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RESEARCH CONCERNING THE BIOTECHNOLOGY OF VIRUS-FREE HOP CUTTINGS

Rodica Vârban, D. Vârban
University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca. Faculty of Agriculture. Corresponding author
dan_varban@yahoo.com

Abstract. Biotechnology research on hop cuttings production have focused on small cuttings behavior in the nursery, trying to establish their optimal age at the time of planting in nursery, and also the most effective technologies and their planting densities. The following parameters were analyzed: mass, length and diameter of hop cuttings.
Key words: *small cuttings, prerooting, nursery.*

Introduction

The experiments conducted have as objective to establish the appropriate age of small hop cuttings for planting in nursery and to establish the most effective technologies and planting distances, in order to limit losses caused by establishment percentage and the rate of growth and development affected by transfer stress from the greenhouse in nursery.

Materials and methods

For research we have used two Romanian varieties, Aroma and Productiv, created at University of Agriculture and Veterinary Medicine Cluj-Napoca, department of Plant culture and the foreign variety Perle, created at Research Institute from Hull (Germany).

We analyzed the optimal age of small hop cuttings at planting in the nursery and the most effective technologies and distances for their transplantation. Small cuttings were produced in greenhouse; prerooting was done in an optimal substrate, consisting of peat, sand and undisturbed soil (80% peat, 15% undisturbed soil and 5% river sand).

Results

The influence of age of small cuttings on planting in nursery

To establish the optimal age we compared three different ages of respectively 35, 45 and 50 days after prerooting start until planting in the nursery. We planted in nursery three replications, with a total of 100 small

cuttings/replication for each variety. Planting was done in early May, after a period of heavy rainfall. Planting was done in shallow open ditches. The results were expressed by the rate (percentage) of establishment for each variety studied. Control variant was considered to the youngest age of small cuttings (35 days).

From Table 1 and fig. 1 it appears that in all varieties the percentage is greater at 45 and 50 days, with distinct and very significant differences compared to control; the percentage of the plant established was equal (96%). For Aroma variety the rates of post-planting survival were quite high (72%) even for cuttings at the age of 35 days. For Perle variety the percent was 91% and 92%, at 45 and 50 days, compared to 52% at 35 days. This variety has a weaker ecological plasticity compared to other two varieties, a phenomenon that explains the reduced post-survival rates. The two Romanian varieties (Aroma and Productiv) behave roughly the same, with high post-survival rates (96%).

Table 1

Post-survival rates of small hop cuttings separated on variety and prerooting age (days)

Variety	Age	Post-survival rate	%	Differences	Significance	LSD (DL)
Aroma	35 days	72.0	100	0	-	5%-12.7 1%-21.0 0.1%-39.3
	45 days	96.0	133.3	24.0	xx	
	50 days	96.0	133.3	24.0	xx	
Perle	35 days	52.3	100	0	-	5%-10.2 15-17.o 0.1%-31.8
	45 days	91.3	174.5	39.0	xxx	
	50 days	92.3	176.4	40.0	xxx	
Productiv	35 days	69.0	100	0	-	5%-3.7 1%-6.1 0.1%-11.4
	45 days	96.3	139.6	27.3	xxx	
	50 days	96.6	140.1	27.6	xxx	

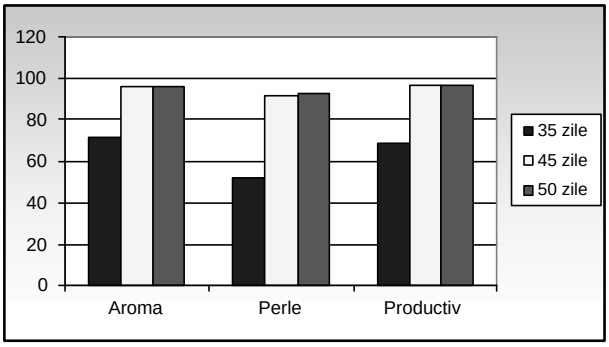

Fig. 1 Influence of age and variety on post-survival rate

Influence of technology and planting distances on biological parameters of virus-free hop cuttings

For this purpose we established a trifactor (2x2x3) experience, resulting in 12 variants with prerooted small cuttings in greenhouse at the same age and quality. Factors and their graduations were:

Factor A – variety: A_1- AROMA / A_2- PERLE
B – planting technology: b_1 - hilled rows
b_2 - ditch
C – planting distances: c_1 - 10/75 - 133.333 cuttings/ha
c_2 - 15/75 - 88.888 cuttings /ha
c_3 - 20/75 - 66.666 cuttings /ha

Experience has been established based on subdivided parcels method, a variant surface is 8.25 m^2 (11 x 0.75) and the total area of experience – 594 m^2 (44 x 13.5 m). Each variant consisted of 4 repetitions.

Measurements and weighing of cuttings were performed immediately after harvest (October). Experimental data on an interaction of factors planting x planting distances were statistically analyzed by analysis of variance for multiple factor experiences and the results were interpreted based on statistical differences between variants. It was analyzed the influence of technology and planting distances on the main quality parameters (mass, total length, diameter).

Influence of technology and density on cuttings mass

The mass of cuttings planted in a ditch registered higher values. Cuttings of Aroma variety planted in ditch had a mass with 5 g higher than those planted in hilled rows (distinct significant difference). This variety is not influenced by planting distances, even if we found higher values as the distance between plants in the row increases, but with no significant differences (table 2)

Table 2.

Influence of technology and density on cuttings mass – Aroma variety

Technology	Planting distance (cm)	Cuttings mass		± Difference	Significance
		(g)	%		
Hill rows	10/75	58.70	100.0	0	-
	15/75	59.70	101.7	1.00	-
	20/75	59.00	100.5	0.30	-
Ditch	10/75	69.13	100.0	0	-
	15/75	71.50	103.4	2.37	-
	20/75	73.17	105.8	4.03	-

LSD (DL) 5%- 4.3 LSD (DL)1% -5.8 LSD (DL) 0,1% -7.8

Perle variety is generally less vigorous than Aroma variety and with a smaller ecological plasticity. We found lower values compared to the other variety studied, the cuttings planted in ditch had significant negative difference towards the mass of cuttings planted on hilled rows. In terms of planting distances least they had a small influence on the mass of cuttings for the variety Perle, lower values were recorded at 15 cm between rows (significantly negative difference) (table 3).

Table 3.

Influence of technology and density on cuttings mass – Perle variety

Technology	Planting distance (cm)	Cuttings mass		± Difference	Significance
		(g)	%		
Hill rows	10/75	58.87	100.0	0	-
	15/75	58.13	98.8	- 0.73	-
	20/75	59.47	101.0	0.60	-
Ditch	10/75	54.80	100.0	0	-
	15/75	56.43	103.0	1.63	-
	20/75	58.47	106.7	3.67	xx

LSD (DL) 5%- 2.6 LSD (DL) 1% -3.6 LSD (DL) 0.1% -4.8

Influence of technology and density on cuttings total length

Planting distances did not affect the overall length of cuttings belonging to Aroma variety. The cuttings planted in ditch had a total length greater than those planted in hill rows.

Fort the interaction of factors technology x planting distances we found significant differences compared to control for cuttings planted in ditch at 20 cm between plants. For cuttings planted in hill rows there were no differences compared to control variant (Table 4).

Table 4.

Influence of technology and density on total length of cuttings – Aroma variety

Technology	Planting distance (cm)	Total length of cuttings		± Difference	Significance
		(cm)	%		
Hill rows	10/75	49.83	100.0	0	-
	15/75	46.17	92.6	- 3.67	-
	20/75	50.97	102.3	1.13	-
Ditch	10/75	48.23	100.0	0	-
	15/75	50.20	104.1	1.97	-
	20/75	55.93	116.0	7.70	xxx

LSD (DL) 5%-3.6 LSD (DL) 1% -2.0 LSD (DL) 0.1% -2.7

For the interaction of these two factors on variety Perle total length of the hop cuttings remains approximately constant, with no significant differences to control (Table 5).

Table 5.

Influence of technology and density on total length of cuttings – Perle variety

Technology	Planting distance (cm)	Total length of cuttings		± Difference	Significance
		(cm)	%		
Hill rows	10/75	55.67	100.0	0	-
	15/75	56.40	101.3	0.73	-
	20/75	56.80	102.0	1.13	-
Ditch	10/75	56.80	100.0	0	-
	15/75	56.93	100.2	0.13	-
	20/75	57.80	101.8	1.00	-

LSD (DL) 5%-2.7 LSD (DL) 1% -3.6 LSD (DL) 0.1% -4.9

Influence of technology and density on cuttings diameter

For the diameter of Aroma cuttings, studied interactions shows differences between the two technologies of planting. Thus, for the cuttings planted in hill rows at a distance of 15 cm between plants there is a significant negative difference compared to, and significant positive difference to the cuttings planted at 20 cm. Diameter of cuttings planted in ditch present significantly distinct negative differences for the variant with 15 cm between plants, but with no significant differences for variant of planting at 20 cm (Table 6).

Perle variety is not influenced by the technology of planting and distances between rows. There were no significant differences between variants, diameter of cuttings being approx. 22 mm (table 7).

Table 6.

Influence of technology and density on total length of cuttings – Aroma variety

Technology	Planting distance (cm)	Diameter		± Difference	Significance
		(mm)	%		
Hill rows	10/75	23.47	100.0	0	-
	15/75	22.47	95.7	- 1.00	0
	20/75	24.57	104.7	1.10	X
Ditch	10/75	25.83	100.0	0	-
	15/75	24.57	95.1	- 1.27	00
	20/75	25.47	98.6	- 0.37	-

LSD (DL) 5%-0.9 LSD (DL) 1% -1.2 LSD (DL) 0.1% -1.6

Table 7.

Influence of technology and density on total length of cuttings – Perle variety

Technology	Planting distance (cm)	Diameter		± Difference	Significance
		(mm)	%		
Hill rows	10/75	21.57	100.0	0	-
	15/75	21.80	101.1	0.23	-
	20/75	22.13	102.6	0.57	-
Ditch	10/75	22.23	100.0	0	-
	15/75	21.77	97.9	- 0.47	-
	20/75	22.07	99.3	- 0.17	-

LSD (DL) 5%-2.8 LSD (DL) 1% -3.8 LSD (DL) 0.1% -5.1

Conclusions

For all varieties studied rate of post-survival is positively correlated with the time from prerooting. Small hop cuttings optimum age is 45 days. Maintaining plants in greenhouse over this age is unnecessary, at the age of 50 days survival rates being practically equal. Small cuttings can be transplanted in the nursery for full rooting when the roots reach the bottom of the small nutritious pot and swarm all its volume.

Planting technology (hill rows or ditch) generally does not influence the studied biological parameters, each variant showing advantages and disadvantages. Cuttings thrives on hill rows, roots explores a large volume of soil and for mechanic harvesting cuttings are less affected. But, cuttings losses are much higher in hill rows especially in years whit lacking rainfall. Ditches are much better in dry years than planting in hill rows. In both planting technologies biological material it is characterized by a high quality, so each planting variant is chosen due to the advantages it presents.

Planting distances does not influence the quality of cuttings, with no significant differences. If we need large number of cuttings / ha the technology will be directed toward smaller distances of planting between plants/row, but maintenance is easier to be done at higher distances.

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