Effect of Organic and Mineral Fertilizers on the Growth of *Acer Platanoides* L.

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Abstract

A field experiment was carried out with *Acer platanoides* L. saplings fertilized using organic fertilizer 'Sapton' in different variants: control (K); variant 1 (V_1) - low dose of "Siapton" (1ml); variant 2 (V_2) - high dose of "Siapton" (50ml); variant 3 (V_3) - high dose of 'Siapton" and mineral fertilizer "Krystalone" and variant 4 (V_4) - high dose of "Siapton" and organic fertilizer "Biohumus". All fertilized variants show better growth in mean diameters (root collar diameter (D_0) and breast height diameter (BHD)), average height and wood biomass accumulation with the exception of V_1. The dose turns out to be definitive in relation with the fertilization effect. Good results are obtained by combining two organic fertilizers (V_4) during the first two years of fertilization. Variant 3 (combination with mineral fertilizer), however, has a longer duration and is manifested in a long time after application of fertilization (especially in the third year after treatment) and is also recommended to be applied in practice. The increment of height is most pronounced in V_4 (a combination of two organic fertilizers) for a longer period, too: an increment of 0.43 m versus 0.07 m for the control during the third year. This gives the reason to recommend organic fertilization in improving the growth characteristics of Norway maple for the needs of forestry and urban planning where good growth and accumulation of woody biomass is desired.

Key words: increments, stem form coefficients, tree growth characteristics, total volume

Introduction

Fertilizing of forest-tree vegetation is mainly used in forest nurseries or in urban environments – mainly in public parks and gardens. In spite of the non-extensive use of fertilization, it has been assumed that in general it has a positive influence on the metabolism, growth and development of woody plants (Donov et al., 1975, Miller and Tarrant, 1983, Gebauer and Schulze, 1991, Balster et al., 2009). Fertilization has an immediate positive effect on growth indicators of trees, such as the basal area increment (for example, which effect may last for a very long time), sometime up to 20 years (Brooks and Coulombe, 2009, Ponton et al., 2019). Significant positive effect on soil properties can be achieved by using organic fertilizers (Kachova, 2018) or some mulch types (Awopegba et al., 2016). An important question in forest management when fertilization be applied is to determine the effect of fertilizars on the overall development of forest plantations. There are also a number of other questions, such as: What is the best ratio of nutrients used in the fertilizer combination? What is the best time for fertilizing? What are the most appropriate doses? etc. Essential is also a question about the impact of fertilization on growth in height and thickness of tree saplings, or rather how the variation of doses or fertilizer combination is in line with the height and diameter changes of the saplings. In Bulgaria, these issues have been studied mainly with using mineral fertilizers (Dakev, 1972, Dakev and Badjov, 1975, Denev, 1966, Broshtilov, 1986, Tsanov and Broshtilova, 1986, Zhelyazkov and Markova, 1993, Petterson and Dimov, 2013). The use of organic fertilizers is not widely applicable and the issues involved still remain poorly studied and experimentally unclear. Special issues is the effect of organic fertilizers on soil organic matter because the majority of Bulgarian soils have very low organic content and fertilization is occurred to be an good practice for improving the agrochemical status of cultivated soils (Petkova, 2016). In addition, the effect of fertilization also depends on the tree species (Cukor et al., 2017), and the Norway maple is poorly studied.

The species *Acer platanoides* L. can be used for afforestation of eroded terrains, production of wood and musical instruments, and in urban landscaping due to its high decorative crown. It is relatively resistant to harmful external influences, especially urban environments (Nowak and Rowntree, 1990, Dirr, 1998). However, the species is more susceptible to pathogenic fungi and insects along heavy-traffic roads in comparison with the trees growing along a road with pedestrian traffic (Wilkaniec et al., 2018). In Bulgaria, the species is widely distributed from 500 to 1500 m a.s.l. mainly in fresh habitats (Milev et al., 2004). It is used mainly for the creation of mixed plantations, predominantly with oaks, beech and silver fir, and is one of the most valuable for forestry (Pandeva, 2004). These plantations are successfully used for the collection of reproductive seed material, however, conservation activities are needed to be carried out there (Tomov et al., 2014). The growth and development of the species and the action of various abiotic and biotic factors on it has not been well studied worldwide. The effect of composted green waste on the growth of saplings of *Acer platanoides* has been studied and a positive effect on growth in height and diameter, as well as increased survival rate, has been found (Ashwood et al., 2018). It is ascertained that as non-native species *Acer platanoides* has been more phenotypically plastic than some native species especially when fertilization is used (Cook-Patton and Agrawal, 2011). Long et al., (2011) studied the effect of liming on sugar maple (*Acer saccharum* Marsh.) and found that over the 23-year period its basal area increment increased significantly whereas in the other tree species this fertilization was ineffective. Dakev and Badjov (1975), using N-mineral fertilizer, found that the fertilized and non-native saplings of *Acer platanoides* had approximately the same weight. The influence of organic and mineral fertilization on the development of soil microflora in the cultivation of seedlings of Norway maple was studied (Kachova et al., 2017). The effect of composted green waste on the growth of saplings of *Acer platanoides* has also been investigated and a positive effect on growth of height and diameter, as well as increased survival rate, has been found (Ashwood et al., 2018).

The aim of this workis to follow the effect of organic fertilizer (alone and in combination with other organic fertilizer or mineral fertilizer) on the growth of Norway maple over a three-year period.

Organic fertilizer ‘Siapton’ was used, which is new to the Bulgarian market, but has proven properties for improving the productivity and sustainability of agricultural crops. It is applied for the first time for tree plants and it is of interest to trace its effect on forest plantations as well.

Material and Methods

The saplings of Norway maple were planted as a field experimental in the yard of the Forest Research Institute – BAS, Sofia, at the end of March 2016. The scheme used is 7 rows of 7 saplings or a total of 49 saplings at a distance of 1 m from each other (Kachova et al, 2017). Saplings are fertilized two times: in the beginning of the growing season (08.06.2016) and 20 days later (28.09.2016). The variants of experience are as followed:

• Control (K) – untreated saplings;

• Variant 1 (V_1) – Fertilizing with 'Siapton' at a dose of 1 ml per sapling;

• Variant 2 (V_2) – Fertilizing with higher dose (50 ml) 'Siapton' per sapling;

• Variant 3 (V_3) – 'Siapton' 50 ml + 0.5 mg mineral fertilizer 'Krystalone' dissolved in 500 ml of water;

• Variant 4 (V_4) – 'Siapton' 50 ml + 50 % solution of 'Biohumus'.

The organic fertilizer 'Siapton' R is new to the Bulgarian market and is recommended for foliar and soil application. Its composition is: total, organic, ammonium nitrogen up to 4 %; organic carbon – 25 %; aminoacids of animal origin – 54.34 %. This fertilizer has shown good results for agricultural crops to increase yield and quality of production and to increase plant defense in stressful situations. The mineral fertilizer 'Krystalone' contains mainly N, P, K, Mg and more than 10 other trace elements in smaller quantities (<1 %). 'Biohumus' is a fertilizer of red California worm, widely used in agriculture.

The experience was set up on *Vertisols* with the following characteristics: pH = 6.4; organic carbon = 3.93 %; total nitrogen content = 0.12 %. The site is in the southeastern part of the metropolitan city – with a moderate continental climate; altitude of 630 m a.s.l.; average precipitation 693 mm, and temperatures in the metropolitan city 0.1 to 5 °C higher than in the rest of the valley (Climate and Microclimate of Sofia, 1983).

To calculate the mean diameter of the saplings, a method from the descriptive statistics was used, calculated as an average arithmetic and separately using the basal area of the saplings after the formula (1):

$$d_{cp} = \sqrt{\frac{4Gav}{\pi}} = \sqrt{1.274 \cdot Gav}\ , \qquad (1)$$

where Gav is a basal area.

The average height was calculated as an arithmetic average. The Lorey's formula was not used because there were saplings that did not reach a breast height (1.30 m) and applying the formula gave very large deviations.

The growing stock was calculated by Huber's formula (2) for stem volume:

$$V = G_{1/2} \cdot H_{av}, \qquad (2)$$

where: $G_{1/2}$ is a basal area calculated at ½ of the height of each sapling, and H_{av} is average height. Then the volumes of all saplings from the variant were summed and the total volume or the growing stock for each variant was obtained.

For statistical processing of the results, programs Statistics 4.0 and Excel used.

Results

Measurements of the diameter of the saplings were done every month in 2016 and 2017 and twice during the vegetation period of 2018. The diameter is measured in two places: at the root collars and at breast height (1.30 m). The variation in mean diameter by variants in 2016 and 2017 and 2018 are given in Tables 1, 2, 3 and 4. Initially, during planting, the saplings of the different variants begin their growth from uneven diameters at the root collor. As of June 2017, however, V_2 and V_4 outweighed the control in their growth in root collar diameter (RCD). Particularly pronounced is the higher RCD increase in 2018, V_2, V_3 and V_4 predominate significantly over the control. The highest are the values of V_3 – combination of 'Sapton' with mineral fertilizer. The combination of two organic fertilizers (V_4) also shows good results. The lowest result is V_1 –a low dose of 'Siapton'. It is obvious that at this low dose – 1ml the effect of the organic fertilizer is minimized and practically does not exist.

The mean breast height diameter (BHD) is also unequal for the variants in the beginning of the growth – 31.03.2016. Highest value shows the control (Table 3). The saplings of V_4 started their growing with the lowest value of BHD. However, this was compensated in the beginning of the second year (02.05.2017), when the saplings of V_4 also outrunned the control (Table 4). Here again, the effect of fertilization in 2018 is most pronounced when all variants are significantly above the control in relation of BHD. The influence of fertilization is strongest again in V_3 and in V_4.

If data about the mean diameters are given as an increment during the years, then the following results are obtained (Table 5).

The highest growth rate of RCD and BHD for the second and third years after fertilization have V_2, V_3 and V_4. The highest RCD in organic fertilization is in the first and second year of fertilization, alone V_2 and in combination with 'Biohumus' – V_4. However, in the third year (2018) variant V_3 ('Sapton' + mineral fertilizer) showed the best growth of saplings in relation to the RCD (2.20 mm). The variants with organic fertilization (V_2 and V_4) also have a good RCD increments and in the third year (2018) higher than that of the control approximately 2 times. The control lagged behind the growth of RCD and BHD in the first and second years, and in the third year it was markedly the lowest.

Table 1. *Dynamics of RCD (cm) in 2016.*

Variant	**Date**						
	31.03	**27.04**	**01.06**	**30.06**	**01.08**	**01.09**	**05.10**
K	125 ±0.17	1.26 ±0.24	1.29 ±0.16	1.31 ±0.15	1.31 ±0.15	1.33 ±0.15	1.33 ±0.15
1	1.17 ±0.11	1.18 ±0.12	1.20 ±0.12	1.25 ±0.11	1.25 ±0.12	1.26 ±0.12	1.26 ±0.12
2	1.17 ±17	1.18 ±0.17	1.19 ±0.18	1.24 ±0.16	1.25 ±0.15	1.28 ±0.15	1.29 ±0.15
3	1.28 ±22	1.29 ±0.22	1.31 ±0.21	1.36 ±0.22	1.39 ±0.24	1.39 ±0.24	1.40 ±0.24
4	1.11 ±15	1.19 ±0.16	1.22 ±0.18	1.27 ±0.17	1.27 ±0.17	1.28 ±0.17	1.28 ±0.17

Table 2. *Dynamics of RCD (cm) in 2017 and 2018.*

Variant	Date							
	31.03	**02.05**	**30.05**	**06.07**	**01.08**	**31.08**	**05.10**	**19.06.2018**
K	1.35 ±0.14	1.35 ±0.13	1.37 ±0.14	1.41 ±0.15	1.44 ±0.17	1.45 ±0.17	1.46 ±0.17	**1.55 ±0.16**
1	1.29 ±0.12	1.28 ±0.12	1.28 ±0.12	1.32 ±0.13	1.34 ±0.14	1.39 ±0.09	1.40 ±0.09	**1.50 ±0.10**
2	1.31 ±0.15	1.32 ±0.15	1.36 ±0.12	1.49 ±0.11	1.55 ±0.12	1.57 ±0.12	1.58 ±0.11	**1.65 ±0.15**
3	1.40 ±0.24	1.41 ±0.23	1.45 ±0.23	1.53 ±0.22	1.61 ±0.24	1.63 ±0.26	1.63 ±0.26	**1.84 ±0.32**
4	1.29 ±0.17	1.30 ±0.17	1.35 ±0.19	1.49 ±0.22	1.58 ±0.26	1.59 ±0.26	1.59 ±0.26	**1.73 ±0.29**

Table 3. *Dynamics of BHD (cm) in 2016.*

Variant	Date						
	31.03	**27.04**	**01.06**	**30.06**	**01.08**	**01.09**	**05.10**
K	0.42 ±0.26	0.43 ±0.26	0.45 ±0.21	0.46 ±0.22	0.46 ±0.22	0.47 ±0.22	0.47 ±0.22
1	0.40 ±0.21	0.46 ±0.24	0.48 ±0.22	0.51 ±0.22	0.51 ±0.22	0.51 ±0.22	0.52 ±0.22
2	0.37 ±0.20	0.40 ±0.16	0.43 ±0.16	0.44 ±0.06	0.46 ±0.06	0.46 ±0.17	0.46 ±0.17
3	0.41 ±0.27	0.43 ±0.21	0.45 ±0.25	0.48 ±0.25	0.49 ±0.25	0.49 ±0.25	0.49 ±0.25
4	0.32 ±0.26	0.33 ±0.26	0.37 ±0.17	0.41 ±0.22	0.41 ±0.22	0.42 ±0.25	0.42 ±0.19

Table 4. *Dynamics of BHD (cm) in 2017 and 2018.*

Variant	Date							
	31.03	**02.05**	**30.05**	**06.07**	**01.08**	**31.08**	**05.10**	**19.06.2018**
K	0.48 ±0.27	0.48 ±0.23	0.49 ±0.23	0.50 ±0.23	0.52 ±0.24	0.52 ±0.24	0.52 ±0.24	**0.57 ±0.26**
1	0.52 ±0.22	0.53 ±0.30	0.54 ±0.15	0.55 ±0.15	0.58 ±0.15	0.59 ±0.15	0.59 ±0.15	**0.65 ±0.17**
2	0.47 ±0.17	0.50 ±0.07	0.53 ±0.06	0.61 ±0.07	0.67 ±0.08	0.68 ±0.08	0.70 ±0.08	**0.80 ±0.11**
3	0.50 ±0.14	0.52 ±0.22	0.59 ±0.24	0.63 ±0.26	0.69 ±0.28	0.69 ±0.28	0.70 ±0.28	**0.81 ±0.34**
4	0.46 ±0.09	0.49 ±0.09	0.57 ±0.13	0.63 ±0.15	0.68 ±0.19	0.68 ±0.19	0.69 ±0.19	**0.78 ±0.25**

Table 5. *Increment (mm) in diameter during 2016, 2017 and 2018.*

Variant	2016	2017	2018
Increment of RCD, mm			
К	0.80	1.1	0.80
1	1.00	1.3	1.00
2	1.20	2.9	1.60
3	1.20	2.2	2.20
4	1.70	3.0	1.50
Increment of BHD, mm			
К	0.40	0.50	0.50
1	0.90	0.70	0.60
2	0.80	1.30	1.50
3	0.70	1.90	1.10
4	1.00	2.30	0.90

The height of the saplings measured during the period was statistically processed and the data on the average height during the years is given in tables 6 and Table 7.

Table 6. *Dynamics of average height (m) in 2016*

Variant	Date						
	31.03	27.04	01.06	30.06	01.08	01.09	05.10
К	1.57 ±0.17	1.61± 0.23	1.62± 0.24	1.63± 0.24	1.66± 0.27	1.66± 0.27	1.67± 0.21
1	1.55 ±0.70	1.60± 0.19	1.64± 0.64	1.64± 0.21	1.64± 0.21	1.64± 0.21	1.65± 0.22
2	1.42± 0.09	1.46± 0.04	1.48± 0.04	1.51± 0.09	1.52± 0.09	1.53± 0.08	1.54± 0.08
3	1.47± 0.08	1.53± 0.06	1.55± 0.11	1.55± 0.09	1.58± 0.06	1.58± 0.06	1.58± 0.08
4	1.43± 0.01	1.48± 0.01	1.51± 0.10	1.56± 0.14	1.56± 0.16	1.57± 0.16	1.57± 0.16

Table 7. *Dynamics of average height (m) in 2017 and 2018.*

Variant	Date							
	31.03	**02.05**	**30.05**	**06.07**	**01.08**	**31.08**	**05.10**	**19.06.2018**
K	1.67±0.20	1.67±0.20	1.69±0.21	1.69±0.23	1.70±0.23	1.70±0.23	1.70±0.23	1.77± 0.18
1	1.65±0.22	1.69±0.24	1.73±0.27	1.73±0.28	1.73±0.28	1.73±0.28	1.74±0.28	1.80± 0.32
2	1.55±0.07	1.57±0.08	1.57±0.06	1.62±0.13	1.63±0.13	1.63±0.11	1.67±0.15	2.09± 0.31
3	1.59±0.16	1.63±0.15	1.63±0.17	1.70±0.15	1.71±0.17	1.71±0.18	1.72±0.18	2.08± 0.32
4	1.57±0.18	1.63±0.15	1.64±0.12	1.69±0.13	1.73±0.16	1.73±0.16	1.73±0.15	2.16± 0.34

The height growth of saplings starts from uneven values, with the lowest growth rates of V_2 and the highest – that of the control. However, at the end of the second year after treatment (5.10.2017) control is overtaken by all other variants, except for V_2, which began to grow from the lowest rate. At the end of the third year, this difference melted and in 2018 all of the fertilized saplings of all variants outrunned the control in height, although the control had the best growth indicators in the beginning of the studied period.Table 8 shows the increment in height during the investigated period.

Table 8. *Current increment in height (m) in 2016, 2017 and 2018.*

Variant	2016	2017	2018
K	0.10	0.03	0.07
1	0.10	0.09	0.06
2	0.12	0.13	0.42
3	0.11	0.13	0.36
4	0.14	0.16	0.43

Only V_1 (‘Siapton’ at a very low dose) showed a lower increment in comparison with control during all years. Obviously, at this low dose, the effect of fertilization is neglected and almost zero. In the other variants, a growth rate is in times greater than that of the control – for example, 0.43m growth in 2018 for V_4 (fertilized with two organic fertilizers), against 0.07m increment of the control for the same year.

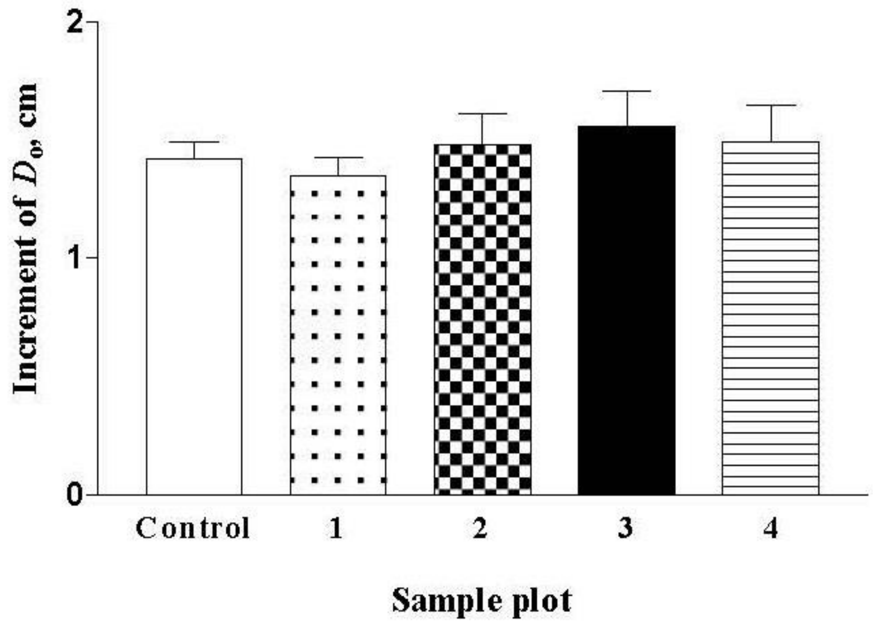

Fig. 1. *Increment of D_0 during 2017–2018.*

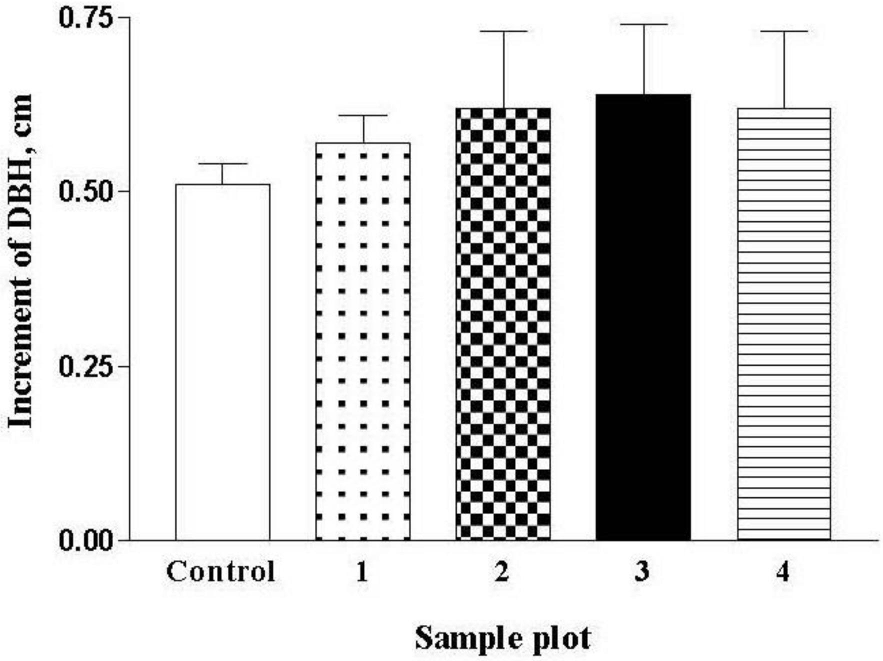

Fig. 2. *Increment of DBH during 2017 – 2018.*

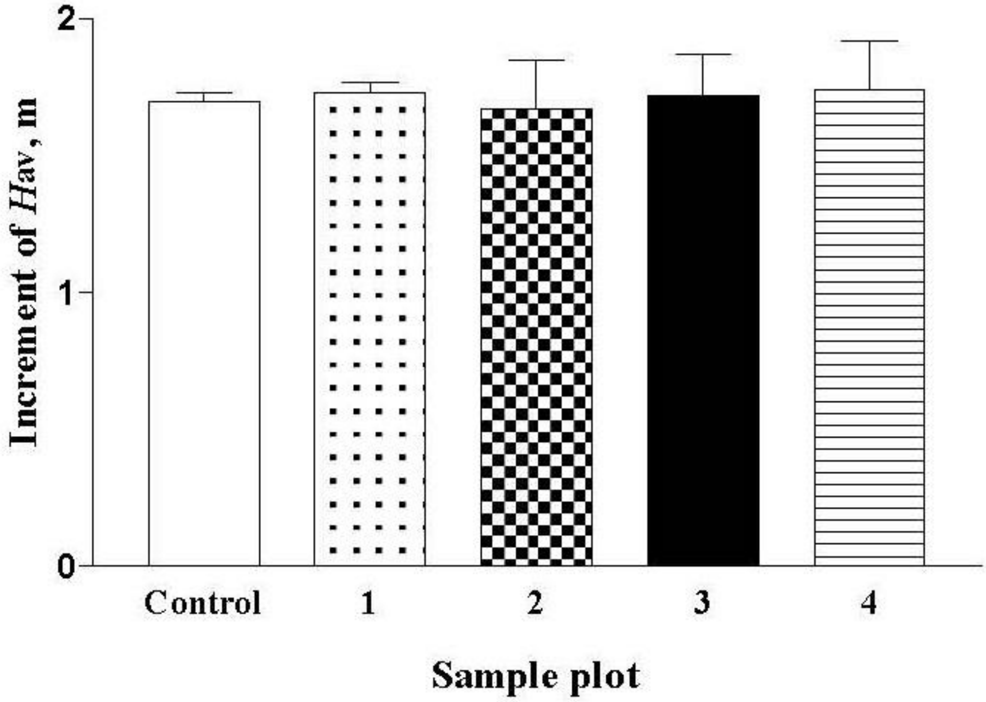

Fig. 3. *Increment of Hav during 2017 – 2018.*

The best growth rates of height in the three years after application of fertilizers show variants with organic fertilization: V_1 – high doses 'Siapton' and V_4 – combination of 'Siapton' with 'Biohumus'. Especially high is the growth of saplings fertilized with high doses in the third year (2018). Obviously, the effect of fertilization – organic and mineral is prolonged and long lasting.

Due to close growth rates, statistical analyzes indicate a lack of statistically proven differences for all tested dendrometric indicators. In all cases $P>0.05$ – no statistical significance. In Figures 1, Figure 2 and Figure 3 are presented the differences in the increment of D0, DBH and Hav over the months of 2017 – 2018.We have also computed some of the stem form coefficients (Table 9).

There is a difference in the coefficients that are indicators of the stem form. The closer to 1 is coefficient, the more cylindrical is stem. It is only coefficient *q* calculated according to the mean height that has clearly higher results for the fertilized variants in comparison with the control. The higher this coefficient is, the closer it is to 1, the thinner and the higher is the stem. All fertilized variants show better results for thickness and height of saplings compared to those of the control.

Regarding the total volume of biomass, the following results were obtained, shown in Table 10.

Table 9. *Stem form coefficients in the end of 2016, 2017, and 2018.*

Variant	2016	2017	2018
	$q_0 = d_{RCD}./d_{1.30}$		
К	2.87	2.79	2.70
1	3.01	2.36	2.32
2	3.27	2.49	2.11
3	3.33	2.47	2.29
4	3.74	2.43	2.23
	$q_2 = d_{1/2}./d_{1.30}$		
К	1.74	1.67	1.56
1	1.85	1.55	1.38
2	1.98	1.63	1.24
3	2.05	1.63	2.13
4	2.26	1.57	1.29
	$q = d_{RCD}/H\text{av}$		
К	0.28	0.30	0.32
1	0.0030	0.0033	0.0036
2	0.0029	0.0036	0.0038
3	0.0030	0.0037	0.0039
4	0.0025	0.0036	0.0036

Note: q_0, q_2 и q are stem coeficients calculated as fallowed: $q_0 = d_{RCD}/d_{1.30}$; $q_2 = d_{1/2}/d_{1.30}$; $q = d_{RCD}/H_{av}$.

Table 10. *Total volume (m^3/ha) in the end of 2016, 2017 and 2018.*

Variant	2016	2017	2018
К	0.10	0.11	0.13
1	0.13	0.17	0.19
2	0.12	0.21	0.28
3	0.14	0.22	0.31
4	0.12	0.22	0.29

In all fertilized variants, larger tree biomass stocks are obtained, compared to the control. During the second year of fertilization, V_2, V_3, V_4 show high, almost equal, results for the biomass accumulation. In the third year, however, V_3 ('Sonton' with mineral fertilizer) is particularly well in relation with the accumulation of biomass – it outpaces nearly 3 times the yield of biomass in comparison with that of the control – 0.31 m^3/ha against only 0.13 m^3/ha for the control.

Discussion

The results show that organic fertilization has a strong positive effect on the growth performance of Norway maple saplings. It improves their diameter and height growth and biomass accumulation. The first condition for fertilizing, however, is the fertilizer dose. We found that at low doses the effect of fertilization is practically reduced to zero. At optimal doses, however, this effect is strongly expressed. Organic fertilizers greatly enhance the height and diameter at breast growth of saplings. In combination with two organic fertilizers this effect is even more pronounced. It is also a good combination of organic fertilizer with mineral, but here the effect of fertilization is shifted over time and is more pronounced after the second year of fertilization. Stronger in the third year, especially in biomass accumulation, is the combination with mineral fertilization, whereas only organic fertilization weakens its effect over time.

Secondly, after the dose, the effect of fertilization is mainly determined by the deficiency of trace elements in the soil (Zhelyazkov and Markova, 1993). In our case, the soil (*Vertisol*) is well-stocked (on average) with carbon (≈4 %), but is poorly stocked with nitrogen (<0.15 %). We actually improve the soil conditions by introducing the necessary additional amounts of digestible nitrogen, which also improves the growth indicators of the tree saplings. There is sufficient evidence in the literature about the influence of mineral fertilization on woody plants. Denev (1966) demonstrates the positive effect of hyperphosphate, which increased the saplings growth in height, diameter, above ground and underground biomass. Donov et al., (1975) found the positive effect of mineral fertilization on the growth of Scots pine saplings and their photosynthesis due to improved metabolism. Fertilization with N, P and K leads to a strong increase in the absorption of these macroelements, especially of N, which are mobilized in the soil as a result of the intensification of the microbiological activity (Dakev and Badjov, 1975). Significant increment of height and mean diameters is also noted by Tsanov and Broshtilova, (1986) in the fertilization of various branches of poplars. It is noted that improved mineral nutrition prolongs the growth period of saplings, and this is also observed by us where in fertilized variants the leaves fall a little later (unpublished data). The data presented in this publication is consistent with studies on the composition of soil microorganisms in the experiment with Norway maple saplings (Kachova et al., 2017). The best results of the ratio of heterotrophic microorganisms, actinomycetes, bacteria digesting mineral nitrogen, microscopic fungi and cellulose-digested microorganisms are found in V_3 (combination of ‘Siapton’ with mineral fertilizer) (Kachova et al., 2017). It should be noted that also better results than controls are available for organic fertilizer variants. However, the question of the impact of organic fertilizers on the growth of tree plants remains unclear. We show that it is particularly beneficial for the height growth of saplings.

Data obtained in this study show that the effect of fertilization is long-lasting and is observed strongly in both second and third year of treatment. Investigating the consequence of the mineral fertilization of saplings, Denev (1966) notes that the impact of the imported additional quantities of N and K lasts for 4–6 years. Here, too, we have a long-lasting influence on fertilization over time, with some differences being observed – the effect of mineral fertilization is increased and the effect of organic fertilization is diminished. However, the impact of organic fertilization is manifested over a longer period and the growth performance is better than the control. It is possible to expect the impact of fertilization with organic fertilizer ‘Siapton’ and in the next 4–6 years, by improving the height and diameter growth and total biomass stock.

With regard to the influence of the density and scheme of planting on crop productivity, the experience is unified. The main difference in the experiment is mainly due to differences in fertilization (organic, mineral) and in the fertilizer dose used.

Conclusions

The experiment with fertilization of *Acer platanoides* saplings with organic fertilizer ‘Siapton’ shows that fertilization has a favourable effect on the growth of saplings. This increases their average diameter, height and biomass in comparison with non-fertilized variant (control). Combination with other mineral and organic fertilizers strengthens the positive effect on growth indicators. The highest values of the diameter at breast height are in case of self-fertilization with organic fertilizer ‘Siapton’. The best growth of saplings in diameter at the root colloar in a long-term period (in the third year) is observed in the joint fertilization of organic fertilazer and mineral fertilizer. This combination is also best for the accumulation of woody biomass from saplings in a longer time period. However, for height growth of saplings, the combination of two organic fertilizers: ‘Siapton’ and made by red California worm fertilizer – is the best.

In general, we can conclude that the applying of fertilization with organic fertilizers when aiming a rapid growth and accumulation of biomass of Norway maple saplings is recommended for both urban environment and forest nurseries. The method is effective and is investment, which is paid out in the future.

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