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Full Length Research Paper

The Role of Nitrogen in the Vital Processes of Tangerine

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Abstract

We have studied the influence of the norms of nitrogen in 20-27 years of age tangerine plants cultivated in conditions of yellow soil on tangerine crop, agrochemical index of the soil as well as on the chemical index of leaves and biochemical index of fruit. We have found out the norms of nitric fertilizers increase the tangerine crop. The optimal norm is N_{400} g/tree. The consistence of humus and total nitrogen in the soil is increased, the amount of moving phosphorus and potassium reaches its limits, the consistence of calcium and magnum is reduced. The usage of nitric fertilizers in an optimal norm has a positive influence on the qualitative index of the fruit. The consistence of nitrogen, phosphorus and potassium which are within the optimal limits, is increased in tangerine leaves.

***Key words**: soil, tangerine, nitrogen, potassium, phosphorus, fruit, norms, leaves, sugars, vitamins, etc.*

Introduction

In the case of high and stable yield, in agro-technical measures, the usage of the rational system of fertilization should be of crucial importance, because of the nature of the soils and subtropical climatic zone and air features as well as the high demand of the subtropical regime towards the soil nutrition. It should also be mentioned that in order to turn the Republic of Georgia into highly developed agricultural country, the field of agricultural industry should be radically improved. It is necessary to specialize in agriculture and science-based optimization in order to achieve the rational use of the unique soil and climatic conditions.

According to biological features of citrus, for their successful cultivation, it is very important to study the meso and micro-climate indicators and the improvement of agro-technical measures of cultivation. Citrus plants require a special amount of nitrogen. On the basis of researches of Georgian and foreign science, it was revealed a close correlation of nitrogenous fertilizers among the soil and the amount of the citrus crop. In order to provide further improvement of the nitrogenous fertilizers it is needed to study the effectiveness of fertilization in soil and climatic conditions, the impact on the productivity and chemical processes of the plant and soil. There is enough data where the impact of norms and forms of nitrogenous fertilizers on yield has been established, on fruit quality and agricultural chemical properties of the soil. According to data, with nitrogenous fertilizers the citrus yield increases by 30%, it is estimated that nitrogen is a limiting factor of tangerine growth and crop (1.2.3.4.8.).

We have also studied that in the young lemon and orange plantation while using nitrogenous fertilizers norms and forms, the orange plant uses a greater degree of nitrogen fertilizer, while the use of nitrogen fertilizer by the lemon plant is of low quality. Nitrogen fertilizer in the soil attached to the important points. Here is the possibility to enhance this attachment after adding energetic materials of organic fertilizers in the soil and of organic fertilizers and thus to reduce losses on the expense of evaporation (9.10.1.). These studies were conducted in red soil conditions.

Materials and Methods

Research objects and methodology

The study was conducted in the western zone of the subtropical yellow soil conditions, in Natanebi experimental farm of tea and subtropical crops research institute (in a long-fertilized citrus garden); Mineral fertilizers and agro-technical measures were held on the basis of agricultural rules and methodological instructions of citrus crops (11); Nitrogenous fertilizers were added in the form of ammonium nitrate according to the scheme, and the phosphate fertilizer - in the form of superphosphate P2O5 -400 g / tree once in four years, potassium - in the form of - potassium chloride K2O-200 g / tree in every two years. Tangerine species "Unshiu" with the area of plant nutrition 2x5 = 10 m2, the option includes 15 plants, the repetition is fivefold.

Results

The harvest data received after the survey conducted in the tangerine garden are given according to years in Table 1, Fig. 1, 2. From where one can see that show that the norms of various nitrogenous fertilizers have certain influence on plant productivity. If we compare the test production with the background in years, all the nitrogen norm has a positive effect on the yield of tangerines. The counts on the effectiveness of the nitrogenous fertilizers were carried out during 5 years, but in the summarized table the data of 4 years are used. As the table 1 and the figure 1.2. show, with the four-year average data, the maximum growth (compared with 90-130% background) of the agricultural productivity of tangerine plants was provided by 300 and especially 400 g per tree nitrogen dose. A further increase in the dose of nitrogen has a negative impact on the productivity of the tangerines. Such a regularity is maintained as in how harvested also in high yield years.

We have studied the impact of the norms of nitrogenous fertilizers on the mechanical indicators of the tangerine fruit.

Table 1. The impact of the norms of nitrogenous fertilizers on the tangerine harvest in conditions of yellow soils

Variants	Low harvest (3 years old average)		Increase kg/tree	High harvest (2 years old average)		Increase kg/tree	4 years old average		4 years old average Increase kg/tree
	kg/tree	%		kg/tree	%		kg/tree	%	
PK-background	8,8	100	-	32,6	100	-	21,5	100	-
PK+N_{200}g/tree	11,8	134,1	3,0	52,5	161,0	19,9	32,3	150,2	10,8
PK+ N_{300}g/ tree	20,8	236,4	12,0	56,5	173,3	23,9	40,8	189,8	19,3
PK+N_{400}g/ tree	25,9	294,3	17,1	68,1	208,9	35,5	50,0	232,5	28,5
PK+N_{500}g/ tree	22,1	251,0	13,3	59,8	183,4	27,2	43,3	201,4	21,8
Sx%		1,5			1,39				
HCP_{05}		1,8			4,11				

Almost every norm of the nitrogenous fertilizers increases the fruit weight with 22,8, 27,7 and 25,7. There is no significant difference between the standards. In the years following the test production, the obvious preference is given to the increased standards; as for the ratio of the pulp and skin, such an image is received: the pulp percentage from the fruit weight on the variants of PK+N_{400}g/tree and PK+N_{500}g/tree is 64,4 – 66,4 %, and the pulp weight and fruit weight as well on the mentioned variants equal to 68,2-68,7 g. i.e. it is high. The increase of the nitrogen norms increases the size of skin – it can be noted that increasing norms of nitrogen have positive

effect on the mechanical characteristics of the fruit - especially during the fruit production the weight of the fruit and the pulp increases as well, which has special effects on productivity structure.

The plant requirements on nutrient elements is determined by the nature of the plant itself and it significantly changes according to the environmental conditions, where an important part belongs to the soil factor. In the red, yellow and podzolic soils of the subtropical zone of western Georgia the use of nitrogenous fertilizers is considered to be a highly effective measure, where in terms of productivity growth or soil fertility a long-term and systematic fertilization significantly changes the soil properties.

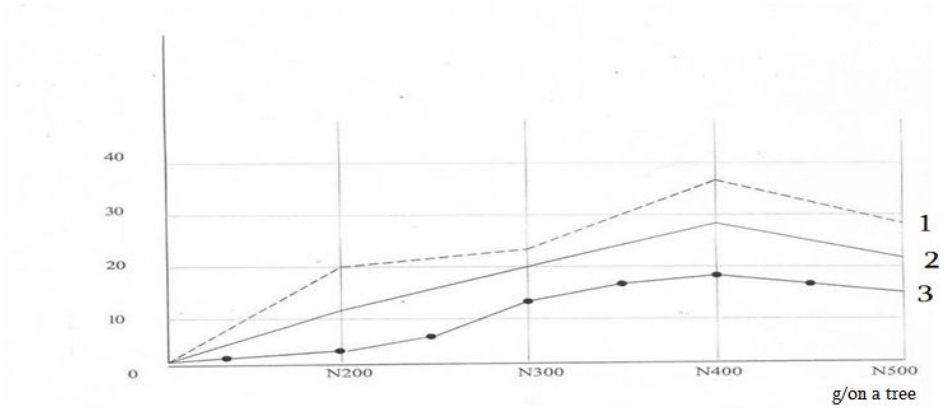

Fig.1. The impact of the norms of nitrogenous fertilizers on the tangerine harvest (increment compared to the background)

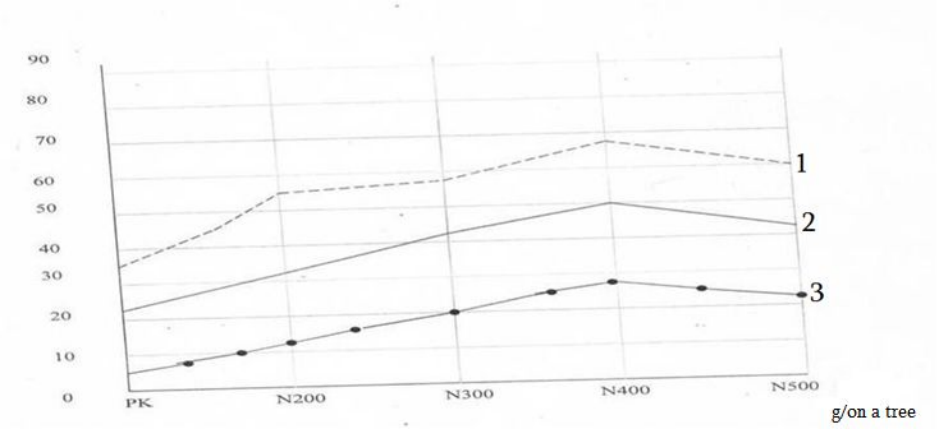

Fig 2. The impact of the norms of nitrogenous fertilizers on the tangerine harvest on the yellow soils
1.Highly productive years; 2. Average 4 years of age; 3. Low productive years;

It is true that the soil type is not changed but the initial agro-physical and agrochemical properties are expressively changed which provide the high productivity of citruses. We have studied the impact of the norms of nitrogenous fertilizers on agrochemical indicators, the obtained results are shown in the table 2. It is known that the soil area reaction is of great importance for citrus crops, because the tangerine requires and is doing well in weak acidic and neutral conditions. According to the data of A. P. Kampa, I. P. Sarishvili, G. S. Godziashvili and I. D. Hamkhrelidze the optimal pH=5,3–6,0 for citruses; the increased norms of nitrogenous fertilizers (table 2) are not significantly changed by the soil area reaction, the indicators of exchange and hydrolytic acidity are not changed as well. In conditions of the experiment, as expected, there is an increase in forms of moving food items. The basic indicators of soil fertility are increased such as humus and common nitrogen. It is known that two contradictory natural processes are going on in the soil - the decomposition and synthesis of organic compounds; if the synthesis process is activated then the organic compounds (including humus) are intensively accumulated, and in case of the predominance of the decomposition process, then the mineralization increases and the humus decreases. It is established by G. S. Godziashvili, M. K. Daraselia, G. I. Goletiani, M. L. Bziava, I. A. Chanturia and J. I. Oniani that in conditions of tea culture in the soil its pruned mass cause 1-2% increase of humus.

Mineral fertilizers and especially using nitrogenous fertilizers in conditions of yellow soil have certain influences on the total nitrogen and humus accumulation. The data of the table 2 show that high doses of nitrogenous fertilizers increase the total nitrogen as well as the humus content; Systematic soil enrichment with nutrients enhances organic stock of substances, in comparison with the

background variant the increase is 1,27 %, of course, this is the indicator of the positive impact of the nitrogenous fertilizers on processes taking place in the soil, which in turn influences on the productivity growth, as well as on the accumulation of organic compounds. Increased norms of the nitrogen slightly decrease the levels of calcium and magnesium (PK- background option, on CaO 0-15sm depth is 271,6 mg, MgO-31,6 mg, and on PK + N_{400} g / tree option CaO-252 and MgO-32,5 mg). As for the content of the moving phosphorus and potassium, it should be mentioned that the experimental plot is rather provided in this regard with these materials – in case of fertilizing with different norms of nitrogenous fertilizers, favorable conditions are created for plants.

Table 2. The impact of nitrogenous fertilizers on the agrochemical indicators of the yellow soil

Variant	Depth of taking sample cm.	%				Mg/100g.soil				pH		Mg/equ. 100g soil	
		Humus	C	C:N	Common nitrogen	P_2O_5	K_2O	CaO	MgO	H_2O	KCl	Exchange acidity	Hydrolytic acidity
PK-background	0-15	4,43	2,50	8,6	0,29	32,3	13,6	271,6	31,6	4,2	3,5	4,5	9,3
	15-30	3,72	2,20	9,2	0,24	28,0	6,5	126,0	17,0	4,0	3,6	6,2	7,4
	30-45	2,05	1,20	8,6	0,14	24,2	5,2	121,5	12,3	3,8	3,3	4,3	6,0
PK+N_{200}g/tree	0-15	5,60	3,25	9,2	0,35	51,2	22,0	254,0	32,0	5,4	4,5	3,6	9,2
	15-30	4,21	2,40	7,7	0,31	36,2	14,0	235,0	26,0	5,0	4,0	4,7	7,0
	30-45	3,50	2,00	8,3	0,24	35,0	9,5	156,0	23,0	4,9	3,9	4,8	5,0
PK+ N_{300} g/tree	0-15	5,72	3,30	8,7	0,38	53,7	36,0	260,0	34,0	5,2	4,5	4,0	10,6
	15-30	4,23	2,46	8,7	0,28	37,5	20,0	215,0	28,0	5,1	4,2	4,5	6,0
	30-45	3,12	1,80	8,9	0,20	21,2	9,0	154,0	71,0	4,9	3,9	4,6	5,5
PK+N_{400} g/tree	0-15	5,25	3,05	8,5	0,36	43,7	29,0	252,0	32,5	4,8	3,8	4,7	9,0
	15-30	3,72	2,16	8,7	0,25	36,7	15,0	196,6	22,0	4,4	3,4	5,0	8,4
	30-45	3,00	1,74	8,7	0,20	31,2	11,0	131,6	16,0	4,2	3,2	6,0	7,5
PK+N_{500} g/tree	0-15	5,15	2,99	8,8	0,34	36,2	21,0	208,8	30,0	4,5	3,4	5,0	10,0
	15-30	3,21	1,87	8,9	0,21	26,2	19,0	91,0	20,0	4,4	3,2	6,0	9,3
	30-45	2,25	1,31	8,6	0,15	17,5	13,0	70,5	16,6	4,0	3,0	6,7	9,1

Mineral nutrition optimization of tangerine affects not only the growth of productivity, but also has positive effects on the, chemical and biological indicators of fruit. Many people thought that the optimization of mineral nutrition, in particular, the optimal content of nitrogen in citrus leaves provides optimal the growth of quality indicators (5.6.7.1.).

Table 3. The impact of norms of nitrogenous fertilizers on the consistency of the nutritious elements in tangerine leaves in conditions of yellow soils (the three-year average data)

Variants	% - consistency calculated on dry substances				
	Common nitrogen	Common Phosphorus	Common Potassium	Common Calcium	Common Magnum
PK-background	0,91	0,38	0,71	4,40	0,210
PK+N_{200}g/tree	1,46	0,42	0,69	4,71	0,230
PK+ N_{300} g/tree	1,69	0,44	0,91	4,85	0,234
PK+N_{400} g/tree	2,42	0,45	0,79	4,06	0,210
PK+N_{500} g/tree	2,50	0,44	0,63	3,75	0,195

We have studied the effect of the norms of nitrogenous fertilizers in tangerine leaves on the consistency of nutritious elements in conditions of yellow soils. The results obtained (Table 3) shows that the nitrogen norms increase the overall nitrogen content in the tangerine leaves. Its optimum content is within the limits of 2,42-2,50 in the high norms of the choices nitrogen, total phosphorus - 0,38-0,45% and total potassium - 0,79-0,91% for the same options. The total calcium and magnesium content in common tangerine leaves is not much different from the norms of nitrogen compared to the changes of the background of the options (Table 3, Figure 3).

Table 4. The impact of the norms of nitrogenous fertilizers on the quality indexes (the three-year average data)

Variants	three-year average data in %–				
	monose	saccharose	total sugar	Acidity mg% transfering onto citric acid on 100 ml. Juice	Vitamin C 100 mg% transfering onto 100 ml. juice
PK-background	1,78	4,82	6,60	0,92	45,0
PK+N_{200}g/tree	1,85	4,87	6,72	0,89	45,5
PK+ N_{300} g/tree	1,85	4,84	6,69	0,92	44,5
PK+N_{400} g/tree	1,81	4,84	6,65	0,88	45,2
PK+N_{500} g/tree	1,70	4,79	6,49	0,81	41,4

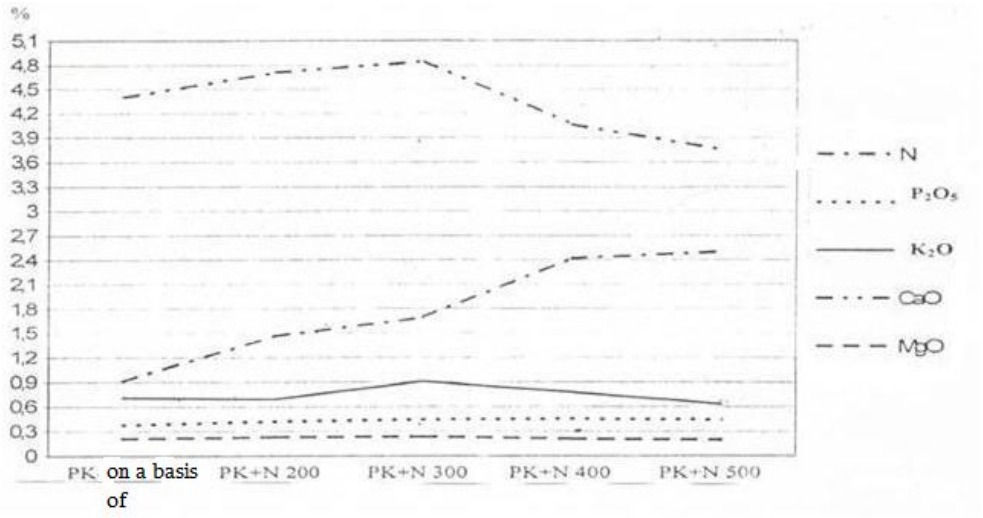

Fig 3. The impact of norms of nitrogenous fertilizers on the consistency of nutritious elements in tangerine leaves.

Based on the obtained results, we can conclude that for tangerine plants grown in the yellow soil conditions the optimal consistency of nitrogen and basic nutritious elements, which corresponds to maximum harvest, is within the following limits: N-1,69-2,42%; P2O-0,44-0,45%, K2O-0,78 -0,91%, CaO-3,75-4,06%, MgO-0,196-0,230%.

We have identified the biochemical indexes in tangerine fruits and the results obtained are presented in Table 4, which shows that the rate of acidity in tangerine fruits increase with decreasing nitric norms - as for the vitamin C, its content increase influenced by the mineral fertilizers and in this case it ranges within the limits of 41,4-45 , 2 mg%. The analyses of biochemical indexes of the tangerine fruits allow us to conclude that the use of nitrogenous fertilizers in the optimal norm (PK + N_{400} g / tree) has the positive effect on qualitative indices of fruits.

Conclusions

The data obtained as a result of the experimental surveys in tangerine garden enables us to make the following conclusions:

- The results obtained confirm that in conditions of the yellow soil, in 20-27-year-old tangerine plantation the optimal norm of nitrogen is PK + N_{400} g / tree, which increases the harvest with 132.6% compared to the background options and compared to the nitrogen norms on 200, 300 and 500 g / tree - with 52, 0, 22.9 and 10.9% respectively;
- The optimal nitrogen level in tangerine leaves, which corresponds to a high crop equals to 2.46%. Increased nitrogen norms do not lead to a reduction of total phosphorus in tangerine leaves, the potassium is increased and as for the general calcium and magnesium, they are reduced when the nitrogen norms are increased.
- Using nitrogenous fertilizers in the optimal norm has positive effect on the rate of qualitative indices of the fruit.

- The nitrogen norms have positive effects on the tangerine fertility of the yellow soil indicators, in particular, the consistency of common humus, nitrogen, moving phosphorus and potassium increase in the soil. The calcium, magnesium and actual soil acidity are slightly decreased.

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