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Efficiency of Different Fertilizers Doses Introduction Under Potatoes On Grey Forest Soils Of The Tatarstan Republic

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ABSTRACT

One of the priority potatoes directions is a grocery half-complex of the Tatarstan Republic is selection of the new highly productive potato sorts steady to action of abiotic and biotic factors and introduction of optimum fertilizer doses providing a steady potato harvest. Researches were conducted on the gray forest mid-loamy with particle size distribution, for the purpose of establishing optimum nutrition level. For this purpose were studied the efficiency of introduction under an early ripe grade of potatoes Karatop 40t/hectare organic and different doses of mineral fertilizers. As a result of researches it is established that introduction 40t/hectare manure under potatoes increased the area of leaves by 9,56 thousand sq.m/hectare, a tubers harvest on 5,32 t/hectare, gathering starch on 0,88t/hectare, introduction of mineral fertilizers in a dose of $N_{90}P_{90}K_{120}$ reduced distribution of late blight by 1.29%, early blight for 0,41%, provided a harvest increase on 8,41 t/hectare, the top tubers yield of 28,49 t/hectare was formed at introduction of the raised dose of mineral fertilizers in $N_{120}P_{90}K_{140}$ dose, however on this background the maintenance of some decrease quality indicators was noted. **Keywords:** grade, sheet surface, potatoes, productivity, Amylum, vitamin C, Sodium nitritums.

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INTRODUCTION

The question of potatoes responsiveness on fertilizers application is studied for a long time, however so far such researches are urgent. Reaction of different potato sorts to fertilizers application differs, especially it depends on fertility of the soil and weather conditions.

With high quality of tubers they have to be available to formation of a potato harvest in time, in necessary quantity and in the necessary form [Korshunov, 1982; Sturm, Buchner, Zerulla, 1994].

In V. M. Shramko and I. G. Meltsayev [2005] experiences fertilizers application in $N_{120}P_{90}K_{120}$ dose in comparison with control option increased productivity of a grade the Nevsky – on 11,5, Belongings on 6,0, Lugovskoy on 9,8 t/hectare at productivity – 20,7; 20,8 and 20,7 t/hectare on control. Content of starch in tubers at the same time decreased, and gathering with 1 hectare increased.

In researches M. K. Koksharova and S. N. Karimova [2002] for conditions of Central Ural Mountains Pomegranate was an optimum dose of fertilizers for a grade $N_{90}P_{180}K_{180}$ at which the most big crop of tubers - 35,1 t/hectare was formed, against 15,0 t/hectare on control without use of fertilizers.

A. V. Korshunov and A. V. Semenov [2003] the researches established that in the Moscow region a big crop a grade Nevsky – 29,0 t / GAI Blueness of 25,3 t/hectare created a grade against the background of fertilizers application in $N_{100}P_{150}K_{150}$ dose.

In researches Y. P. Zhukova and T.I. Volodin [2001] on the dark-chestnut soil of Northern Kazakhstan the greatest harvests of potato tubers were formed at introduction of a dose of the $N_{90}P_{90}K_{90}$ and sostavili23,0 fertilizers - 24,0 t/hectare.

In G. A. Zykova [2007] experiences in the conditions of the Mari Republic at introduction of mineral fertilizers in the ratio $N_{90}P_{40}K_{110}$ depending on predecessors provided a harvest increase on 4,2 and 4,27 t/hectare or for 37,5 and 43,5%.

According to A. V. Korshunov and B. A. Popov [1976] for formation of big crops about 60 t/hectare with high quality of tubers in relation to the cultivated cespitose and podsolic sandy soils in the conditions of irrigation (75-85% of NV) are $N_{150}P_{150-180}K_{180}$ doses.

B. A. Pisarev [1990] considers that for increase in a harvest and tastes of potatoes organic fertilizers have special value. However they decay slowly and during an initial stage of growth of plants are used by them rather poorly. To provide potatoes with enough nutrients and during the earliest period of life, it is necessary in addition to organic to introduce the mineral fertilizers containing nutrients in a readily available form.

A number of researchers indicates decrease in content of starch by 0,24-1,9% under the influence of mineral fertilizers [Masur, войтас, 1992].

Y. S. Avdeev (1973), V. A. Tsaregorodtsev and N. S. Almetov (1996) explain negative influence of fertilizers on the content of starch in tubers with the wrong ratio of nutritious elements in the introduced fertilizers. Considerable prevalence of nitrogen over phosphorus as a part of fertilizer promoted strengthening of growth processes in tubers to the detriment of education and adjournment of spare substances that led to decrease in starch.

CONDITIONS, MATERIALS AND RESEARCH METHODS

Experiments were made on pilot fields of the Kazan state agricultural university in 2013-2015. Before laying of experience detailed examination of the soil of pilot sites was conducted. Soil of the pilot site gray forest srednesuglinisty particle size distribution. Relief of the pilot site equal. Capacity of an arable layer of 24-26 cm, pH a salt extract 4,58-5,26, content of a humus across Tyurin 3,27-3,54%, mobile phosphorus 124-131 and exchange potassium of 164-172 mg on 1 kg of the soil.

Scheme of experience: 1. Without fertilizers (control). 2. Manure 40 t/hectare. 3. N₆₀P₆₀K₉₀. 4. N₉₀P₉₀K₁₂₀. 5. N₁₂₀P₉₀K₁₄₀.

For landing used tubers of average fraction (60-65 g). Landing carried out 8-10 cm on landing depth. Total area of an allotment of 72,0 accounting 60,0 m². Frequency of experience triple. For landing tubers of the first reproduction, density of landing of 53,2 thousand pieces/hectare used. A predecessor – the winter wheat going on black steam.

Crests with a row-spacing of 75 cm cut four-row a crest - the forming mill. Staining of tubers with the medicine Prestige of KS (1,0 l/t, with a consumption of working liquid of 10 l/t) was seen off when landing. Organic fertilizers brought under autumn plowing, mineral in landing time.

Care of landing consisted of milling of the soil in case of which weeds were destroyed and closed up to the soil. After the shrinkage of the soil brought herbicide Zenkor Tekhno of VDG in a dose of 1,2 kg/hectare. Against late blight and early blight used fungicide Ridomil gold MTs (2,5 kg/hectare), Shirlan of SK (0,4 l/hectare) and cupriferous medicines.

ANALYSIS AND DISCUSSION OF RESULTS OF A RESEARCH

The developing weather conditions in the years of carrying out researches had no significant effect on efficiency of potatoes, though they differed by years. It was promoted by the applied irrigations during vegetation of plants, especially in a phase of budding and formation of tubers.

The potato plants number on unit of area by options of experience differed slightly as density of landing was identical – 53,20 thousand pieces/hectare. However it is necessary to carry out attentively plants during their growth and development of plants. Attaching value above told, we defined form influence and doses of fertilizers on change of potato plants number during vegetation. By the time of harvesting control option there was a decrease in number of plants by 0,15 thousand pieces/hectare, against the background of introduction of 40 t/hectare of manure – on 0,13 thousand pieces/hectare. Against the background of introduction of the maximum dose of mineral fertilizers (N₁₂₀P₉₀K₁₄₀) their number decreased only by 0,07 thousand pieces/hectare.

Real Square of potato is defined not only by quantity of the yielded tubers, but also quantity of stalks in a bush. The data obtained by us during the researches showed that on average for 3 years on one plant from 4,06 to 4,52 stalks were formed. At the same time the applied organic fertilizers in a dose of 40 t/hectare and the increasing doses of mineral fertilizers significantly didn't change number of stalks on a plant. Their number depending on the increasing backgrounds of nutrition increased by 0,21-0,46 pieces on 1 bush or on 11-25 thousand pieces/hectare. It demonstrates that the number of stalks on a bush is a high-quality sign which is defined by number of sprouts, the mass of seed tubers, a physiological condition of landing material.

	Plants height	Quantity of stalks, p./bush	Quantity of stalks, th. p./he
no fertilizers	64,8	4,06	214
manure 40 t./he	70,6	4,27	225
N ₆₀ P ₆₀ K ₉₀	72,5	4,36	230
N ₉₀ P ₉₀ K ₁₂₀	77,4	4,47	236
N ₁₂₀ P ₉₀ K ₁₄₀	81,5	4,52	239

Table 1. Height of plants and number of potato stalks of a grade Karatop depending on introduction of different types and doses of fertilizers, 2013-2015.

On control with no fertilizers application height of potato plants made 64,8 cm. Introducing manure in a dose of 40 t/hectare raised it on 5,8 cm, mineral fertilizers N₆₀P₆₀K₉₀-dose on 7,7 cm. The highest plants of 81,7 cm are noted against the background of introduction of mineral fertilizers in N₁₂₀P₉₀K₁₄₀ dose that is 16,7 cm higher than plants from control option.

Diseases of potatoes differ in the increased injuriousness that is considerably caused by features of its biology and possibility of constant existence of causative agents of diseases in parasitic active form in connection with vegetative reproduction of culture.

Losses from late blight as it is the most widespread and harmful disease of potatoes in all farms making potatoes are especially big.

Dynamics of development of a disease of late blight in yielding of potatoes is presented in the table 2. The analysis of the obtained data showed, a chto the highest distribution of late blight (9,90%) is noted on control option (table 2). Introduction of mineral fertilizers in a dose of N₆₀P₆₀K₉₀ reduced distribution of late blight on yielding potato of 1,29%. In option with introduction of 40 t/hectare of manure number of the struck plants decreased by 0,43%, and the highest distribution of late blight among the fertilized options (9,31%) is noted at the introducing mineral fertilizers in N₁₂₀P₉₀K₁₄₀ dose.

	Late blight, %	Early blight, %
no fertilizers	9,90	1,87
manure 40 t./he	9,47	1,64
N ₆₀ P ₆₀ K ₉₀	8,61	1,46
N ₉₀ P ₉₀ K ₁₂₀	8,94	1,34
N ₁₂₀ P ₉₀ K ₁₄₀	9,31	1,21

Table 2. Development of diseases on grade potatoes plants Karatop depending on soil nutrition, 2013-2015.

Symptoms of a disease of early blight were shown to a phase of budding and blossoming. Generally the mushroom struck leaves and only in 2014 at some plants also stalks were struck. It is established that the greatest early blight of potato leaves was in options without fertilizers application. The minimum defeat of plants this disease is noted in the option providing use of mineral fertilizers in N:P ratio: To = 13:1:1,55 (kg N₁₂₀P₉₀K₁₄₀).

The physiological principles of formation of big and stable crops provide formation of yielding of potatoes with optimum indicators of the area of the leaves and efficiency of its work providing a big crop.

Such yielding quickly form rather high area of leaves, and then, whenever possible long keeps in an active state at this level and by the end of vegetation practically die off, giving at the same time plastic substances on formation of tubers.

In our experiences, fertilizers were one of the major agrotechnical receptions in regulation of the area of leaves, and their activity during the vegetative period was doses of the applied fertilizers.

The analysis of dynamics of growth of the area of leaves showed that in a phase of shoots the area of leaves by options of experience differed slightly. In a phase of shoots its size depending on option varied from 8,23 to 10,76 thousand sq.m/hectare. In a phase of formation of buds its size reached 24,98-42,97 thousand sq.m/hectare (table 3).

Table 3. Area of Potato Leaves Yielding of a Grade Karatop depending on the level of mineral nutrition, one thousand sq.m/hectare, 2013-2015.

Nutrient status	Development stage				
	seedlings	budding	blooming	Beet withering start	harvesting
No fertilizers (control)	8,23	24,98	26,86	23,96	15,24
Manure 40 t/hectare	9,42	34,86	36,42	33,82	18,58
N ₆₀ P ₆₀ K ₉₀	9,69	33,65	35,76	31,54	19,44
N ₉₀ P ₉₀ K ₁₂₀	10,14	37,90	40,38	35,94	20,26
N ₁₂₀ P ₉₀ K ₁₄₀	10,76	42,87	46,94	43,26	21,68

The area of potato plant leaves reached the maximum sizes in a blossoming phase irrespective of a nutrition background. In option without fertilizer the maximum area of leaves made 26,86 thousand sq.m/hectare. At fertilizers application in $N_{60}P_{60}K_{90}$ dose size made 35,76, and against the background of $N_{120}P_{90}K_{140}$ – 46,94 thousand sq.m/hectare. By the time of cleaning occurred considerable dying off of a tops of vegetable and its photosynthetic activity.

The major process in life of a potato plant is formation of tubers which depends on age changes of plants and on influence of environmental conditions.

We began to determine the mass of tubers this process in most cases begins with an education phase at which. Further the intensive gain of mass of tubers began and proceeded before cleaning (table 4).

In a phase of formation of buds the mass of tubers between options differed slightly. In a phase of shoots its size depending on option of experience made 67-80 g, and in a blossoming phase depending on experience option its weight reached 160-224 g / a bush. By the time of cleaning against the background of introduction of organic fertilizers in a dose of 40 t/hectare the mass of tubers made 437 g and exceeded control option on 96 g. In option of mineral fertilizers introduction in $N_{60}P_{60}K_{90}$ tuber mass made 430 g, and against the background of $N_{120}P_{90}K_{140}$ -563 g / a bush.

	budding	blooming	Beet withering start	Harvesting
no fertilizers	67	160	248	341
manure 40 t./he	71	174	320	437
$N_{60}P_{60}K_{90}$	71	187	312	430
$N_{90}P_{90}K_{120}$	76	201	399	485
$N_{120}P_{90}K_{140}$	80	224	428	563

Table 4 - Accumulation Dynamics of Potatoes Tubers Mass of a Grade Karatop depending on the level of mineral nutrition, 2013-2015.

Fertilizers application is a necessary condition for formation of big crops which visually was confirmed in our experiences where fertilizers considerably increased productivity of potato tubers (table 4).

On average on effective fertility, productivity of tubers without use of fertilizers made 16,44 t/hectare. Against the background of introduction of organic fertilizers in a dose of 40 t/hectare it increased by 5,32 t/hectare. Against the background of introduction of mineral fertilizers in $N_{60}P_{60}K_{90}$ a tubers harvest formed dose of-21,28 t/hectare, against the background of $N_{90}P_{90}K_{120}$ – 24,19, and against the background of $N_{120}P_{90}K_{140}$ – 28,49 t/hectare or are 12,05 t/hectare higher in comparison with control.

Table 5 – Productivity of potatoes for a grade Karatop depending on the level of mineral nutrition, 2013-2015.

Nutrient status	Crop yield, t/he				
	2013 r	2014 r	2015 r	medium	± per potato
No fertilizers (control)	16,65	15,46	17,21	16,44	–
Manure 40 t/hectare	20,16	23,28	21,86	21,76	+ 5,32
$N_{60}P_{60}K_{90}$	20,18	21,62	22,05	21,28	+ 4,84
$N_{90}P_{90}K_{120}$	22,46	25,46	24,65	24,19	+ 8,41
$N_{120}P_{90}K_{140}$	27,52	31,29	26,67	28,49	+ 12,05
HCP _{0,5}		0,97			

Indicators of a harvest structure are given in table 3. The analysis of the obtained data showed that with increase in soil nutrition the number of plants to cleaning increased.

Table 6 – Structure of a potato harvest of a grade Karatop depending on the level of mineral nutrition, 2013-2015.

Nutrient status	Number of plants, one thousand pieces/hectare	Mass of tubers g/bush	Number of tubers, pieces/bushes	Weight one tuber, g	Ut., %
	52,66	341	7,1	48,0	61,6
No fertilizers (control)	52,69	437	8,2	53,3	61,2
Manure 40 t/hectare	52,73	430	8,1	53,1	61,9
N ₆₀ P ₆₀ K ₉₀ .	52,77	485	8,6	56,4	62,7
N ₉₀ P ₉₀ K ₁₂₀ .	52,80	563	9,4	60,0	63,0

The mass of tubers from 1 bush also was in direct dependence on the level of mineral nutrition. If on control option without fertilizers application the mass of tubers made 341 g / a bush, then on the highest background of mineral fertilizers it made 563 g / a bush.

The average mass of one tuber from control (without fertilizers) nutrition level to a background of N₁₂₀P₉₀K₁₄₀ fluctuated from 48,0 to 60,0 g, number of tubers from one bush from 7,1 to 9,4 pieces.

I. S. Shatilov [1993] and V. P. Vladimirov, P. A. Chekmarev, S. V. Vladimirov, etc. [2012] note that even at full providing with water if the need for mineral nutrition isn't satisfied, crops with optimum structure won't be created and in a biological harvest there will be an insufficient percent of farm valuable part of a harvest.

Really, use of fertilizers in our experiences provided a stable ratio tubers: tops of vegetable, depending on soil nutrition made 61,2-63,0%.

The highest content of starch in potato tubers of 17,96% was noted on control. Introduction of organic fertilizers in a dose of 40 t/hectares reduced the content of starch in tubers by 0,34%, mineral fertilizers in N₆₀P₆₀K₉₀ dose for 0,11% in relation to control. Decrease was noted by more considerable (0,84%) on the raised background of mineral fertilizers – N₁₂₀P₉₀K₁₄₀ (table 7).

Table 7 – Quality indicators of potato tubers of a grade Karatop depending on the level of mineral nutrition, 2013-2015.

Nutrient status	Maintenance of quality indicators			
	solid, %	starch, %	vitamin C, % mg	nitrates, mg/kg
No fertilizers (control)	22,57	17,96	18,36	48,56
Manure 40 t/hectare	22,08	17,62	18,64	59,46
N ₆₀ P ₆₀ K ₉₀ .	21,87	17,85	18,72	64,62
N ₉₀ P ₉₀ K ₁₂₀ .	21,48	17,71	18,85	67,65
Nutrient status	21,14	17,12	17,94	80,74

CONCLUSIONS

Data of researches showed that introduction of moderate doses of fertilizers, on the studied grade didn't lead to essential depression of content of vitamin C in tubers and the norms of the mineral N₉₀P₉₀K₁₂₀ and N₁₂₀P₉₀K₁₄₀ fertilizers only increased, reduced its contents in comparison with control without fertilizers application by 0,25 and 0,84 mg of %.

In our experiences, on all options the maintenance of Sodium nitritums in tubers was below maximum allowable concentration though with augmentation of the brought norms of NPK their quantity in tubers was enlarged a little.

The option without fertilizer of Sodium nitritums in tubers contained 48,56 mg/kg, at introduction of 40 t/hectare of organic fertilizers – 59,46 mg/kg. Introduction of mineral fertilizers in $N_{120}P_{90}K_{140}$ dose – increased the maintenance of Sodium nitritums to 80,74 mg/kg.

SUMMARY

On a measure with increase in doses of mineral fertilizers the area of leaves of yielding of potatoes increased. In a phase of its maximum development increased by the areas of leaves on control made 27,92 thousand, and on the highest background where introduced mineral fertilizers in $N_{120}P_{90}K_{140}$ dose – 45,82 thousand sq.m/hectare.

Introduction of 40 t/hectare of organic fertilizers raised a tubers harvest on 5,32 t/hectare, mineral fertilizers in a dose of $N_{120}P_{90}K_{140}$ and respect for technology of cultivation of potatoes provided the most big crop of tubers at the level of 28,49 t/hectare that above control option on 12,05 t/hectare.

The largest content of solid of 22,57%, content of starch in potatoes tubers – 17,96% is noted on control option. Content of nitrates in tubers was higher, than fertilizers were brought more. Introduction of organic fertilizers in a dose of 40 t/hectare reduced the content of starch in tubers by 0,34%, mineral fertilizers in $N_{60}P_{60}K_{90}$ dose for 0,11% in relation to control. Decrease was noted by more considerable (0,84%) on the raised background of mineral fertilizers – $N_{120}P_{90}K_{140}$.

Tubers against the background of introduction of mineral fertilizers in dozen90r90k120 contained more vitamin C of 18,85 mg of %, nitrates of 80,75 mg/kg against the background of – $N_{120}P_{90}K_{140}$.

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