow, the crop declines and in the case of rise of nitrogen there is a strong growth of the haulms, plant growth is delayed and crop declines. The deficiency of potassium and phosphorus reduces the efficiency of photosynthesis, yield and quality of tubers [11, 13].

It is proved that the chemical composition of the leaves and roots of potato, including nitrogen, phosphorus and potassium content, largely depends on soil and climatic conditions, stage of plant growth and nutrient availability. Such relation allows to determine the supply of nutrients (NPK, etc.) of potato and the need for fertilization based on the determination of the chemical composition of the leaves.

It is proved that the active nutrient absorption of plants occurs during its rapid growth which coincides with the stages of leaf foliage, buttoning and flowering [16, 21, 28, 36]. During the further growth of the plant the absorbtion of nutrients out from the soil significantly decreases but the plant still uses organic agents and nutrients accumulated in the stems, leaves and roots (13, 18, 20). As a result during the natural death of haulms the main content of nutrients in the mentioned parts minimizes. The plant of potato uses 27-28% of nitrogen, 22-23% of phosphorus and 20-21% of potassium during the period of buttoning and during the period of flowering when the overground part of the plant is already formed, the plant uses 67% of nitrogen, 75% of phosphorus and 80% of potassium and during the active period of tuber formation these rates reach correspondingly to 91, 95 and 98% [13, 18]. These rates show that fertilization should be done in such periods when the plant is provided with necessary nutrients. While fertilizing the nutrition of early sorts of potato is done within uncomparably shorter time than that of late grown crops which should be taken into account [18, 20].

The fluctuations of potato nutrition were proved to have a greater effect on the content of nitrogen, phosphorus, potassium and other elements in the leaves. Consequently, this relation enables to determine the supply of NPK of the plant and to determine the need for nutrition and the amount of application of fertilizers based on the determination of these elements. Unstable nutrition not only affects plant growth and viability but also reflects the nutritional status of the plant which the plant growth, yield, tuber quality and resistance to disease and partly to pests depend on [5, 10, 12, 14, 19].

Conflict setting

Field studies and laboratory observations were done in 2011-2015 in Qrasni village of RA Askeran region by the following schemes:

Experiement № 1	Experiment № 2
1. Without fertilizing (tester)	1. Without fertilizing (tester)
2. $N_{90}P_{90}K_{90}$	2. $N_{90}P_{90}K_{90}$ (KCl)
3. Manure 30 t/ha	3. $N_{90}P_{90}K_{90}$ (RDT) 600 kg/ha
4. $N_{90}P_{90}K_{90}$ + manure 30t/ha	4. $N_{90}P_{90}K_{90}$ (RDT) 600 kg/ha + MM
5. $N_{90}P_{90}K_{90}$ + manure 30t/ha	5. $N_{90}P_{90}K_{90}$ (KCl) + bentonite 300 kg/ha
6. $N_{90}P_{90}K_{90}$ + manure 30t/ha	6. $N_{90}P_{90}K_{90}$ (KCl) + gypsum 300 kg/ha

As it is seen from the schemes of the experiments, during the first experiment manure and mineral fertilizers were applied separately and mixed and during the second experiment the impact of ameliorators and mineral fertilizers on the content of nitrogen, phosphorus and potassium dynamics in potato leaves and the yield of tuber was revealed. Relation was established between the content of NPK in the leaves and the supply and yield of the plant connected with these nutrients. Those «optimal» amounts of nitrogen, phosphorus and potassium in the leaves were stated on the basis of studies when the plant is privided by all these nutrients and there is no need for fertilization.

Experiments were held thrise, the dimension of one experimental row is 105m^2 (3.5m x 30m = 105m^2) and feeding surface of one plant is 0.21m^2 (0,7m x 0,3m). All the observations, biometric measurements and crop amount accounting were done repeatedly.

Studies have been carried out on “Impala” sort which is a high-yield, edible and early grown sort. The tubers are oval shaped, the sarcocarp is partially yellowish and medium. The resistance of haulms is medium to phytophtora and the plant is resistant to eelworm.

“MM” biofertilizer was obtained by the Institute of Biochemistry of the National Academy of Sciences of the Republic of Armenia and it contains various useful microorganisms and also micro-elements. It is used for soaking the seeds, watering the soil and providing extra nourishment.

Recycled dacite tuff (RDT) is a complex fertilizer containing potassium, calcium, magnesium, phosphorus and amorphous silicon dioxide. It is obtained by thermochemical treatment of rich potassium (up to 9,5-15,1%) dacite tuff. The method of obtaining was developed by the Institute of

General and Inorganic Chemistry of NAS RA and ANAU. Fertilizer also has indirect positive properties which makes it more effective compared to KCl [21].

During vegetation the stages of the growth and development of the plant were determined: germination, buttoning, flowering and natural death of haulms by visual method and plant height by linear measurement method.

Nitrogen, phosphorus and potassium content in the leaves of plants were determined at the stages of germination, buttoning, flowering and natural death of the haulms: nitrogen by the Kieldall, phosphorus by the method of colorimetric and potassium by the flame photometer method.

Pieces of land were cut for soil characterization (N 1 and 2) and were described, then soil samples were taken from genetic horizons and their agrochemical and agrophysical properties were determined. Humus was determined by Turin method, pH was determined by pH-meter, water-solvent salts were determined by ultrameter, carbonates - by calcimeter and mechanical composition was determined by pipette method.

Nitrogen which is available to plants was determined by Thurin-Cononova solvent extract, phosphorus by Machigin and potassium by Machigin solution extracts [24].

Tuber crop was calculated according to the experimental rows, then data was recalculated by c/ha. The data of yield were subjected to mathematical processing. The most significant difference between variants (SM) and experimental error (Sx%) was calculated (34).

Research results

Field studies were done on forest brown soils [25] and the agrochemical rates of experimental soils were summarized in Table 1.

Table 1

Agrochemical characteristics of experimental soils

The site of taking soil sample and the experiment	Depth of taking soil sample, cm	Humus content, %	pH in water intake	Content of water solvent salts, %	Carbonates, $CaCO_3$, %	Physical clay, %	Available nutrients, mg, 100 g soil		
							N	P_2O_5	K_2O
Experiment N=1 Cutting N=1	0-19	4.29	7.1	0.116	3.60	58.9	4.5	3.80	55.1
	19-44	3.71	7.3	0.091	4.70	56.6	3.6	3.10	48.6
Experiment N=2 Cutting N=2	0-22	3.18	6.8	0.108	0.12	61.2	4.6	0.78	45.5
	22-49	2.06	6.9	0.081	1.21	60.4	2.8	0.49	39.5

The data of the table show that they are significantly different from each other. Humus content in the upper layer of the soil of the experimental site is 4,29%, reaction is neutral, the content of solvent salts is permitted within 0,116%, carbonates comprise 3,6%, mechanical composition is heavy clay, i.e. physical clay is 58,9%.

According to soil sample number 1 of ANAU branch of scientific centre of Soil Science, Agrichemistry and Amelioration after H. Petrosyan, it is considered to be weak in nitrogen, medium in phosphorus and strong in potassium.

The soil sample number 2 is poor in nutrients and humus available for plants. In the upper layer the content of humus comprises 3,18%, pH is 68, water solvent salts is 0,108, carbonates comprise 0,12% and physical clay is 61,2%.

It is poorly supplied by nitrogen and phosphorus and well supplied by potassium (Table 1).

Taking into consideration that numerous studies have linked the content of nitrogen, phosphorus and the content of potassium and in four stages of the growth of potato (germination, blossomig, flowering, natural death of haulms) the content of these nutrients was determined in the leaves which enabled us to define the optimal amount of these elements when the plant does not need any fertilization. The obtained results are summarized in Tables 2 and 3.

According to the data presented in these tables, the NPK content in the leaves gradually decreases during vegetation reaching to a minimum at the end of vegetation. However, the amount of reduction depends on the fertilization.

As in Experiment 1, nitrogen content in leaves of potatoes during blooming period was 4,75%, 4,47% at flowering stage, 3,61% at the end of flowering stage and 0,93% at the beginning of natural death of haulms (Table 2). Only in the fertilized versions ($N_{90}P_{90}K_{90}$) the nitrogen content was about as much as it was in the checker that is 4,67% and at the end of vegetation it is 0,95%.

Table 2

The impact of fertilizers on the content of nutrients in potato leaves (2012-2015 average), % Experiment №1

Versions		Germimnation			Buttonning			End of flowering			Beginning of natural death of haulms		
		N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
1	Without fertilization	4,75	0,61	5,01	4,47	0,58	4,65	3,61	0,39	3,90	0,93	0,15	0,95
2	$N_{90}P_{90}K_{90}$	4,67	0,70	5,18	4,41	0,70	4,92	3,82	0,50	4,32	0,95	0,23	1,13
3	Manure 30t/ha	5,04	0,70	5,14	4,50	0,62	4,90	3,70	0,44	4,35	1,12	0,30	1,24
4	$N_{90}P_{90}K_{90}$ + manure 30t/ha	4,90	0,78	5,30	4,42	0,82	5,02	4,01	0,63	4,65	1,24	0,35	1,30
5	$N_{120}P_{90}K_{90}$ + manure 30t/ha	4,95	0,75	5,31	4,50	0,79	5,09	4,12	0,60	4,67	1,30	0,35	1,29
6	$N_{150}P_{90}K_{90}$ + manure 30t/hha	4,96	0,76	5,28	4,53	0,81	5,10	4,35	0,57	4,64	1,37	0,31	1,28

This is due to the fact that nitrogen feeding was performed later in the stage of blooming-flowering of the plant and as a result, the nitrogen content had increased at the end of flowering to a certain extent compared to the tester but further decreased again to the level of the tester. This fact indicates that 90 kg/ha of nitrogen in $N_{90}P_{90}K_{90}$ system did not meet the plant requirement for that element.

Only in the version which had received organic fertilizer (manure 30 t/ha), nitrogen content (germination) was 5,04% at the beginning of vegetation, 4,50% at the blooming stage and 3,70% and 1,12% at the end of flowering and at the beginning of natural death of haulms respectively. Nitrogen content in the leaves was maintained at higher levels and varied from 4,90 to 1,24% and from 4,95 to 1,30% respectively during the whole vegetation period in the system of (NPK) fertilizers and 30t/ha manure in the versions of N_{90} and N_{120} (versions 4 and 5). The sharp reduction of nitrogen content at the end of plant flowering and later on is due to the rapid growth of the plant that time which requires large amounts of nitrogen and other nutrients as it has been proven by other researchers [19]. Higher nitrogen content in leaves was preserved in the version where the maximum amount of nitrogen fertilizer was applied with manure (version 6).

In case of sufficient quantities of essential nutrients they have contributed to both increased crop yields and improved tuber quality.

Hence, by examining the effect of fertilizer application on the dynamics of nitrogen, phosphorus and potassium content in potato leaves, it was found out that their quantities decrease gradually along with the stages of growth and less amounts are preserved during the natural death of haulms which is conditioned by the biological peculiarities of potato.

Table 3

Impact of fertilizers and ameliorators on the dynamics of nutrient content in potato leaves (NPK) (2012-2015), % Experiment №2

Versions		Germination			Buttoning			End of flowering			Beginning of natural death of haulms		
		N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
1	Without fertilizer (tester)	3,65	0,37	4,12	3,54	0,31	3,72	2,94	0,25	3,14	0,67	0,10	0,65
2	$N_{90}P_{90}K_{90}$ (KCl)	3,66	0,36	4,10	3,48	0,48	4,15	3,58	0,31	3,62	0,78	0,16	0,87
3	$N_{90}P_{90}K_{90}$ (RDT) 600 kg/ha	3,71	0,35	4,26	3,78	0,60	4,75	3,73	0,42	3,95	0,86	0,38	0,95
4	$N_{90}P_{90}K_{90}$ (RDT) 600 kg/ha + MM	3,63	0,38	4,29	3,68	0,69	4,73	3,71	0,50	4,04	1,06	0,38	1,08
5	$N_{90}P_{90}K_{90}$ (KCl) + bentonit 300 kg/ha	3,61	0,36	4,12	3,45	0,39	4,12	3,41	0,32	3,57	0,75	0,16	0,79
6	$N_{90}P_{90}K_{90}$ (KCl) + gypsum 300 kg/ha	3,68	0,35	4,15	3,60	0,39	4,33	3,35	0,30	3,63	0,80	0,26	0,89

At the end of vegetation most of the nutrients and organic substances accumulated from the upper mass flow into the tubers (storage organs) [26]. Despite this, the content of nutrients (NPK) in the leaves is conditioned by the supply of these elements in the leaves: the higher the plant is provided with these nutrients, the higher the content of the nutrient is and this allows the chemical analysis of the leaves to determine the degree of provision of the specified elements of potato and also the need for fertilization.

It should be noted that many countries with developed agriculture have defined “optimal amounts” of nitrogen, phosphorus, potassium and other nutrients in the leaves (varieties) according to the stages of plant growth and crop varieties when the plants are considered to be fully provided with nutrients and yield a good harvest typical of the certain sort.

According to the results of our research, at the end of the flowering stage of “Impala” sort of potato 4,01 - 4,12% of nitrogen, 0,44 - 0,63% of phosphorus and 4,32 - 4,64% potassium in the leaves can be considered as “optimal" quantities”.

Table 3 presents the results obtained in Experiment 2 which concern the impact of using mineral fertilizers, biofertilizer “MM” and ameliorators on the dynamics of nitrogen, phosphorus and potassium contents in potato leaves. The data show that as in Experiment 1, the nutrients are gradually decreasing during the vegetation process here starting from the buttoning stage the extent of which is entirely conditioned by fertilization (plant nutrition).

The nitrogen, phosphorus and potassium content is less in the tester the amount of which declines sharply during vegetation and at the end of flowering and the natural death of the haulms they reach the minimum amounts. While NPK content was relatively high in fertilized versions, their size still depends on fertilization. Thus, the application of $N_{90}P_{90}K_{90}$ (KCl) increased the nitrogen, phosphorus and potassium amounts in the leaves at all stages of plant growth and the use of bentonite or gypsum (versions 5,6) had no effect on the NPK content in this case, so we can conclude that it did not affect the nutritional process of the plant. Whereas when KCl was replaced by dacitic tuff (RDT) in NPK system and biofertilizer “MM” was applied in this case, the NPK content in leaves increased significantly compared with tester and $N_{90}P_{90}K_{90}$ (KCl) version. Especially in the case of increased nitrogen this phenomenon is conditioned by the fact that RDT prevents nitrogen loss from the soil and fertilizers which the plants use. The use of “MM” biofertilizer contributes to the accumulation of biological nitrogen in soil as it also contains nitrogen fixing bacteria among other bacteria [20]. This fertilizer also mitigates the development of diseases. The increase of phosphorus is conditioned by certain amount of phosphorus in RDT and with increasing hard solubility of phosphorus compounds in the soil [21]. The increase of potassium in leaves influenced by RDT is again conditioned by the positive effect of fertilizer contributing to the increase of absorption of potassium by the plant which has been stated by other researchers [12, 14].

As it was mentioned, the purpose of the study was to determine the relation between NPK content in potato leaves, crop yield, nutrient availability and efficiency of fertilizer application. These studies allow to determine NPK content in the plant, the need and application of fertilizers through leaf analysis. The results of these studies are summarized in Tables 4 and 5.

The data from these tables show that applying fertilizers has a significant effect on both the potato yield and NPK content of the leaves. But their size depends on the fertilizing system. Hence, according to the data of Experiment 1 (Table 4), the tuber harvest in the tester (average of 3 years) was 145 c/ha and in fertilized versions it was 172-218 c/ha. The highest yield (203-218 c/ha) was obtained in the places where manure was applied with mineral fertilizers (variants $N_{120}P_{90}K_{90}$N + manure 30 t/ha, + manure 30 t/ha and $N_{120}P_{90}K_{90}$N + manure 30 t/ha). In these versions the NPK content in leaves is also significantly higher, nitrogen – 4,01 - 4,35%, phosphorus is 0,57 – 0,63% and potassium is 4,64 -4,67%. However, the yield of tubers in tester was 145 c/ha, nitrogen in leaves – 3,61%, phosphorus – 0,39% and potassium – 3,90%.

Table 4

The impact of fertilizers on NPK content and yield of tubers in potato leaves (experiment №1)

№	Versions	Tuber yield for years, c/ha			Average yield of tuber, c/ha	Content in leaves, %		
		2012	2013	2014		N	P_2O_5	K_2O
1	Without fertilizer (tester)	148	127	160	145	3,61	0,39	3,90
2	$N_{90}P_{90}K_{90}$	174	147	195	172	3,82	0,50	4,32
3	Manure 30t/ha	193	164	216	191	3,70	0,44	4,35
4	$N_{90}P_{90}K_{90}$ + manure 30t/ha	206	175	228	203	4,01	0,63	4,65
5	$N_{90}P_{90}K_{90}$ + manure 30t/ha	223	193	238	218	4,12	0,60	4,67
6	$N_{90}P_{90}K_{90}$ + manure 30t/ha	209	176	230	205	4,35	0,57	4,64

DSM 05 = 7,5 c/ha Sx% = 1,3%

Similar regularity between the yield, efficiency of fertilzing and NPK content in leaves is regarded also in Experiment 2 (Table 5). Therefore, more harvest and more efficicnecy of fertilizers was obtained in those versions where the nitrogen content comprised 3,71 – 3,73%, phosphorus was 0,4 2- 0,50 and potassium was 3,95 – 4,04%, whereas the crop in tester was 157c/ha, nitrogen in leaves comprised 2,94%, phosphorus 0,25% and potassium 3,14%.

Table 5

The impact of fertilizers and ameliorators on the yield of tuber and NPK content in potato leaves (experiment №2)

№	Versions	Tuber crop for years, c/ha			Average crop of tuber, c/ha	Content in leaves, %		
		2012	2013	2014		N	P_2O_5	K_2O
1	Without fertilization (tester)	195	140	136	157	2,94	0,25	3,14
2	$N_{90}P_{90}K_{90}$ (KCl)	201	174	195	190	3,58	0.31	3.62
3	$N_{90}P_{90}K_{90}$ (RDT) 600 kg/ha	231	193	230	218	3,73	0,42	3,95
4	$N_{90}P_{90}K_{90}$ (RDT) 600 kg/ha + MM	252	217	254	241	3,71	0,50	4,04
5	$N_{90}P_{90}K_{90}$ (KCl) + bentonite 300կգ/հա	220	180	221	207	3,41	0.32	3,57
6	$N_{90}P_{90}K_{90}$ (KCl) + gypsum 300 kg/ha	204	160	194	186	3,35	0,30	3,63

DSM = 22,3 c/ha Sx% = 3,6%

Conclusion

Field studies and laboratory experiments show that during the observations in 2011-2015 in forest dark brown crop fields of Askeran region of the Republic of Artsakh these soils differ greatly in terms of agrochemical and agrophysical properties and also in terms of fertility.

1. The plants are weakly provided with available nitrogen, medium or weak by phosphorus and medium or good by potassium. Hence the use of fertilizers is an important agri-technical activity.

2. By creating favorable conditions for potato nourishing through efficient system of fertilization the absolute and relative amounts of nitrogen, phosphorus and potassium in potato leaves fluctuate within certain limit of dimension. It enables to determine the “optimal” amounts of NPK supply of the plant.
3. According to the results of the experiments in the end of flowering stage of Impala sort the “optimal” amount of nitrogen in the leaves comprises 3,71 – 4,01%, phosphorus is 0,32 – 0,62% and potassium is 3,57 – 4,64%.
4. More crop was obtained in experimental site number 1 as 203-2018 c/ha where the amount of nitrogen comprises 4,01 - 4,35% in the leaves of potato under the influence of fertilizers, phosphorus comprised 0,57 – 0,63% and potassium was 4, 64 – 4,67% respectively. In the second experiment we have obtained more crop as 218 – 241 c/ha as a result of those versions of fertilization where the amount of nitrogen in leaves comprised 3,71 – 3,73%, phosphorus was 0,42 – 0,50% and potassium 3,95 – 4,04% respectively.

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ԿԱՐՏՈՖԻԼԻ ՏԵՐԵՎՆԵՐՈՒՄ ՍՆՆԴԱՏԱՐՐԵՐԻ ՊԱՐՈՒՆԱԿՈՒԹՅԱՆ ԱԶԴԵՑՈՒԹՅՈՒՆԸ ԲՈՒՅՍԻ ԱՃԻ ՈՒ ԲԵՐՔԱՏՎՈՒԹՅԱՆ ՎՐԱ

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Բույսի տերևներում սննդատարրերի պարունակության որոշման մեթոդը (բույսի քիմիական անալիզ) հանդիսանում է, որպես պարարտացման պահանջի որոշման և սննդատարրերով ապահովված մեթոդ:

Հետազոտության նպատակն է եղել պարզել կարտոֆիլի տերևներում NPK-ի պարունակության, բերքատվության, բույսի այդ սննդատարրերով ապահովվածության և պարարտանյութերի կիրառման արդյունավետության միջև եղած կապը: Այդ ուսումնասիրությունները հնարավորություն են տալիս տերևների անալիզի միջոցով որոշել բույսի NPK-ով ապահովվածությունը, պարարտանյութերի կիրառման անհրաժեշտությունը և չափաքանակները: Այս կապակցությամբ կատարված ուսումնասիրությունների արդյունքներն ամփոփված են թիվ 4 և 5 աղյուսակներում:

Ուսումնասիրությունները կատարվել են «Իմպալա» սորտի վրա, որը գերվաղահաս, սեղանի, բարձր բերքատու սորտ է: Բույսի տերևներում ազոտի, ֆոսֆորի և կալիումի պարունակությունը որոշվել է ազոտը՝ Կյելդալի, ֆոսֆորը՝ գունաչափական, կալիումը՝ բոցային ֆոտոմետրի մեթոդով:

Բանալի բառեր. տերև, քիմիական անալիզ, սննդատարրեր, պարարտանյութ, բույս, կարտոֆիլ:

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ВЛИЯНИЕ СОДЕРЖАНИЯ ПИТАТЕЛЬНЫХ ВЕЩЕСТВ В ЛИСТЬЯХ КАРТОФЕЛЯ НА РОСТ И УРОЖАЙНОСТЬ РАСТЕНИЯ

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Метод определения содержания питательных веществ в листьх растения (химический анали), является метод определения необходимости удобрения и обеспеченности питательными веществами.

Цель исследования – выяснить содержание NPK в листьях картофеля, урожайность, обеспеченность этими элементами растения и связь между применением удобрений и эффективностью. Исследования дают возможность с помощью анализа листьев определить обеспеченность растения NPK, необходимость применеия удобрений и определения их количества. Результаты проведенных исследований обобщены в таблицах 4 и 5.

Исследования проведены на ранеспелом, высокоурожайном сорте картофеля Импала. В листьях растения содержание азота, фосфора и калия определили: азот-методом Кейдаля, фосфор-колориметрическим методом, калий-методом пламенного фотометра.

Ключевые слова: лист, химический анализ, питательное вещесво, растение, картофель.

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