

UDC 631.51.82:634.1.03

## **GROWTH OF SEEDLINGS ROOT SYSTEM OF FRUIT CROPS AND DECORATIVE CROPS DEPENDING ON THE CONDITIONS OF A MINERAL NUTRITION AND DEPTH OF SOIL TREATMENT**

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### **ABSTRACT**

The root system plays an important role in the life of plants. Growth and development of seedlings can fluctuate significantly under the influence of growth conditions. The purpose of the study - to determine the optimal dose of mineral fertilizers and depth of soil treatment in completion of growing seedlings of fruit and decorative breeds. Found that mineral fertilizers in high doses enhanced the root growth of seedlings of fruit and decorative breeds. The best root system growth of fruit crops seedlings occurred in variants with applying mineral fertilizers in a dose  $N_{198}P_{180}K_{198}$  for pear seedlings and  $N_{264}P_{240}K_{264}$  for seedlings of apple, cherry and plum with a depth of soil treatment 40 cm. Maximum length of the seedlings roots of decorative crops was identified in the variant with application the dose of  $N_{132}P_{120}K_{132}$ . Depth of soil treatment did not affect the growth of roots.

### **KEYWORDS**

Seedlings; Fruit crops; Decorative crops; Root system; Soil treatment; Mineral fertilizers.

The root system plays an important role in the life of plants. Through it seedlings get water and basic nutrients that are used by plants to provide physiological processes, as well as for the construction of vegetative and generative organs. Like an aerial organs, root system develops according to hereditary program. At the same time growth and development can fluctuate significantly under the influence of growth conditions, which is an important aspect in growing seedlings of fruit crops and decorative crops [1,2]. Development of the aerial parts of plants largely depends on the state of the root system. The growth of the roots can be activated by adjusting its conditions of growth in the soil [3-5]. According to some authors, the deep applying of mineral fertilizers provides greatest action efficiency [6,7]. Also, there is evidence that increasing the availability of basic nutrients led to restriction of growth of the apple root system and to decrease of the active surface [8-10].

For the purpose of carrying out research, experiment «Determining the optimal dose of mineral fertilizers and depth of soil treatment in completion of growing seedlings of fruit and decorative breeds» was put.

### **MATERIALS AND METHODS**

Area of accountable plots - 48 m<sup>2</sup>; experiment was repeated four times. Scheme of planting seedlings - 0.8 x 0.2 m. In each plot 300 seedlings were planted for completion of growing. Ammonium nitrate and nitrophosphate were used as fertilizer.

Variants: Factor A – breeds:

1. Pear - cultivar «Belorusskaya Pozdnyaya».
2. Apple - cultivar «Sinap Orlovsky».
3. Cherry – cultivar «Vladimirskaaya».
4. Plum - cultivar «Eurasia 21».
5. Edible honeysuckle – cultivar «Goluboe Vereteno».
6. Thunberg's barberry.
7. Vanhoutte spiraea.

Factor B – doses of fertilizers:

1.  $N_{66}P_{60}K_{66}$  (control)
2.  $N_{132}P_{120}K_{132}$
3.  $N_{198}P_{180}K_{198}$
4.  $N_{264}P_{240}K_{264}$

Factor C – depth of preplant soil treatment:

1. Soil treatment to a depth of 23-25 cm.
2. Soil treatment to a depth of 40 cm.

## RESULTS OF RESEARCH

Observations of the root system growth of seedlings were carried out during 2011-2012. Found that mineral fertilizers in high doses enhanced the root growth of seedlings of fruit breeds and decorative breeds. In 2011, in variant with the application of  $N_{198}P_{180}K_{198}$ , the maximum length of the roots of pear seedlings was 44.3 cm against 32.1 cm in variant with application the dose of  $N_{66}P_{60}K_{66}$  (Table 1). Maximum length of the apple roots (43.1 cm) was observed in variant with application the dose of  $N_{264}P_{240}K_{264}$ . Maximum length of cherry and plum roots (37.9 cm and 47.2 cm, respectively) was observed with application the dose of  $N_{264}P_{240}K_{264}$ .

The root system of shrub species seedlings was less developed. Herewith the largest root length was in the second variant with application the dose of  $N_{132}P_{120}K_{132}$ . In this variant, the length of the seedlings roots of honeysuckle was 24.8 cm, barberry - 27.7 cm, spiraea - 22.3 cm.

Along with application of fertilizers, soil treatment depth had a positive effect on root growth of seedlings. With increasing depth of soil treatment up to 40 cm, the creation of a larger volume of soil with favorable physical properties contributed to the increase of the growth processes of the root system of fruit crops seedlings. More active root growth observed in all variants regardless of the dose of fertilizers application. Thus, the length of the apple seedlings roots was 31.0 cm in variant with application the dose of  $N_{66}P_{60}K_{66}$  and depth of soil treatment 23-25 cm; with a depth of soil treatment 40 cm the length of roots was 37.1 cm.

In variant with application the dose of  $N_{132}P_{120}K_{132}$ , depending on the soil treatment method, roots length was 34.1 cm and 42.6 cm respectively; in variant with application the dose of  $N_{198}P_{180}K_{198}$  – 38.7 cm and 47.8 cm; In variant with  $N_{264}P_{240}K_{264}$  - 43.1 cm and 52.3 cm. Similar regularity was observed with seedlings of pears, cherries and plums.

Table 1 – Length of the root system of seedlings of fruit breeds and decorative breeds, cm (2011)

Breed (A)	Doses of fertilizer (B)			
	$N_{66}P_{60}K_{66}$	$N_{132}P_{120}K_{132}$	$N_{198}P_{180}K_{198}$	$N_{264}P_{240}K_{264}$
Depth of soil treatment 23-25 cm (C)				
Pear	32,1	37,6	44,3	44,7
Apple	31,0	34,1	38,7	43,1
Cherry	24,9	28,7	32,3	37,9
Plum	36,3	40,2	43,2	47,2
Honeysuckle	20,4	24,8	24,7	23,9
Barberry	21,1	27,7	27,4	27,6
Spiraea	17,6	22,3	22,1	21,9
Depth of soil treatment 40 cm				
Pear	40,7	48,3	54,9	54,7
Apple	37,1	42,6	47,8	52,3
Cherry	28,6	32,2	37,9	45,9
Plum	40,8	46,7	51,8	54,6
Honeysuckle	21,0	25,7	25,6	25,1
Barberry	21,3	28,3	28,1	28,8
Spiraea	17,7	24,0	24,6	23,9

HCP<sub>05</sub>: A=2,4; B=3,1; C=2,6; AB=3,3; AC=4,9; BC=4,8; ABC=5,1.

As already noted, the root system of seedlings of shrubby breeds was less developed and had more superficial location. For this root system, depth of soil treatment of 23-25 cm was sufficient (Fig. 1 and 2). Therefore, increasing the depth of soil treatment to 40 cm had no effect on root growth of seedlings.



Figure 1 – The development of the root system of barberry seedlings with depth of soil treatment 23-25 cm on the background of N<sub>66</sub>P<sub>60</sub>K<sub>66</sub>



Figure 2 – The development of the root system of barberry seedlings with depth of soil treatment 23-25 cm on the background of N<sub>132</sub>P<sub>120</sub>K<sub>132</sub>

Table 2 – Length of the root system of seedlings of fruit breeds and decorative breeds, cm (2012)

Breed (A)	Doses of fertilizer (B)			
	N <sub>66</sub> P <sub>60</sub> K <sub>66</sub>	N <sub>132</sub> P <sub>120</sub> K <sub>132</sub>	N <sub>198</sub> P <sub>180</sub> K <sub>198</sub>	N <sub>264</sub> P <sub>240</sub> K <sub>264</sub>
Depth of soil treatment 23 - 25 cm (C)				
Pear	34,2	38,5	46,4	45,9
Apple	32,9	36,2	40,6	45,7
Cherry	25,3	29,8	34,1	39,2
Plum	35,8	41,1	44,2	48,9
Honeysuckle	21,3	25,6	25,4	26,0
Barberry	22,4	29,2	29,6	28,9
Spiraea	18,5	24,4	24,5	24,3
Depth of soil treatment 40 cm				
Pear	41,6	49,4	55,7	56,2
Apple	38,4	44,1	49,5	54,8
Cherry	28,9	33,8	39,4	47,7
Plum	39,9	48,2	51,2	55,4
Honeysuckle	22,6	26,1	25,8	25,9
Barberry	23,0	29,8	30,1	29,9
Spiraea	18,7	25,1	24,9	25,4

HCP<sub>05</sub>: A=2,1; B=2,7; C=3,4; AB=3,1; AC=3,7; BC=4,1; ABC=4,6.

In the version with applying optimal dose of fertilizers N<sub>132</sub>P<sub>120</sub>K<sub>132</sub>, depending on the depth of soil treatment, length of roots of honeysuckle seedlings was 24.8 cm and 25.7 cm, barberry - 27.7 cm and 28.3 cm, spiraea - 22.3 cm and 24.0 cm. In 2012, the regularity of growth of the seedlings root system remained as in the previous year (Table 2). Maximum

length of pear seedlings roots was in variant of  $N_{198}P_{180}K_{198}$ , at the depth of soil treatment 23-25 cm it equaled 46.4 cm, at a depth of soil treatment 40 cm - 55.7 cm. Maximum length of apple seedlings roots was in variant with applying dose of  $N_{264}P_{240}K_{264}$ , at the depth of soil treatment 23-25 cm it equaled 45.7 cm, at a depth of soil treatment 40 cm - 54.8 cm. Application of fertilizers in a dose  $N_{264}P_{240}K_{264}$  provided the greatest length of roots of cherry and plum seedlings. In this variant, depending on the depth of soil treatment, root length of cherry seedlings was 39.2 cm and 47.7 cm respectively, plum seedlings - 48.9 cm and 55.4 cm.

Maximum length of the roots of decorative breeds seedlings observed in variant with application of dose  $N_{132}P_{120}K_{132}$ . Maximum length of the roots of decorative breeds seedlings was observed in variant with application of dose  $N_{132}P_{120}K_{132}$ . The depth of soil treatment did not affect the growth of roots. Depending on the depth of soil treatment, root length of honeysuckle seedlings was 24.6 cm and 26.1 cm, root length of barberry seedlings - 29.2 cm and 29.8 cm, root length of spiraea seedlings - 24.4 cm and 25.1 cm.

## CONCLUSIONS

1. The best root system growth of fruit crops seedlings was observed in variants with application of mineral fertilizers in a dose of  $N_{198}P_{180}K_{198}$  for pear seedlings and  $N_{264}P_{240}K_{264}$  for seedlings of apple, cherry and plum with a depth of soil treatment 40 cm.
2. Root growth of shrubby breeds does not depend on the depth of soil treatment.  $N_{132}P_{120}K_{132}$  is optimal dose for application of mineral fertilizers providing the greatest growth of the roots of honeysuckle, barberry and spiraea seedlings.

## REFERENCES

1. Gurin, A.G. Optimization of mineral nutrition during rearing seedlings of gardening and decorative cultures / A.G. Gurin, I.I. Sychev // Vestnik OrelGAU, 2012. - № 4 (37). – pp. 73 - 75.
2. Rodin, S.A. Improving soil ecology of heavy loamy soil of forest nurseries / S.A. Rodin // Vestnik of Moscow State University of forests - lesnoy vestnik, 2000. - № 4. - pp. 34 – 37.
3. Gurin, A.G. Increase the capacity of the original varieties of fruit and ornamental crops / A.G. Gurin, S.A. Plygun, V.I. Averin // Vestnik OrelGAU, 2009. - № 4 (18). - pp. 55 - 56.
4. Kuzin, A.I. The growth of roots and rootstocks of apple seedlings with application of mineral fertilizers / A.I. Kuzin, Y.V. Trunov, N.S. Vyazmikina // Vestnik of Michurinsky SAU, 2012. - № 4. - pp. 18 - 22.
5. Muhanin, I.V. Modern production technology of planting material for intensive apple orchard / I.V. Muhanin // Proceedings: Scientific bases of gardening. Voronezh, 2005. - pp. 168 - 173.
6. Kondakov, A.K. Fertilizing fruit trees, berries, nurseries and flower crops / A.K. Kondakov. – Michurinsk : OOO "BIS", 2007. – 328 p.
7. Xu, Z.Z. Nitrogen metabolism and photosynthesis in *Leumischinensis* in response to long-term soil drought / Z.Z. Xu // J. Plant Growth Regul., 2006. – 25, № 3. – pp. 252 – 266.
8. Kuzin, A.I. Diagnosis of mineral nutrition of apple trees on weakly clonal stocks: the dissertation of the PhD of Agricultural Sciences. - Michurinsk, 1997. – 24 p.
9. Trunov, Y.V. Reproduction of fruit and berry plants / Y.V. Trunov, A.V. Verzilin, A.V. Soloviev. – Michurinsk, 2004. – 180 p.
10. Atkinson, D. The effect of medium composition on the subsequent initial performance of micropropagated strawberry plant / D. Atkinson, C.M. Cvips, S.E. Wiltshire // Act. Hort., 1986. – pp. 877 – 878.