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RESULTS REGARDING BEHAVIOR OF POTATO CULTIVAR IN MINITUBERIZATION PROCESS DURING 2021-2022

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Abstract

In order to investigate the effect of variety, nutrion space on minitubers production, a study was carried out in the Laboratory of Vegetable Tissue Cultures of NIRDPSB Braşov, in period 2021-2022. The trifactorial experience (3 x 2 x 2), on 3 repetitions, included the following factors: experimental factor A: cultivar, with three gradations: a1 - Marvis; a2 - Castrum; a3 - Ervant (considered control); experimental factor B: year of study, with two graduations: b1 - 2021 (considered control); b2 - 2022; the experimental factor C: the volume of the nutrition space, with two graduations: c1 - 1.5 l (considered control); c2 - 2 l. In this study Ervant cultivar stands out with a high number of minitubers (7.81), and the Castrum variety obtained the highest value of minitubers weight (75.65 g). The use of increased space for culture has a positive influence on minituberization, both in the number and weight of minitubers obtained/plant.

Key words*: cultivar, minitubers, nutrition space, plantlets, potato.*

INTRODUCTION

Potato is conventionally propagated vegetatively through tubers. The multiplication rate is usually one to ten in one growing season Therefore, it takes several years to multiply a new variety and meet the demand of the growers. Besides, the pathogen population keeps on accumulating generation after generation which lead to the varietal decline. Micropropagation ensures, true to type, disease free and rapid, year-round multiplication of plants. The technique is being used to bulk up new varieties or breeding lines, it is also an ideal material for national and international exchange of germplasm (Kaur et al., 2000).

Protected multiplication using non-conventional approaches, through micro-propagation of nodal cuttings and micro-tuber production followed by further multiplication of minitubers in net houses can be followed to produce high quality potato seed within the region (Ramani and Srivastava, 2010).

In vitro propagated plantlets are commonly used in potato seed production as a source of healthy propagation material (Sharma et al., 2014). Nowadays seed potato (*Solanum tuberosum* L.) programmes worldwide include production of small tubers called minitubers that are grown from *in vitro* derived potato plantlets (Struik, 2007).

Producing minitubers from *in vitro* plantlets allows a faster multiplication rate in seed tuber production programs and reduces the number of field generations needed (Imma and Mingo-Castel, 2006). Prenuclear minitubers of potato (*Solanum tuberosum* L.) are the source material used to produce field-grown seed potatoes (Brendan et al, 1995).

Minitubers can be produced throughout the year and are principally used for the production of pre-basic or basic seed by direct field planting (Lommen, 1999; Ritter et al., 2001)

In vitro produced disease-free potato clones combined with conventional multiplication methods have become an integral part of seed production in many countries (Naik et al., 2000).

Production of healthy potato clones combined with *in vitro* procedures have become an important part of potato seed production, resulting in high quality seed tubers (Jones 1994).

MATERIALS AND METHODS

During 2021 and 2022 years, the experiments were placed in the isolated space of NIRDPSB

Brasov, Laboratory of Vegetal Tissue Culture. The statistical analysis was carried out to establish the influence of the genotype, the study year and the influence of the volume of the culture vessels in obtaining the number of minitubers/plant and their weight. The trifactorial experience (3 x 2 x 2), on 3 repetitions, included the following factors: experimental factor A: variety, with three gradations: a1 - Marvis; a2 - Castrum; a3 - Ervant (considered control); experimental factor B: year of study, with two graduations: b1 - 2021 (considered control); b2 - 2022; the experimental factor C: the volume of the nutrition space, with two graduations: c1 - 1.5 l (considered control); c2 - 2 l. The objective of the conducted research consisted in determining the capacity of plantlets obtained *in vitro* to produce minitubers. The aim was to obtain minitubers from plantlets, after the initiation of meristem culture and the regeneration of healthy plantlets from them, free of diseases, material that will be the starting point in the production of minitubers (obtained *in vivo*).

The experiments for obtaining minitubers were set up in protected spaces of NIRDPSB Brasov, following the location sketch according to Figure 1, a sketch that was respected every year. This experience included 12 variants.

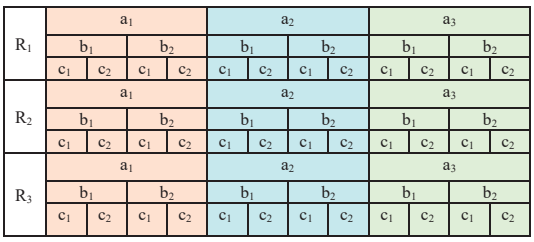

Figure 1. The location sketch of the experimental variants made for three varieties of potato, two years of study and two variants of nutrition spaces (a - cultivar; b - year of study; c - the variety; r - repetition)

RESULTS AND DISCUSSIONS

Regarding variety influence (Table 1) on the average number of minitubers obtained/plant, distinctly significant negative differences are observed for the Marvis (-2.77 minitubers) and Castrum varieties (-1.75 minitubers), compared to the control genotype.

When analysing the influence of the variety on the weight of the minitubers, very significant positive differences are highlighted for Castrum (51.31 g) and Marvis (40.79 g) cultivars, compared to the control variety. For the two years of the study, the control genotype showed a high capacity to produce minitubers, but their weight was low.

Table 1. The influence of cultivar on mean number of minitubers obtained/plant and on mean weight (g) of minitubers/plant for the years 2021-2022

Cultivar (a)	Number of minitub./pl.	Diff./ Sign.	Weight of minitub./pl. (g)	Diff./ Sign. (g)
Marvis (a_1)	5.04	-2.77 oo	65.31	40.79 ***
Castrum (a_2)	6.06	-1.75 oo	75.65	51.13 ***
Ervant (a_3) (Ct)	7.81	-	24.52	-
	LSD 5% = 0.92; 1% = 1.52; 0.1% = 2.85.		LSD 5% = 5.52g; 1% = 9.13 g; 0.1% = 17.09 g.	

The analysis of study year influence on minitubers number obtained/plant and on their weight highlights distinctly significant positive difference in 2022 year, influencing the parameters studied in a positive sense (Table 2).

Table 2. Influence of study year on mean number of minitubers obtained/plant and on mean weight of minitubers/plant (g) for years 2021-2022

Year of study (b)	Mean number of minitub./pl.	Diff./ Sign.	Mean weight of minitub./pl. (g)	Diff. (g)/ Sign.
2021 (b_1) (Ct)	5.31	-	41.76	-
2022 (b_2)	7.31	2.00 **	68.55	26.80 **
	LSD 5% = 1.11; 1% = 1.68; 0.1% = 2.70.		LSD 5% = 14.26 g; 1%= 21.60 g; 0.1% = 34.69 g.	

In the two years of study, when comparing the experimental differences with the limit differences calculated in examination of nutrition space volume influence over mean number of minitubers obtained/plant, the positive effect of the increased nutrition space is observed, resulting a very significant positive difference (2.56 minitubers).

Analysing the results regarding the weight of minitubers/plant in the two years of minitubers obtaining, highlights the beneficial influence of the increased nutrition space, expressed by a very significant positive difference (31.72 g) (Table 3).

In 2022, compared to 2021, the Ervant variety stands out with high values of minitubers number (Table 4), with a very significant positive difference (4.88 minitubers). In 2022, by comparing the differences obtained between the Marvis and Castrum varieties, compared to the control genotype, very significant negative differences are found (-4.50 minitubers and -4.33 minitubers).

Table 3. Influence of nutrition space volume on mean number of minitubers obtained/plant and on minitubers weight /plant (g) for the years 2021-2022

Nutrition space volume (l) (c)	Minitub. number/ pl.	Diff./ Sign.	Weight of minitub./pl. (g)	Diff. (g)/ Sign.
1.5 (c_1) (Ct)	5.03	-	39.30	-
2 (c_2)	7.58	2.56 ***	71.02	31.72 ***
	LSD 5% = 0.86; 1% = 1.21; 0.1% = 1.71.		LSD 5% = 9.24 g; 1% = 12.97 g; 0.1% = 18.31 g	

In the period 2021-2022, the Ervant and Castrum cultivars stand out with high values of the minitubers number obtained for the increased nutrition space, determining positive, very significant differences to be obtained (4.71 g and 3.29 g). The increased nutrition space strongly influenced the formation of minitubers for these varieties (Table 5).

The analyse of combined influence of study year and nutrition space volume over mean number of minitubers obtained/plant shows the beneficial effect of the increased nutrition space, for both study years, with distinctly significant differences (1.83 minitubers/2021) and very significant positive (3.28 minitubers/2022). By planting the biological material obtained *in vitro* in the increased nutrition space, a very significant positive difference (2.72) is obtained for the year 2022, compared to the control year. When comparing the results obtained in the culture vessels with reduced volume, a significant positive difference (1.28) is observed in 2022, compared to the control year (Table 6).

Combined influence of variety and year of study on minitubers weight (g) obtained/plant draws our attention to Marvis and Castrum cultivars, which stand out with significant positive differences (37.20 g and 35.78 g), in 2022 (Table 7).

For period 2021-2022, the analysis of cultivar behavior regarding the weight of minitubers obtained on the two nutrition spaces highlights the Castrum and Ervant varieties that determine the achievement of very significant positive differences (60.55 g) and distinctly significant positive differences (24.84 g) for increased nutrition space. The variety/nutrition space interaction draws our attention to: very significant differences by comparing the varieties Marvis and Castrum (48.33 and 33.28 g), with the control genotype, by using the reduced nutrition space. Also, by comparing the previously mentioned cultivars with the control variety, but when using the increased nutrition space, very significant positive differences are observed (Table 8).

Analysing the combined influence of study year and nutrition space volume on minitubers weight highlights the beneficial effect of increased nutrition space for both study years, with distinctly significant and highly significant positive differences (23.71 and 39.73 g). When it was compared the differences obtained for the two study years, a very significant positive difference is observed for the year 2022, compared to the control year for the increased nutrition space (34.80 g) and a significant positive difference (18.79 g) for the reduced space of nutrition, by reporting the year 2022 compared to the year 2021 (Table 9).

Table 4. Combined influence of cultivar and study year on mean number of minitubers obtained/plant for the years 2021-2022

Variery (a)/ Year of study (b)	Marvis (a_1)		Castrum (a_2)		Ervant (a_3)		a_1-a_3/ Sign.	a_2-a_3/ Sign.
	Minitub. number/pl.	Diff./ Sign.	Minitub. number/pl.	Diff./ Sign.	Minitub. number/pl.	Diff./ Sign.		
2021 (b_1) (Ct)	4.33	-	6.21	-	5.38	-	-1.04 ns	0.83 ns
2022 (b_2)	5.75	1.42 ns	5.92	0.29 ns	10.25	4.88 ***	-4.50 ooo	-4.33 ooo
	LSD 5% = 1.93; 1% = 2.92; 0.1% = 4.68.				LSD 5% = 1.53; 1% = 2.38; 0.1% = 4.01.			

Table 5. Combined influence of cultivar and nutrition space volume over mean number of minitubers obtained/plant for the years 2021-2022

Cultivar (a)/ Nutrition space volume (l) (c)	Marvis (a_1)		Castrum (a_2)		Ervant (a_3)		a_1-a_3/ Sign.	a_2-a_3/ Sign.
	Minitubers number/plant	Diff./ Sign.	Minitubers number/plant	Diff./ Sign.	Minitubers number/plant	Diff./ Sign.		
1.5 (c_1) (Ct)	5.21	-	4.42	-	5.46	-	-0.25 ns	-1.04 ns
2 (c_2)	4.88	-0.33 ns	7.71	3.29 ***	10.17	4.71 ***	-5.29 ooo	-2.46 oo

LSD 5% = 1.50; 1%= 2.10; 0.1% = 2.97. LSD 5% = 1.28; 1%= 1.91; 0.1% = 3.06.

Table 6. Combined influence of the study year and nutrition space volume over mean number of minitubers obtained/plant for the years 2021-2022

Year of study (b) / Nutrition space volume (l) (c)	2021 (b_1)		2022 (b_2)		b_2-b_1/ Sign.
	Minitubers number/ plant	Diff./ Sign.	Minitubers number/ plant	Diff./ Sign.	
1.5 (c_1) (Ct)	4.39	-	5.67	-	1.28 *
2 (c_2)	6.22	1.83 **	8.94	3.28 ***	

LSD 5% = 1.22; 1% = 1.72; 0.1% = 2.42. LSD 5% = 1.19; 1% = 1.75; 0.1% =2.68.

Table 7. Combined influence of cultivar and study year on minitubers weight (g) obtained/plant for 2021-2022

Cultivar (a)/ Year of study (b)	Marvis (a_1)		Castrum (a_2)		Ervant (a_3)		a_1-a_3/ Sign.	a_2-a_3/ Sign.
	Minitubers weight. (g)/pl.	Diff./ Sign.	Minitubers weight. (g)/pl.	Diff./ Sign.	Minitubers weight. (g)/pl.	Diff./ Sign.		
2021 (b_1) (Ct)	46.70	-	57.76	-	20.81	-	25.89 *	36.95 **
2022 (b_2)	83.91	37.20 *	93.53	35.78 *	28.22	7.41 ns	55.69 ***	65.31 ***

LSD 5% = 24.70 g; 1%= 37.40 g; 0.1% = 60.09 g. LSD 5% =17.97 g; 1%= 27.42 g; 0.1% = 44.69 g.

Table 8. Combined influence of cultivar and nutrition space on minitubers weight (g) obtained/plant for 2021-2022

Cultivar (a)/ Nutrition space volume (l) (c)	Marvis (a_1)		Castrum (a_2)		Ervant (a_3)		a_1-a_3/ Sign.	a_2-a_3/ Sign.
	Minitubers weight. (g)/pl.	Diff./ Sign.	Minitubers weight. (g)/pl.	Diff./ Sign.	Minitubers weight. (g)/pl.	Diff./ Sign.		
1.5 (c_1) (Ct)	60.43	-	45.37	-	12.10	-	48.33 ***	33.28 ***
2 (c_2)	70.19	9.76 ns	105.92	60.55 ***	36.94	24.84 **	33.25 ***	68.98 ***

LSD 5% = 16.00 g; 1%= 22.46 g; 0.1% = 31.71 g. LSD 5% = 12.13 g; 1%= 17.51 g; 0.1% = 26.17g.

Table 9. Combined influence of study year and nutrition space volume on minitubers weight (g) obtained/plant for 2021-2022

Year of study (b) / Nutrition space volume (l) (c)	2021 (b_1)		2022 (b_2)		b_2-b_1/ Sign.
	Minitubers weight. (g)/pl.	Diff./ Sign.	Minitubers weight. (g)/pl.	Diff./ Sign.	
1.5 (c_1) (Mt)	29.90	-	48.69	-	18.79 *
2 (c_2)	53.61	23.71 **	88.42	39.73 ***	34.80 ***

LSD 5% = 13.07 g; 1%= 18.34 g; 0.1% = 25.89 g. LSD 5% = 13.92 g; 1%= 20.59 g; 0.1% = 31.86 g

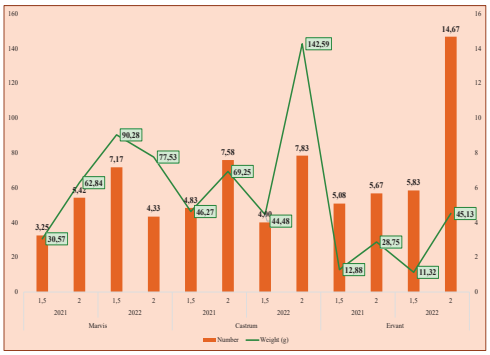

Figure 2. Number and weight of minitubers

Examining the results for two years of study, regarding the number and weight of minitubers/plant, highlights the high capacity of the Castrum variety (Figure 2) to produce minitubers grown in the increased nutrition space for the year 2022 (7.83 minitubers and 142.59 g).

Figures 3 and 4 show the distribution of minitubers number and weight.

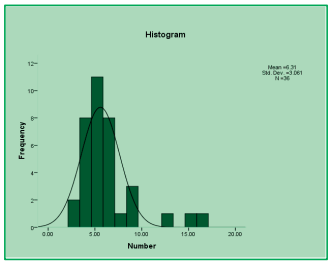

Figure 3. Distribution (Histogram) of minitubers number

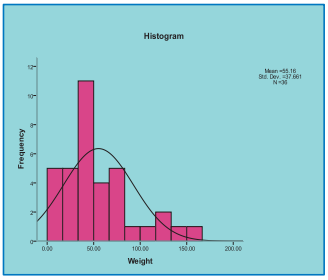

Figure 4. Distribution (Histogram) of minitubers weight (g)

CONCLUSIONS

The Ervant cultivar stands out for recording a high number of minitubers (7.81), and the Castrum variety obtained the highest value of minitubers weight (75.65 g).

The use of increased space for culture has a positive influence on minituberization, both in the number and weight of minitubers obtained/plant.

In 2022, compared to the previous year, higher values were obtained for the analyzed parameters.

In the 2021-2022 period, the Ervant and Castrum varieties stand out with high values of the number of minitubers obtained for the increased nutrition space, causing positive, very significant differences to be obtained. The increased nutrition space strongly influenced the formation of minitubers for these cultivars.

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