

INFLUENȚA BIOSTIMULATORILOR ȘI A FERTILIZĂRII FOLIARE ASUPRA CREȘTERII ȘI COMPOZIȚIEI CHIMICE A BUTAȘILOR VERZI LA 4 SPECII DE ARBUȘTI FRUCTIFERI

BIOSTIMULATORS AND FOLIAR FERTILIZATION INFLUENCE ON THE GROWTH AND CHEMICAL COMPOSITION OF SOFTWOOD CUTTINGS

Mihail Iancu, Mihai Nița, Claudia Nicola
Research Institute for Fruit Growing Pitesti, Romania

Abstract

The accomplishment of adequate amounts of small fruits planting stock according to the international regulations demands new working methods and techniques which has to be more efficiently. As a consequence, at the Research Institute for Fruit Growing Pitesti some studies were done between 2008-2009. The following experimental scheme was organized. A Factor – The species involved, with the graduations: a_1 = chokeberry; a_2 = hip rose (*Rosa canina*); a_3 = thornless blackberry; a_4 = honeysuckle; B Factors – biostimulators for rooting with the graduations: b_1 = without biostimulators (control); b_2 = Radistim (powder); b_3 = indole acetic acid. C factors – foliar fertilization, with the graduations: c_1 = unfertilized; c_2 = fertilized with Folimax 2%; c_3 = fertilized with Plantfert (14-5-4) 2%. For of rooting the softwood cuttings a substratum consisting in 60% peat, 20% manure and 20% sand was employed. This rooting substratum of 8-10 cm thick was placed in plastic boxes put on high beds in a solarium where artificial mist may be intermittently applied. On average, for the graduations of B, C experimental factors, significant differences between the 4 species with regard to the values of the 4 growth characteristics were noticed. In case of control treatment (without biostimulators) versus the 2 foliar fertilization treatments, the mean shoot length was significantly higher by 14-17% for all 4 species and 3 foliar fertilization levels. On average for all 4 species and 3 rooting biostimulator treatments, the mean length of shoots was significantly higher by 10% in the unfertilized treatment versus the 2 foliar fertilized treatments. The foliar fertilization versus the unfertilized treatment induced a rise of N and P contents in rise leaves by 8-13% and 4-5% respectively, of dry weight by 8% and a decrease of K content.

Cuvinte cheie: aronia, măceș, mur fără ghimpi, Ionicera, Folimax, Plantfert;

Keywords: aronia, hip rose, thorn blackberry, honeysuckle, Folimax, Plantfert

1. Introduction

The accomplishment of adequate amounts of small fruits planting stock according to the international regulations demands new working methods and techniques which has to be more efficiently. As a consequence, at the Research Institute for Fruit Growing Pitesti some studies were done between 2008-2009.

2. Material and methods

The following experimental scheme was organized. A Factor – The species involved, with the graduations: a_1 = chokeberry; a_2 = hip rose (*Rosa canina*); a_3 = thornless blackberry; a_4 = honeysuckle; B Factor – biostimulators for rooting with the graduations: b_1 = without biostimulators (control); b_2 = Radistim (powder); b_3 = indolil acetic acid. C factor – foliar fertilization, with the graduations: c_1 = unfertilized; c_2 = fertilized with Folimax 2%; c_3 = fertilized with Plantfert (14-5-4) 2%. At the level of the C factor graduation 40 soft cuttings were planted. The production of softwood cuttings and their rooting was done late July when usually the small fruit species develop annual shoots, long enough to obtain the softwood cuttings. In this period the shoots have ceased their growth but their tissues were enough developed not showing any lignifications. The optimum time for shoots collecting was when the shoots were elastically enough not to break at bending. The shoots collecting for cuttings was done at the planting moment in the morning. They were immediately put in water buckets. The cuttings were made in covered places with shade, with no air ventilation to avoid as much as possible their drying. They had 10-15 cm of a shoot length, removing the leaves at the bottom introduced in the planting hole (2/3 of cutting length). In the upper part of the cutting, 2-3 full leaves were left for the small foliage species (seabuckthorn, chokeberry and hip rose) and in case of large foliage species (thorn and thornless blackberry, chokeberry) 1/3 from each leaf was removed. It was not necessary to reduce too much the foliage surface of the cutting because the artificial mist conditions inside the plastic tunnel may limit the elimination of great water amounts by evapotranspiration. The cuttings were treated by biostimulators

introducing the cutting bottom in AIA solution and Radistim powder. These treated cuttings were planted on the rooting bed in some holes done previously with a special planting device.

Their rooting was done on a substratum of 8-10 cm, consisting in: 60% peat, 20% manure, 20% sand. The substratum was put in plastic boxes placed on high beds in a solarium with intermittent artificial mist applied shortly, 30 second followed by a break of 15-30 minutes for about 30 days since planting of the cuttings. In this period of time, the cuttings developed good roots.

There applied 3 foliar fertilizations, every 5 days, within June 26 – July 5, 2009 when the leaves of cuttings attained the normal size being able to absorb the foliar fertilizer.

The chemical composition of leaves was determined according to common methods used in the special laboratories from Romania.

3. Results and discussions

Influence of the experimental factors on the growth of softwood cuttings

On average, for the graduations of B, C experimental factors, the mean length of the cutting roots varied significantly among the 4 species, recording the highest value with chokeberry (213.7 cm) and the lowest with hip rose (32.4 cm). Likewise, the highest number of secondary roots was recorded with the chokeberry, 7 times higher than that of hip rose.

The mean length of shoot was recorded for the 3 species, so chokeberry and hip rose having the highest values, exceeding by 67-70%, the mean length of thorny blackberry. On the contrary, the thorny blackberry had the highest value in the shoot diameter (5-6 mm) exceeding by 180% the value recorded with chokeberry and by 93% with hip rose (table 1).

On average, for the 4 species and the 3 foliar fertilization treatments, the mean length of shoots was 14-17% higher in the treatment with no rooting biostimulators than in the 2 treatments with biostimulators. The other 3 growth characteristics showed also higher values in the treatment without biostimulators versus the others with biostimulators but the differences were not statistically significant. That could be explained by a lower number of rooted plants in the no biostimulator treatment (Nita et lancu., 2009).

On average, per graduation of A, B experimental factors, the mean length of shoot was 10% higher in the treatment with no foliar fertilization versus the 2 foliar fertilization treatments. The values of the other growth characteristics were not significantly different in the 2 foliar fertilized treatments (table 1). Also, in the 2 treatments with foliar fertilization versus the unfertilized one, it was noticed an obvious increase in the length of the main roots and in number of the secondary roots, especially in the treatment with no biostimulators versus the biostimulator treatments (table 2).

Examining the behaviour of the 3 treatments with biostimulators and foliar fertilization for each species (interaction of A/B/C experimental factors) it is noticed that the results varied related to the species and growth feature observed (table 3).

Influence of the rooting biostimulator and foliar fertilization on some chemical components in the leaves of the 4 species involved.

On average for the 3 treatments with rooting biostimulators and foliar fertilization, the highest N value (1.742%) and ash (8.8%) showed the thorn blackberry, the highest P. value (0.234%), had the hip rose and highest K content (0.83%) had chokeberry.

On average, for the 4 species investigated and the 3 treatments with rooting biostimulators, the foliar fertilized treatment versus the unfertilized one induced an increase of N content in leaves by 8-13%, of P content by 4-5%, of dry weight by 8% and a decrease of K content to 94-97% of 100% value recorded in the foliar unfertilized treatment (table 4).

On average, for the 4 species and the 3 foliar fertilized treatments, the application of the rooting biostimulators versus the control induced an increase of N content by 1% and of P content by 13%. Under the same conditions, K content was higher by 15% in the control versus the biostimulator treatments. The ash content was practically similar in all 3 biostimulator treatments.

Some correlations between the growth and chemical composition values of the 4 species softwood cuttings.

The values of the growth characteristics recorded per each graduation of the experimental factors were closely positive correlated. The total length of main roots per cutting showed the closest and most numbers correlations (table 5).

Likewise, the values of 4 chemical components in the leaves of the 4 species were significantly positive correlated. The most significant and closest correlations were between ash, P and K contents and few with N content (table 6).

Positive correlations, statistically measured were between the growth characteristics and values of the main chemical components in leaves. The most numerous and closest ones were recorded with the total length of main roots per cutting and with ash, P, K contents and few with N content (table 7).

Regarding the influence of the 4 species on the growth parameters high differences, were recorded among these species. Nevertheless, the positive correlation between these parameters (table 5) have shown the close relationships, commonly for all 4 species investigated.

Very significantly in this way are very closely positive correlations between the rooting percentage and growth parameters. Thus, the species recording a higher rooting percentage showed also a higher growth potential. The biostimulators application had strongly influenced the rooting of these species (Niță and Iancu, 2009) but controversially these biostimulators have poorly influenced the growth parameters. Moreover, as one can see in table 1, the no biostimulator treatment versus, the 2 biostimulator ones recorded a mean length of shoots by 14-17% higher. That could be explained by a lower number of rooted plants in the no biostimulator treatment (Niță and Iancu, 2009). As the data in table 4 indicate, the foliage fertilization versus the unfertilized one had a beneficial effect on N, P and dry weight contents in leaves but less positive on K content. Comparing N, P, K contents in leaves of the 4 species with the limits of tissue supply after the foliage diagnosis of the ornamental plants, reported by Bovay and Gally, 1956-1979, cited by Davidescu et al (2001), it is noticed a very low content of N and K and a high and very high P content in our case.

Also, comparing the values of global nutrition (N + P + K) with the interpretation limits of the total analysis results in case of the ornamental plants, presented by the aforesaid authors, in our case the values of global nutrition are very low. On the other hand comparing the values of the nutritional balance (the percentage of each macroelement N, P, K from the value of global nutrition) with the interpretation limits of this indicator (reported by Bovay and Gally, 1956; 1979) and cited by Davidescu et al (2001) one can see that the nutritional balance of N is low, of P is high and of K is normal. Comparing the values of N + P/K ratio recorded by us with the limits reported by the aforesaid authors, it is noticed that these values are normal. Comparing the increase of N (8-13%) and of P (4-5%) contents following the foliage fertilization with the percentage increase of the same, components following the application of the nutrient solution on the 3 rooting substrates (Davidescu V., et al 2001), the differences between the 2 experiments were related to each component and substratum involved. Although, the foliage fertilization had positive effects on the chemical components in leaves, it poorly influenced the growth of plants. That could be explained by the short time between the foliage fertilization (26.VI – 5/7 – 2009) and the time of growth readings.

This assertion is also stressed by the fact that the foliage fertilization induced an increase of N content in leaves and a significant correlation was recorded between N content in leaves and the shoots growth.

4. Conclusions

On average for the 3 rooting biostimulator and the 3 foliar fertilization treatments, significant differences regarding the growth characteristics of the softwood cuttings among the 3-4 small fruit species were recorded.

On average, for the 4 species and the 3 foliar fertilization treatments, the mean length of shoots was increased by 14-17% in the treatment with no rooting biostimulators versus the 2 treated ones.

In all, in the foliar unfertilized treatment, versus the 2 treatments with foliar fertilization, a significantly increase by 14-17% of the mean length of shoots was recorded.

The application of the foliar fertilization induced an increase of N content in leaves by 8-13%, of P by 4-5%, of ash by 8% and a decrease of K content versus the unfertilized control.

References

1. Niță, M., Iancu, M., (2009) – Influence of radistim and indolil acetic acid on the major rooting characteristics of softwood cuttings în same small fruit species. In these proceedings.
2. Costea Gabriela, 2001 – Cercetări privind influența substraturilor și a soluțiilor nutritive în cultura containerizată a unor specii de arbuști ornamental. Teză de doctorat USAMV București.
3. Davidescu Velicica, Roxana Madjar, Gabriela Costea, F. Staănică, Georgeta Carețu (2001 – Substraturi de cultură. Editura CERES, București.

Tables and Figures

Table 1. The influence of the rooting biostimulator and foliar fertilization on the growth of the 4 softwood cuttings (average values of experimental factors graduations)

The studied character average / softcutting	Graduations of experimental factors												
	a ₁	a ₂	a ₃	a ₄	5% LSD	b ₁	b ₂	b ₃	5% LSD	c ₁	c ₂	c ₃	5% LSD
1	66.5	32.4	161.6	213.7	18.7	108	120	127	N.S	118	106	132	N.S
2	17.5	3.7	22.8	26.0	9.2	17.1	18.5	16.9	N.S	21.2	14.2	17.1	4.4
3	2.30	1.72	2.52	-	0.409	2.26	2.20	2.07	N.S	2.15	2.13	2.26	N.S
4	19.5	16.7	14.5	-	2.57	18.5	17.7	14.5	2.13	17.8	15.7	17.2	N.S
5	10.0	10.2	6.0	-	1.32	9.6	8.4	8.2	1.05	9.3	8.45	8.45	N.S
6	2.0	2.9	5.6	-	0.5	3.7	3.6	3.2	N.S	3.4	3.5	3.7	N.S

Legend: 1 - length of main roots – cm; 2: Number of secondary roots; 3: number of shoots; 4: sum of shoots growth (cm); 5. average length of shoot – cm; 6: diameter of shoot – mm. The significance of experimental factors graduations a₁ – a₄; b₁-b₃; c₁-c₃ is shown in the text at chapter „material and methods“.

Table 2. The influence of foliar fertilization inside of application of each rooting biostimulator on growth of soft cuttings (average for the analysed 4 small fruits species)

The studied character average / soft catting	Interaction of BC experimental factors				5% LSD	
		C ₁	C ₂	C ₁	1	2
D	b ₁	90.7	91.5	141.3		
	b ₂	114.0	132.8	114.4	53.6	63.5
	b ₃	150.0	92.8	139.5		
E	b ₁	15.0	13.8	22.2		
	b ₂	24.8	13.4	17.2	7.65	7.94
	b ₃	23.7	15.5	11.7		
F	b ₁	2.39	2.33	2.06		NS
	b ₂	2.06	2.11	2.44	NS	
	b ₃	2.00	1.94	2.28		
G	b ₁	19.83	17.25	18.49		
	b ₂	17.09	16.69	19.28	NS	3,68
	b ₃	16.60	13.03	13.86		
H	b ₁	10.5	8.8	9.4		
	b ₂	8.3	8.5	8.4	1.99	1.81
	b ₃	9.2	8.0	7.5		
I	b ₁	3.90	3.45	3.69		
	b ₂	3.06	3.57	4.26	0.80	0.815
	b ₃	3.08	3.54	3.07		

Legend: D - length of main roots – cm; e - Number of secondary roots; f: number of shoots; g: sum of shoots growth (cm); h. average length of shoot – cm; i: diameter of shoot – mm. The significance of experimental factors graduations b₁-b₃; c₁-c₃ is shown in the text at chapter „material and methods“. 5% LSD: 1. = constant b, c different; 2 = constant c, b different;

Table 3. The influence of the rooting biostimulator and foliar fertilization on the growth of the soft cuttings of 4 small fruit species (interaction of experimental factors A/B/C)

The studied character average / soft cutting	Graduations of experimental factors												
	b1			b2			b3			5% LSD			
		c1	c2	c3	c1	c2	c3	c1	c2	c3	1	2	3
D	a1	34	28	c3	97	61	96	83	50	109	107	115	108
	a2	25	20	40	25	46	23	72	25	27			
	a3	142	124	28	228	185	146	139	149	203			
	a4	162	194	137	106	239	192	306	147	219			
E	a1	16	17	359	42	11	20	21	14	5	15	16	17
	a2	3	2	13	4	4	1	5	5	5			
	a3	26	13	5	18	18	28	34	20	24			
	a4	15	23	25	36	21	20	35	24	13			
F	a1	2.67	2.17	46	2.00	2.00	2.50	2.17	2.50	2.33	0.976	0.922	0.964
	a2	1.83	1.83	2.33	1.83	1.83	2.00	1.50	1.67	1.67			
	a3	2.67	3.0	1.33	2.33	2.50	2.83	2.33	1.67	2.83			
	a4	-	-	2.50	-	-	-	-	-	-			
G	a1	18.3	20.9	-	23.1	19.8	22.2	24.4	13.5	11.5	7.14	6.97	7.04
	a2	25.1	17.4	24.1	15.1	14.9	15.7	13.7	16.9	18.2			
	a3	16.1	13.4	12.4	13.1	15.3	19.9	11.7	8.7	11.8			
	a4	-	-	20.8	-	-	-	-	-	-			
H	a1	10	9	-	12	11	9	11	8	7	3.4	3.4	3.4
	a2	14	11	12	9	8	8	10	10	11			
	a3	7	6	10	4	6	8	6	6	5			
	a4	-	-	6	-	-	-	-	-	-			
I	a1	2.6	2.1	-	1.9	1.8	2.3	1.9	1.8	1.7	1.4	1.4	1.4
	a2	3.4	2.5	2.3	2.9	2.5	2.6	3.4	3.2	3.0			
	a3	5.6	5.7	2.6	4.4	6.4	7.9	3.9	5.7	4.5			
	a4	-	-	6.2	-	-	-	-	-	--			
				-									

Legend: D - . length of main roots – cm; e - Number of secondary roots; f: number of shoots; g: sum of shoots growth (cm); h. average length of shoot – cm; i: diameter of shoot – mm. The significance of experimental factors graduations a1 – a4; b1-b3; c1-c3 is shown in the text at chapter „material and methods”. 5% LSD: 1. = constant ab, c different; 2 = constant ac, b different; 3 = constant bc, different

Table 4. Influence of rooting biostimulator and foliar fertilization on content of some chemical components in the four small fruit species leaves

	Nitrogen			Phosphorus			POTASSIUM			ASH		
CHOKEBERRY												
	C ₁	C ₂	C ₃	C ₁	C ₂	C ₃	C ₁	C ₂	C ₃	C ₁	C ₂	C ₃
b ₁	1.05	0.98	1.19	0.16	0.16	0.20	1.01	0.94	0.89	7.48	7.63	7.00
b ₂	0.91	0.91	1.19	0.18	0.20	0.20	0.71	0.84	0.78	6.50	6.60	6.70
b ₃	0.92	1.33	1.19	0.15	0.12	0.18	0.71	0.86	0.73	6.30	7.20	6.90
	0.96	1.073	1.19	0.163	0.160	0.193	0.810	0.880	0.800	6.76	7.143	6.867
HIP ROSE (ROSA CANINA)												
b ₁	1.33	1.47	1.61	0.15	0.25	0.19	0.47	0.60	0.63	7.60	8.20	0.50
b ₂	1.33	1.12	1.33	0.23	0.20	0.18	0.60	0.55	0.47	7.80	8.40	0.30
b ₃	1.61	1.54	1.47	0.39	0.24	0.28	0.73	0.60	0.57	7.60	9.10	8.20
	1.423	1.377	1.470	0.257	0.230	0.217	0.600	0.583	0.557	7.667	8.567	9.00
THORN BLACKBERRY												
b ₁	1.61	1.96	1.82	0.12	0.23	0.18	0.86	0.91	0.73	7.10	9.00	1.09
b ₂	1.47	1.68	1.68	0.16	0.23	0.19	0.78	0.62	0.71	0.30	9.70	8.10
b ₃	1.75	1.82	1.89	0.18	0.19	0.18	0.86	0.68	0.80	7.30	9.50	8.30
	1.61	1.82	1.797	0.153	0.217	0.183	0.833	0.737	0.747	7.900	9.400	9.100
HONEYSUCKLE												
b ₁	1.19	1.20	1.47	0.20	0.19	0.20	0.81	0.73	0.78	8.70	8.80	8.40
b ₂	1.19	1.47	1.61	0.25	0.25	0.20	0.65	0.60	0.52	0.30	9.40	0.45
b ₃	1.47	1.62	1.47	0.20	0.21	0.31	0.65	0.63	0.68	1.007	0.20	1.034
	1.283	1.430	1.517	0.217	0.217	0.237	0.703	0.653	0.660	1.357	0.133	0.357

b₁ – without biostimulator; b₂ – Radistim; b₃ – indolil acetic acid

c – without foliar fertilization; c₂ – folimax, c₃ – plantfert. The significance of experimental factors graduations b1-b3; c1-c3 is shown in the text at chapter „material and methods.

Table 5. Influence of rooting biostimulator and foliar fertilization on correlations nature and intensity between some growth and rooting indicators at Chokeberry, thorn blackberry and honeysuckle

Indicators of growth and rooting (average / softwood cuttings)	2	3	4	5	6	7
1	0.454*	NS	NS	-0.475*	0.662***	-0.489**
2	-	NS	NS	NS	0.391*	NS
3			NS	-0.486*	0.429*	-0.457*
4				0.729***	NS	NS
5					-0.58**	0.708***
6						-0.867***

Legend: 1 . length of main roots – cm; 2: Number of secondary roots; 3: number of shoots; 4: sum of shoots growth (cm); 5. average length of shoot – cm; 6: diameter of shoot – mm. 7. Percentage of rooting, NS = not significant

Table 6. Influence of foliar fertilization on nature and intensity of correlations between some chemical components in the softwood cuttings leaves at four small fruit species

Chemical component	Phosphorus	Potassium	ASh
Nitrogen	N.S	N.S	0.596 ⁺⁺⁺
Phosphorus		0.386	0.345
Potassium	-	-	0.404

NS = not significant

Table 7. The influence of the rooting biostimulator and foliar fertilization on nature and intensity of correlations between the values of growth and rooting indicators and some chemical leaves components at chokeberry, thorn blackberry and honeysuckle

Indicator of growth and rooting (average / softwood cuttings)	Chemical components			
	Nitrogen	Phosphorus	Potassium	ASh
1	0.357*	N.S	N.S	0.428**
2	N.S	NS	0.524**	NS
3	-0.536**	NS	NS	NS
4	-0.386*	NS	NS	-0.62***
5	NS	-0.614***	0.528**	-0.551**
6	NS	0.429*	NS	0.599***
7	NS	-0.553**	0.585**	-0.69***

Legend: The growth and rooting indicator: 1 . length of main roots – cm; 2: Number of secondary roots; 3: number of shoots; 4: sum of shoots growth (cm); 5. average length of shoot – cm; 6: diameter of shoot – mm. 7. Percentage of rooting NS - not significant