THE INFLUENCE OF THE SUBTRATE ON THE ROOTING PROCESS OF CARNATION CUTTINGS IN PROTECTED CULTIVATION

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Abstract

The harvesting of carnation cuttings is performed in the morning when plants are maximally turgescent, from shoots with 6-7 pairs of leaves. Cuttings must include 4-5 pairs of leaves leaving on the shoot the base with 2 pairs of leaves. The harvesting protocol specifies that cuttings must be detached with the left hand maintaining the shoot fixed with the right hand. The cuttings can be planted soon after harvesting or can be preserved at 0.1-2°C and 80% relative humidity for 100 days. The harvest of cuttings can be performed all year round but the best results are obtained at spring. The rooting period extends over 21-30 days at 16-18°C air temperature. The proportion of rooted cuttings can be improved by utilization of appropriate substrates.

Key words: cuttings, rooting substrate, root diameters.

INTRODUCTION

Carnations are herbaceous plants growing to 60-100 cm tall, with linear, sessile, opposed leaves. The flowers are grouped in cymes, with 5-10 stamens and serrated, variously colored petals (Zaharia, 1999).

The latest opinion polls among the buyers and flower growers in Europe situated the carnations on the first position (Verd, 2000).

The carnations are generally propagated by apical cuttings and in special cases such as seed ameliorative works, from seeds (Canarache, 1987). Cuttings are harvested in stock blocks established for this particular aim, from planting material obtained from meristem-tips. The cuttings consist of lateral shoots with 4-5 leaves pairs which are trimmed and put to root in soil, 5 x 5 cm and 4-6 cm deep pots.

The growth and development of plants depend on hereditary characteristics and environmental factors (Preda, 1989).

During the summer, the culture needs 50-70% shadowing (from full light intensity). Good air circulation contributes also as one of the main success factors in carnations cultivation (Sonea, 1983).

The carnations prefer moderate temperatures. Temperature variations are correlated to light and carnations' specific requirements (Runger, 1994). During the periods of reduced light intensity when solar radiation does not interfere with carnations' development, the temperature can be correlated better in conjunction with the light (Oprița, 1988). On the contrary, when light intensity reaches its maximum, it is correlated with high temperatures (Mareş, 1988).

MATERIAL AND METHOD

The research was developed on testing the rooting of carnation cuttings. Two factorial experimental designs were established which consisted of 2 factors and 5 levels for the first factor and 2 levels for the second factor.

Factor A – rooting substrate

A1 – sand
A2 – peat
A3 – perlite
A4 – sand 30% +peat 35%+perlite 35%
A5 - sand 50% + beech sawdust 50%

Factor B – treatment with rhizogenous stimulation

B1 – control
B2 – treated with Radistim 1

The combination of factors resulted in blocked 10 experimental levels with 3 repetitions (table 1).

Table 1

Experimental levels, Sîntandrei 2011-2013

No	Rooting substrate	Treatment with rooting stimulation
1	A_1 – rooting in sand	B_1 – control
2	A_1 – rooting in sand	B_1 – treatment with Radistim 1
3	A_2 – rooting in peat	B_2 – control
4	A_2 – rooting in peat	B_2 – treatment with Radistim 1
5	A_3 – rooting in perlite	B_3 – control
6	A_3 – rooting in perlite	B_3 – treatment with Radistim 1
7	A_4 – rooting in sand 30% + peat 35% + perlite 35%	B_4 – control
8	A_4 – rooting in sand 30% + peat 35% + perlite 35%	B_4 - treatment with Radistim 1
9	A_5 – rooting in sand 50% + beech sawdust 50%	B_5 - control
10	A_5 – rooting in sand 50% + beech sawdust 50%	B_5 - treatment with Radistim 1

The area of the experimental unit covered 1 m^2 while the total area of the experimental plot was 30 m^2. In every experimental plot, 30 cuttings were planted (the total number of cuttings of 12, 000).

The harvesting of cuttings was performed in April, those being planted shortly after harvesting.

The rooting substrate temperature was maintained between 18 and 20°C, air temperature at 16-20 °C. Relative humidity of the substrate was maintained in the range 55-60% and 60-70% in the air.

RESULTS

The rooting period of the cuttings extended over 25 days for the levels with sand 50% + beech sawdust 50%, 28 days for the levels with perlite, 30 days for the levels with peat and 32 days for the levels with sand.

The treatment with Radistim 1 induced sooner the rooting of the cuttings, with 3-7 days.

The average number of rooted cuttings from the total number of cultivated cuttings varied with treatment type and clustered according to the experimental factors (table 2).

Table 2

Average values (2011-2013) for the carnations' rooted cuttings

No	Levels		Rooted cuttings		±D	Significance of the difference
	Rooting substrate	Treatment with Radistim	No	%		
1	Rooting in sand	control	725	100	-	-
2	Rooting in sand	Radistim treatment	797	109	72	**
3	Rooting in peat	control	752	103	27	-
4	Rooting in peat	Radistim treatment	822	121	97	**
5	Rooting in perlite	control	750	103	25	-
6	Rooting in perlite	Radistim treatment	869	119	144	***
7	Rooting in sand 30% + peat 35% + perlite 35%	control	983	136	258	***
8	Rooting in sand 30% + peat 35% + perlite 35%	Radistim treatment	1010	139	285	***
9	Rooting in sand 50% + beech sawdust 50%	control	1001	138	276	***
10	Rooting in sand 50% + beech sawdust 50%	Radistim treatment	1106	153	381	***

LSD 5% - 3.7; LSD 1% - 57.35; LSD 0.1% - 97.5

The results show that on sand, rooting figures are smaller with a difference between control and stimulated cultures. This difference is preserved for all experimental levels showing significant rooting performance in stimulated rooting cultures with further differences depending on the substrate type, best results being obtained on the substrate containing half sand, half beech sawdust.

Statistical analysis shows that in the experimental level with sand, the stimulated culture with Radistim was significantly different compared to the control.

In levels employing peat as rooting substrate, significant difference is preserved for the stimulated culture.

In levels employing perlite as rooting substrate the difference between control and stimulated culture was extremely significant.

In the levels employing a mixture of 30% sand, 35% peat and 35% perlite as well as in the levels with 50% sand and 50% beech sawdust the differences between controls and stimulated cultures were also extremely significant.

Concerning the number of rooted cuttings compared to the total sum of cultivated cuttings, the differences oscillated in the range 60.4 – 92.1%.

The quality of rooted cuttings is determined by the average number of roots per cutting. Between the control number 1 (cuttings planted in sand) and level 10 (cuttings rooted in a mixture of 50% sand and 50% beech sawdust stimulated with Radistim 1) there are consistent differences: from 8.3 roots per cutting to 16.9 roots per cutting.

Statistical analysis shows significant differences between cuttings rooted in perlite (level 50 and in 305 sand, 35% peat and 35% perlite (level 7), also in cuttings rooted in 50% sand and 50% beech sawdust (level 9) controls, distinctly significant in level 2, level 4 and level 6, extremely significant in level 8 and level 10 compared to controls.

Table 3

Average number of roots per cutting, Sîntandrei 2011-2013

No	Levels		Roots per cutting		±D	Significance of the difference
	Rooting substrate	Treatment with Radistim	No	%		
1	Rooting in sand	control	8.3	100	-	-
2	Rooting in sand	Radistim treatment	12.9	155	4.6	**
3	Rooting in peat	control	10.4	125	2.1	-
4	Rooting in peat	Radistim treatment	14.0	169	5.7	**
5	Rooting in perlite	control	11.6	140	3.3	*
6	Rooting in perlite	Radistim treatment	14.2	171	5.9	**
7	Rooting in sand 30% + peat 35% + perlite 35%	control	12.2	147	3.9	*
8	Rooting in sand 30% + peat 35% + perlite 35%	Radistim treatment	16.1	194	7.8	***
9	Rooting in sand 50% + beech sawdust 50%	control	12.6	163	4.3	*
10	Rooting in sand 50% + beech sawdust 50%	Radistim treatment	16.9	204	8.6	***

LSD 5% - 2.7; LSD1% - 4.4; LSD 0.1% - 7.1

The length and width of the roots varied between large limits with best results in cuttings rooted in 50% sand and 50% sawdust substrate, treated with Radistim.

Table 4

Average lengths and widths of carnations' roots, Sîntandrei 2011-2013

No	Levels		Extreme values for root lengths (cm)	Roots' clustering according to widths		Total
	Rooting substrate	Treatment with Radistim		Number of roots below 1mm	Number of roots over 1mm	
1	Rooting in sand	control	0.6 -8.9	4.5	3.8	8.3
2	Rooting in sand	Radistim treatment	0.7 – 9.4	6.8	6.1	12.9
3	Rooting in peat	control	0.7 – 9.9	5.3	5.1	10.4
4	Rooting in peat	Radistim treatment	0.7 – 10.2	7.2	6.8	14.0
5	Rooting in perlite	control	1.1 – 11.1	5.8	5.8	11.6
6	Rooting in perlite	Radistim treatment	1.3 – 12.7	7.2	7.0	14.2
7	Rooting in sand 30% + peat 35% + perlite 35%	control	1.6 – 13.1	6.3	5.9	12.2
8	Rooting in sand 30% + peat 35% + perlite 35%	Radistim treatment	1.8 – 13.8	8.2	7.9	16.1
9	Rooting in sand 50% + beech sawdust 50%	control	1.9 – 14.1	6.4	6.2	12.6
10	Rooting in sand 50% + beech sawdust 50%	Radistim treatment	1.9 – 15.3	8.9	8.0	16.9

Table 4 shows that root length varies between 0.6 – 8.9 cm in level 1 (control) and 1.9 – 15.3 cm in level 10 (substrate composed of 50% sand and 50% beech sawdust, stimulated with Radistim 1).

Data show that in sand the average root length varied in the range 4.75 – 5.05 cm, in peat in the range 5.3 – 5.45 cm, in perlite in the range 6.1 – 7 cm. in mixed substrate with 305 sand, 35% peat and 35% perlite in the range 7.35 – 7.8 cm and in the mixed substrate 50% sand and 50% sawdust, in the range 8 -8.6 cm.

The reported results confirm the hypothesis that the substrate composed of a mixture of 50% sand and 50% sawdust exerts the best influence on the rooting of carnation cuttings.

Concerning the variation of root width, in the class containing roots below 1 mm in diameter the variation was in the range 4.5 and 8.9 roots per cutting (control in level 1 to stimulated rooting in level 10). In the case of roots exceeding 1 mm in diameter, the range of variation was 1.1 to 3.8 roots per cutting, from level 1 to level 10.

CONCLUSIONS

- The rooting period of the cuttings extended over 25 days for the levels with sand 50% + beech sawdust 50%, 28 days for the levels with perlite, 30 days for the levels with peat and 32 days for the levels with sand.
- Statistical analysis shows significant differences between cuttings rooted in perlite (level 50 and in 305 sand, 35% peat and 35% perlite (level 7), also in cuttings rooted in 50% sand and 50% beech sawdust (level 9) controls, distinctly significant in level 2, level 4 and level 6, extremely significant in level 8 and level 10 compared to controls.
- The duration of rooting in carnation cuttings was of 25 – 32 days depending on the rooting substrate.
- The best experimental level in terms of rooted cuttings and number of roots per cutting, of length and width of the roots corresponded to the substrate composed of 50% sand and 50% sawdust when stimulation with Radistim 1 was used.
- The un-stimulated control using the same substrate generated lower figures, with 9.1%.
- Rooting proportion varied within large limits across experimental levels: 60.41% in level 1, 92.16 in level 10.
- The most influential factor in what concerned rooting performance was the substrate.
- The stimulation of the rooting using Radistim 1 ensured a high proportion of rooted cuttings with differences induced by the substrate type: the substrate containing a mixture of 50% sand and 50% sawdust gave the best results while the substrate containing only sand gave the worst results in numbers of rooted cuttings. The increase was of 6%.
- Compared to the control, the best level gave an increase of 381 cuttings, 31.76% respectively.

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