RESEARCH REGARDING THE EFFECT OF FERTILIZATION ON THE GROWTH OF BRANCHES OF PLUM SEEDLNGS IN THE SECOND FIELD

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RESEARCH ARTICLE

Abstract

Taking into account the demand of young plants for nutritional conditions, their relatively high density per surface unit, the need for their intense growth in a relatively short time, the rational application of fertilizers becomes a very important factor for increasing the yield and quality of the planting material. In modern fruit growing, fertilization is one of the most important technological links. Due to their specificity, fruit plants occupy the same area of land for a long period of time, develop their root system to a significant depth and due to the high productivity they achieve, they extract from the soil, with the harvest, appreciable quantities of nutrients. In these conditions, it is necessary to intervene every year, in several rounds, with fertilizations that ensure, on the one hand, the achievement of a certain level of production, and on the other hand, a certain level and ratio of nutritional elements through returning the quantities of easily accessible nutrients extracted with the harvest in order to be able to maintain, in this way, the fertility of the soil in accordance with the age of the plantation and the level of production. The present paper is a research regarding the effect of fertilization on the growth of branches of plum seedlngs in the nursery, in the second field and it is analyzed the influence of fertilization treatment, variety and irrigations rate.

Keywords: orchard, planting material, fertilization
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INTRODUCTION

The fertilization system in the nursery includes, as a whole, long-term activities, intended to ensure the improvement of the physical and chemical properties of the soil and the increase of its fertility, the completion of the necessary assimilable nutrients according to the requirements of the species, rootstocks, variety/rootstock associations in relation to age and the vegetation phases of plants (Megh 2021). Among the main elements of the fertilization system in the modern fruit nursery are: the accumulation of organic matter in the soil through rotations and the incorporation of special plant residues for green fertilizers; administration of mineral fertilizers with nitrogen, phosphorus and potassium (Klock 2019). The doses, terms and methods of fertilizer application are established differently for each sector of the nursery depending on the agrochemical properties of the soil and the requirements of the cultivated plants (Schmid 2019). The use of fertilizers in the cultivation of trees becomes necessary to renew the reserve of nutrients consumed by plants or leached in depth, then to improve the physical condition, the chemical composition and the state of fertilization as a whole of the soil. The most important principle of the efficiency of the fertilization system consists in the maximum utilization and the correct combination of fertilizers on horticultural lands. In the soil fertilization system, fertilizers are considered to be the most important element. They are the main source of ensuring plants with nutrients during the vegetation of horticultural plants. It must be taken into account that by applying fertilizers, it must not favor the decrease of the trees' resistance to critical natural factors (diseases, pests, winter conditions, etc.) or reduce the life span of the trees. Such an orientation leads to the conclusion that fertilization must be done differentiated by species and variety, grafts, rootstocks or by groups of them, the ecoclimatic and pedological particularities of the area, the culture system, the age period and the physiological state of the plants, the productive and quality potential what is to be maintained or created. Thus, for a rational fertilization in fruit plantations, it is necessary to know the physical-chemical state of the soil in the plantations and the level of supply with nutrients easily accessible to the plants. At the same time, the specific consumption requirements for macro and microelements of trees, variable according to the influence of modifying factors, should be known (Prabhu 2020). In horticultural crops, in practice, the limiting factor is rarely the insufficient nutritional elements, but rather the nutritional imbalance, produced by the excess in some elements, as well as insufficient water supply or excess water. Insufficient water supply creates conditions of excessive salinity in the vicinity of the roots, which inhibit both the absorption of nutrients and water. Excess water, on the one hand, leads to the washing of nutrients outside the rhizosphere and, on the other hand, worsens the oxygen supply of the roots and thereby leads to a weaker absorption of nutrients. This interdependence between water supply and mineral nutrition highlights the role of simultaneous and balanced intake of water and fertilizers, which in practice led to fertilizing irrigation. In modern fruit growing, fertilization is one of the most important technological links (Megh 2018). Due to their specificity, fruit plants occupy the same area of land for a long period of time, develop their root system to a significant depth and due to the high productivity they achieve, they extract from the soil, with the harvest, appreciable quantities of nutrients. In these conditions, it is necessary to intervene every year, in several rounds, with fertilizations that ensure, on the one hand, the achievement of a certain level of production, and on the other hand, a certain level and ratio of nutritional elements through returning the quantities of easily accessible nutrients extracted with the harvest in order to be able to maintain, in this way, the fertility of the soil in accordance with the age of the plantation and the level of production (Riedel 2018). For the correct determination of the type and doses of fertilizers that must be applied per surface unit or per productive unit, the physical characteristics of the soil, the degree of supply with nutrients easily accessible to plants and the state of fertility as a whole are taken into account. The physical features take into account the orography of the land, the useful edaphic volume, the depth of the water table, the texture, the structure and the water regime as a whole. The chemical composition refers to the pH or salinity, the content of organic matter, the cation exchange capacity, the degree of saturation in bases, the content of macro and micro elements in forms accessible to plants (Guy 2021). The microbiological activity in the soil is important for the disaggregation of complex organic substances in simple forms, accessible to plants and even for mediating more complex chemical transformations. Vegetative state expressed by the growth vigor of one-year branches, etc. The knowledge so far has proven that when applying fertilization, the soil conditions, species, variety, rootstock, density, forecasted production, etc. must be taken into account. Establishing the optimal doses for each situation in the field must be done after analyzing a series of soil properties, knowing the requirements imposed by the culture and those related to ensuring a certain quantitative and qualitative level of production. Due to the great diversity of conditions and situations, fertilization works in orchards must offer practical solutions for each individual case. Experiments with fertilizers, whether they are carried out in the plantations or in the greenhouse, aim to clarify the mechanisms that direct the mineral nutrition of the trees, to know the balance of nutrients in the plant and in the soil, the possibilities of enhancing the efficiency of fertilization and last but not least, the means to reduce the possible ecological impact of large doses of fertilizers on the fruit ecosystem (Balram 2020). The quantitative and qualitative knowledge of nutrients extracted by fruit plants from the surface unit is very important for the rational application of fertilizers. This knowledge presupposes prior information, based on laboratory chemical analyses, on the qualitative and quantitative presence of different nutrients in the soil. In the nursery, the lack of basic elements - nitrogen, phosphorus, potassium - causes serious deficiencies in the growth process of seedlings.

MATERIAL AND METHOD

The key research methods employed were analysis and synthesis and analogy to resemble the results.

RESULTS AND DISCUSSIONS

Under the effect of the different fertilization treatments, the growth of the canes showed an amplitude of variation of 33.12 cm, with values ranging between 169.88 cm on the unfertilized agricultural fund and 203 cm in the case of applying the dose of 24 kg of NPK, under the conditions of a variability of 8, 49% between treatments (table 18). The application of the fertilization variants with 16-24 kg NPK determined the registration of significant increases in growth of 12.66-19.50% compared to the non-fertilized agricultural fund, instead the variant with 8 kg NPK showed a low and insignificant effect associated with an increase of only 1.84%. The addition of fertilization from 8 to 16 kg and respectively from 16 to 24 kg, was effectively utilized by the seedlings that achieved significant increases in growth of 6.07-10.62%.

Table 1

The average growth of branches in the second field under the effect of different fertilization treatments

NPK Dose	Branches growth (cm)		Relative values (%)	Difference/ Significance
$N_8P_8K_8 - N_0P_0K_0$	173.00	169.88	101.84	3.12
$N_{16}P_{16}K_{16} - N_0P_0K_0$	191.38	169.88	112.66	21.50***
$N_{24}P_{24}K_{24} - N_0P_0K_0$	203.00	169.88	119.50	33.12***
$N_{16}P_{16}K_{16} - N_8P_8K_8$	191.38	173.00	110.62	18.38***
$N_{24}P_{24}K_{24} - N_8P_8K_8$	203.00	173.00	117.34	30.00***
$N_{24}P_{24}K_{24} - N_{16}P_{16}K_{16}$	203.00	191.38	106.07	11.62***

$LSD_{5\%}$=4.58 cm $LSD_{1\%}$=6.07 cm $LSD_{0,1\%}$=7.84 cm

Taking into account the effect of the interaction between varieties and irrigation on the growth of vines in seedlings from field II, table 19 shows that in the case of the Cacanska Lepotica variety, the three watering norms generated significant increases compared to the non-irrigated variant. Also, the seedlings of the Stanley variety efficiently utilized only the norms of 20 and 30 mm which determined significant increases, while the effect of the norm of 10 mm was considerably less than in the Cacanska Lepotica variety.

Table 2

The effect of variety and irrigation on the growth of vines in seedlings from the second field

Variety	Irrigation rate					
	0 mm	10 mm	20 mm	30 mm	$\bar{x} \pm s_{\bar{x}}$	$S_{\%}$
Stanley	z 178,50 a	yz 185,00 a	y 190,75 a	x 199,50 a	188,44±2,46	11,69
Cacanska Lepotica	z 162,25 b	y 175,75 a	y 182,25 a	x 200,50 a	180,19±2.86	14.19
$\bar{x} \pm s_{\bar{x}}$	170.38±4.21	180.38±3.47	186.50±2.35	200.00±3.53	184.30±1.91	
$S_{\%}$	15.61	12.15	7.97	11.15	13.11	

Variety - $LSD_{5\%}$=14.87 cm $LSD_{1\%}$=21.62 cm $LSD_{0,1\%}$=32.44 cm (a,b)
Irrigation - $LSD_{5\%}$=8.52 cm $LSD_{1\%}$=11.56 cm $LSD_{0,1\%}$=15,46 cm (x, y,z)

Regarding the combined effect of the variety and fertilization on the growth of the seedlings, it is found that in both varieties the treatments with 16-24 kg of NPK and respectively the progressive increase of the doses showed significantly positive influences on the growth of the seedlings, against the background of more raised in the Stanley variety.

Table 3

The effect of variety and fertilization on the growth of branches

Variety	NPK Dose					
	$N_0P_0K_0$	$N_8P_8K_8$	$N_{16}P_{16}K_{16}$	$N_{24}P_{24}K_{24}$	$\bar{x} \pm s_{\bar{x}}$	$S_{\%}$
Stanley	z 177.25 a	z 178.50 a	y 193.25 a	x 204.75 a	188.44$\pm$2.46	11.69
Cacanska Lepotica	z 162.50 b	z 167.50 a	y 189.50 a	x 201.25 a	180.19$\pm$2.86	14.19
$\bar{x} \pm s_{\bar{x}}$	169.88$\pm$3.26	173.00$\pm$3.42	191.38$\pm$2.82	203.00$\pm$3.21	184.30$\pm$1.91	
$S_{\%}$	16.15		9.30	9.99	13.11	

Variety - $LSD_{5\%}$=14.59 cm $LSD_{1\%}$=21.83 cm $LSD_{0,1\%}$=34,34 cm (a,b)
Fertilizer - $LSD_{5\%}$=6.48 cm $LSD_{1\%}$=8.58 cm $LSD_{0,1\%}$=11.25 cm (x, y)

Taking into account the effect of the variety on the growth of the shoots of the seedlings on different fertilization treatments, amplitudes are found from 3.5-3.75 cm for the variants with doses of 16-24 kg NPK up to 14.75 cm for the variant unfertilized. Against the background of these differences, it can be observed that the Stanley variety showed a significantly higher growth of seedlings than the unfertilized version by 9.07%. The seedlings of the two varieties utilized the fertilization at a similar level, against the background of higher growth in the Stanley variety, but without the respective differences being statistically ensured.

Table 4

The effect of the variety on the growth of branches on different fertilizations

Varieties x $N_0P_0K_0$	Branches growth (cm)		Relative values (%)	Difference/ Significance
Cacanska Lepotica - Stanley	162.50	177.25	91.68	-14.75^0
Varieties x $N_8P_8K_8$	Branches growth (cm)		Relative values (%)	Difference/ Significance
Cacanska Lepotica - Stanley	167,50	178,50	93,84	-11,00
Varieties x $N_{16}P_{16}K_{16}$	Branches growth (cm)		Relative values (%)	Difference/ Significance
Cacanska Lepotica - Stanley	189,50	193,25	98,06	-3,75
Varieties x $N_{24}P_{24}K_{24}$	Branches growth (cm)		Relative values (%)	Difference/ Significance
Cacanska Lepotica - Stanley	201.25	204.75	98.29	-3.50

$LSD_{5\%}$=14.59 cm $LSD_{1\%}$=21.83 cm $LSD_{0.1\%}$=34.34 cm

Regarding the effect of fertilization on the growth of the stems for each variety, it can be observed that at Stanley the values were between 177.25 cm for the unfertilized variant and 204.75 cm in the case of applying the dose of 24 kg of NPK. Compared to the unfertilized version, only the doses of 8-16 kg had significant effects of 9.03-15.51% on the growth of seedlings.

It is also found that the progressive increase by 8 kg of the applied dose was associated with a significant increase in the growth of the rods of 5.95-8.26 %.

Table 5

The effect of fertilization on the growth of branches in seedlings of different varieties

NPK Dose x Stanley	Branches growth (cm)		Relative values (%)	Difference/ Significance
$N_8P_8K_8 - N_0P_0K_0$	178.50	177.25	100.71	1.25
$N_{16}P_{16}K_{16} - N_0P_0K_0$	193.25	177.25	109.03	16.00***
$N_{24}P_{24}K_{24} - N_0P_0K_0$	204.75	177.25	115.51	27.50***
$N_{16}P_{16}K_{16} - N_8P_8K_8$	193.25	178.50	108.26	14.75***
$N_{24}P_{24}K_{24} - N_8P_8K_8$	204.75	178.50	114.71	26.25***
$N_{24}P_{24}K_{24} - N_{16}P_{16}K_{16}$	204.75	193.25	105.95	11.50***
NPK Dose x Cacanska Lepotica	Branches growth (cm)		Relative values (%)	Difference/ Significance
$N_8P_8K_8 - N_0P_0K_0$	167.50	162.50	103.08	5.00
$N_{16}P_{16}K_{16} - N_0P_0K_0$	189.50	162.50	116.62	27.00***
$N_{24}P_{24}K_{24} - N_0P_0K_0$	201.25	162.50	123.85	38.75***
$N_{16}P_{16}K_{16} - N_8P_8K_8$	189.50	167.50	113.13	22.00***
$N_{24}P_{24}K_{24} - N_8P_8K_8$	201.25	167.50	120.15	33.75***
$N_{24}P_{24}K_{24} - N_{16}P_{16}K_{16}$	201.25	189.50	106.20	11.75***

$LSD_{5\%}$=6.48 cm $LSD_{1\%}$=8.58 cm $LSD_{0,1\%}$=11.25 cm

From the point of view of the influence of fertilization on the growth of canes achieved on a certain watering rate, it can be observed that the highest amplitude of variation (47 cm) was recorded at the watering rate of 10 mm, while in the case the norm of 20 mm. the amplitude between NPK doses was considerably smaller (17 cm).

Table 6

The effect of irrigation and fertilization on the growth of seedlings

Irrigation rate	NPK Dose					
	$N_0P_0K_0$	$N_8P_8K_8$	$N_{16}P_{16}K_{16}$	$N_{24}P_{24}K_{24}$	$\bar{x} \pm s_{\bar{x}}$	$S_{\%}$
0 mm	148.50 b	153.50 d	191.50 ab	188.00 c	170.38±4.21	15.61
10 mm	174.50 a	163.00 c	174.00 c	210.00 b	180.38±3.47	12.15
20 mm	178.00 a	183.50 b	189.50 b	195.00 c	186.50±2.35	7.97
30 mm	178.50 a	192.00 a	210.50 a	219.00 a	200.00±3.53	11.15
$\bar{x} \pm s_{\bar{x}}$	169.88±3.26	173.00±3.42	191.38±2.82	203.00±3.21	184.30±1.91	
$S_{\%}$	16.15	12.15	9.30	9.99	13.11	

Irrigation - $LSD_{5\%}$=9,82 cm $LSD_{1\%}$=12,99 cm $LSD_{0,1\%}$=16,76 cm (a,b,c)
Fertilization - $LSD_{5\%}$=9,17 cm $LSD_{1\%}$=12,14 cm $LSD_{0,1\%}$=15,68 cm (x, y)

CONCLUSIONS

On the non-fertilized agricultural fund, the irrigation determined a significant growth of the seedlings of the Stanley variety by 27-33 cm, under the conditions of small and insignificant variations between the three watering norms. In the case of fertilization with 8 kg of NPK, a significant increase of 20-30 mm of irrigated seedlings is observed compared to the non-irrigated variant and the norm of 10 mm. Under the effect of fertilization with 16 kg of NPK, irrigation showed a higher influence on the growth of seedlings, associated with significant differences between the three watering norms. Under the conditions of application of the dose of 24 kg of NPK, a small and irregular variation is observed between the effects of different watering norms on the growth of seedlings of this variety. For the unfertilized seedlings of the Cacanska Lepotica variety, the application of irrigation allowed the achievement of significant increases in growth with values of 19-33 cm, respectively a significantly higher efficiency than the norm of 30 mm compared to that of 10 mm. Under the effect of fertilization with 8 kg of NPK, the seedlings of this variety efficiently capitalized on irrigation by 20-30 mm, registering significant growth increments of 19-43 cm compared to the other variants. Against the background of fertilization with 16 kg of NPK, only irrigation with 30 mm allowed a significant growth of seedlings by 28 cm, against the background of irregular variations under the effect of the other watering norms. Under the conditions of fertilization with 24 kg of NPK, the saplings efficiently capitalized on the irrigation, registering significant increases in the stems of 19-49 cm compared to the non-irrigated version.

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