

RESEARCH ON THE INFLUENCE OF CULTURE TEHNOLOGY, FOR CERTAIN POTATO CULTIVARS LĂZAREA - HARGHITA COUNTY, ROMANIA, 2008-2009

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Abstract. *Our goals were to increase the coefficient of potato propagation by seed, planting, using different calibration classes of minitubers cultivars of early, mid early and semitardive: Ostara, Christian, Roclas, Desiree; valorification of planting material with high biological value from the fraction <25 mm, from the greenhouse (minitubers) compared with 25-35mm fraction; elaboration of differentiated technological variants (including sequence of technology culture and pest control performance) to produce material from superior clonal link in protected areas such tunnels "insect proof, depending on cultivar, technology conditions, reliable on ecological conditions; obtaining virus-free of planting material (without infection); obtaining of a bigger amount of seed.*

Keywords: minitubers, tunnels "insect proof", planting density, planting size, production .

INTRODUCTION

Tissue culture derived certified greenhouse grown pre-nuclear minitubers and transplants have become standard method in the limited generation seed potato program. The production of prenuclear minitubers and transplants are costly. There is a need to increase the quality and yield of minitubers to minimize the cost of production. Mini-tubers 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). Producing minitubers from in vitro plantlets allows fast multiplication rates in seed programs and reduces the number of field generations needed to obtain certified tubers (Ranalli, 1997). Karafyllidis *et al.* (1997) determined that more minitubers and yield per area are expected in high planting densities in contrast with low densities. Another study showed that increasing planting densities reduces the proportion of large minitubers in favor of more small minitubers (Georgakis *et al.*, 1997).

MATERIAL AND METHOD

In 2009, was done in Lazarea, District Harghita a study on the production of potato (both in free and in tunnels "insect proof"), obtained from mini-tubers.

In the experimental field from Lazarea, was placed a polifactorial experience, on the type 2x4x3x2, located by the method subdivided parcels with a total of 48 variants studied in three repetitions.

Experimental factors:

- experimental factor a –culture technology-with two graduations:

- a1 - experiments in field
- a2 - experiments in tunnels
- experimental factor b - cultivars with 4 graduations
 - b1- Ostara
 - b2 - Christian
 - b3 - Roclas
 - b4 – Desiree
- experimental factor c: planting density, with three graduations:
 - c1- 114. 285 minitubers / ha (70 x 12.5) = 11.4 pl/m² (8 minituber/ linear meter)
 - c2- 86 .058 minitubers / ha (70 x 16.6) = 8.6 pl/m² (6 minituber/ linear meter)
 - c3 - 71. 428 minitubers / ha (70 x 20.0) = 7.1 pl/m² (5 minituber/ linear meter)
- experimental factor d: minitubers size used in planting, with two graduations:
 - d1: <25 mm
 - d2: 25 - 45 mm

Biologic material used in the experiment consisted of four varieties Ostara, Christian, and Desiree Roclas.

Other materials: minitubers of the two size fractions, fertilizers, herbicides, fungicides, insecticides, aficide, mesh “insect proof”.

On this study, minitubers, were planted on high altitudes and these represent the existence of natural barriers create on natural conditions for isolating crops and therefore reduce virotic disease propagation (Bozeșan, 2003).

RESULTS AND DISCUSSION

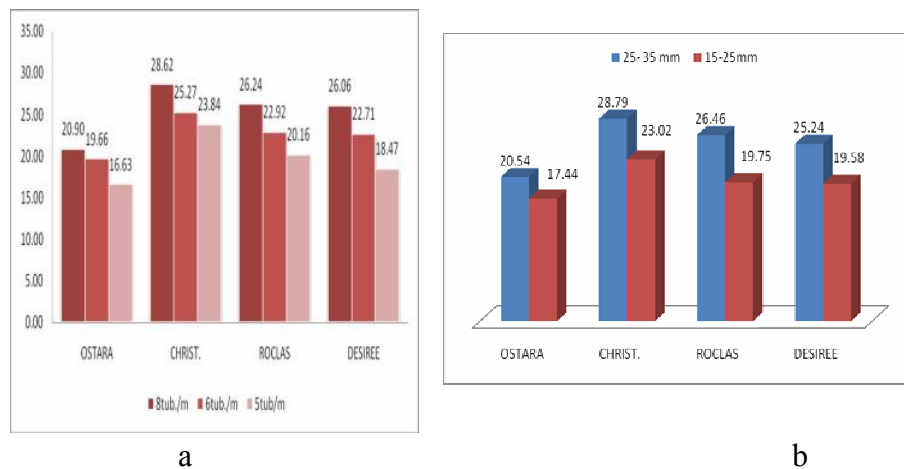


Fig.1.a, b. The total production (t/ha) obtained from culture in the tunnels "insect proof" depending on planting density (a) and size of planted tubers (b) (Lăzarea, 2008)

The assessment of production results obtained in 2008 from culture in tunnels "insect proof", of the different varieties used (Fig.1.a.) shows that the highest yields were obtained from Christian. Thus at density of 5 tuber / linear meter it was made a linear production 23.84 tons / ha, to 6 tubers / linear meter 25.27 t / ha and 8 tubers/ linear meter 28.62 t / ha. Next in sequence was Roclas variety and then Desiree variety.

If we look at total output, in terms of planting density, yields clearly detached for tubers obtained from 8 tuber/linear meter as the largest, followed by 6-tubers density/linear meter and 5 tubers/ linear meter.

Another variable of experiences made at Lazarea was the size of plant material. In the experience with technology tunnel "insect proof" (Fig.1.a), can be seen, that the highest yields were obtained at 25-35 mm size material. In terms of total output produced, you can highlight Christian varieties with 28.79 t / ha, Roclas with 26.46 t / ha and Desiree with 25.24 t / ha.

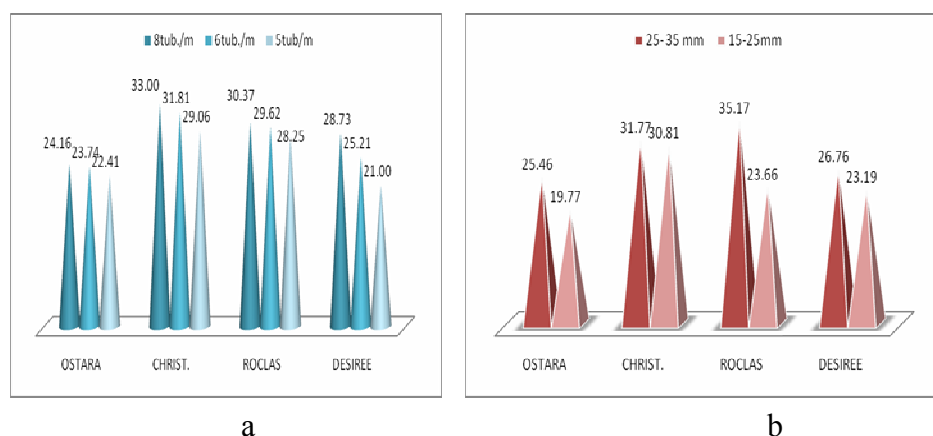


Fig. 2 . The total production of tubers (t / ha) obtained from culture in the open field, depending on planting density (a) and the size of planting material (b) (Lăzarea, 2008)

If variants grown in open field (Fig.2.a) the production of tubers was achieved by the planting density of 8 tubers/linear meter. Thus Christian recorded the highest yield of 33.00 t / ha being Roclas followed with 30.37 t / ha and Desiree with 28.73 t / ha.

In terms of varieties, yield were scored as follows: Christian comes first, followed by variety and Desiree Roclas and last place is Ostara.

Examining the results of production depending on the size of planting material obtained in the open field (Fig.2.b) shows that of 25-35 mm size fraction provided a tuber production increased at all tested varieties.

Statistical interpretation of production results obtained

Examining the results obtained in the tunnels on the average "insect proof, and in the open field (Table 1) indicate that the best production results were achieved in culture in the open field, to experience tunnels " insect proof ", it resulting in a production with a difference of 4.46 t / ha very significant negative.

Table 1

Technology culture influence on the total production of tubers at the experience tunnels "insect proof" and open field (Lăzarea, 2008)

Technology culture	Production		Dif. (t/ha)	Significance
	t/ha	%		
In free field	27,07	100,00	-	-
In tunnels „insect proof”	22,61	83,52	-4,46	ooo

DL 5% = 1,5521 t/ha

DL 1%= 1,9657 t/ha

DL 0,1%=2,7235 t/ha

Statistical analysis shows significant and distinctly significant differences for the varieties Christian, Roclas and Desiree (7.80 t / ha for the Christian variety, and 2.89 t / ha for variety Desiree) (Table 2).

Table 2

Influence of varieties tested for the total production of tubers produced in tunnels "insect proof" and open field (Lăzarea, 2008)

Variety	Prod.		Dif. (t/ha)	Significance
	t/ha	%		
Ostara	20,80	100,00	-	-
Christian	28,60	137,50	+7,80	***
Roclas	26,26	126,25	+5,46	***
Desiree	23,69	113,89	+2,89	**

DL 5% = 1,9802 t/ha

DL 1%= 2,5925 t/ha

DL 0,1%=2,9683 t/ha

Table 3

Combined influence of the plant material size and culture technology used for the total production in the tunnels "insect proof" and open field (Lăzarea, 2008)

Culture technology/ plant material size(mm)	Tunnels „insect proof”, a1			Free field, a2			Dif. a1-a2
	t/ha	Dif.(t/ha)	Signif	t/ha	Dif.(t/ha)	Signif	
15-25	19,95	-	-	24,36	-	-	-4,41 ooo
25-35	25,26	+5,31	***	29,79	+5,43	***	-4,53 ooo

DL 5% =2,8706 t/ha

1,8850 t/ha

DL 1%= 3,6317 t/ha

2,7464 t/ha

DL 0,1%=4,7706 t/ha

3,8384 t/ha

Statistical analysis of the combined size of plant material and technology used shows that from the 25 -35 mm size fraction of tubers planted, yields are high, very significant statistically, with values ranging from 5.31 t / ha in the tunnel "insect proof "and 5.43 t / ha (Table 3)

Table 4

The combined influence of planting material, technology and the variety on the production of tubers produced in the tunnels "insect proof" and open field (Lăzarea, 2008)

Culture technology	Plant material size (mm)	Cultivar			
		Ostara, b1	Christian, b2	Roclas, b3	Desiree, b4
Tunnels "insect proof", a1	25-35	20.54 -	28.79 +8,25 ***	26.46 +5,92 ***	25.24 +4,70 ***
	15-25	17.44 -	23.02 +5,58 ***	19.75 +2,31 *	19.58 +2,44 *
Free field, a2	25-35	25.46 -	31.77 +6,31 ***	35.17 +9,71 ***	26.76 +1,30 irrelevant
	15-25	19.77 -	30.81 +11,04 ***	23.66 +3,89 ***	23.19 +3,42 ***

DL 5% =1,6920 t/ha

DL 1% = 2,8378 t/ha

DL 0,1% =3,2102 t/ha

Analyzing the influence of three factors, namely the size of plant material, technology and variety, it can be said that in order to obtain high production, where tunnels "insect proof" should be used for planting material larger (25-35mm) and the culture in wild plant material using small (15-25mm). The species best adapted to both Christian culture variety (Table 4).

In 2009 the cultivation on the tunnels "insect proof", obtained production varied depending on the size of tuber, used at planting.

On tunnels "insect proof" the assessment of results shows that the Christian cultivar obtained the highest yield of 27.20 t / ha in variant where the planting material used was from fraction 25-35 mm (Fig.3.a).

Variety examination, shows that Christian and Roclas cultivars had the highest production, followed by Desiree and on last place is Ostara (with yields of 24.76, 23.78, 23.35 and 20.98 t / ha).

Another factor considered, is the density of planting; density of 8 tuber / linear meter determined for experimental variants high yields, most production is of 27.82 t / ha, Christian cultivar and 27.51 t / ha for Desiree cultivar (Fig.3.b).

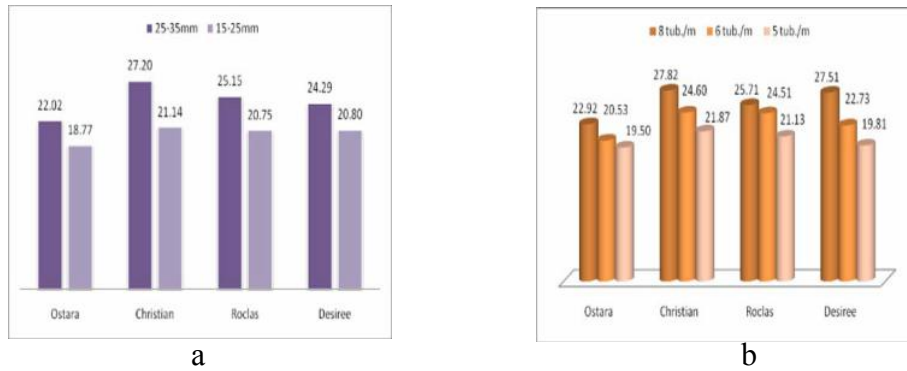


Fig.3.a, b. Production (t/ha) achieved in the experimental variants in function of planted tuber size (a) and planting density (b), in the tunnels “insect proof” (Lăzarea, District Harghita, 2009)

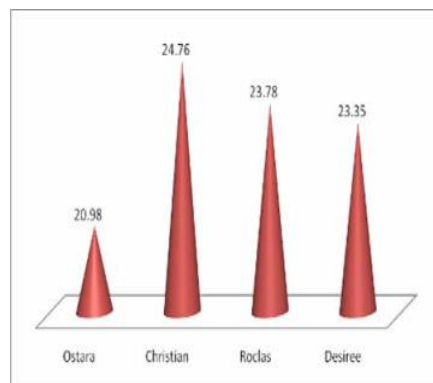


Fig. 4. Production (t/ha) achieved on the four varieties tested in tunnels "insect proof" (Lăzarea, District Harghita, 2009)

Analyzing the used cultivars, high yields were obtained from Christian with 24.76 t / ha and from Roclas cultivar with 23.78 t / ha and the lowest production was obtained at Ostara cultivar with 20.98 t / ha (Fig.4.).

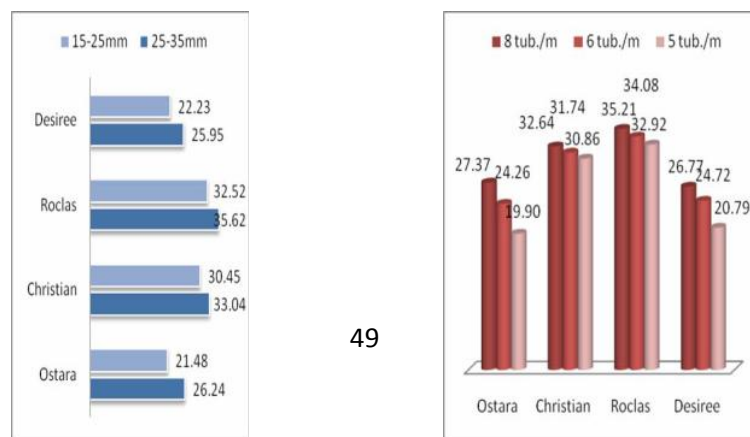


Fig.5.a., b Production (t/ha) on the experimental variants in function of the planted tuber size (a) and planting density (b), in free field (Lăzarea, District Harghita, 2009)

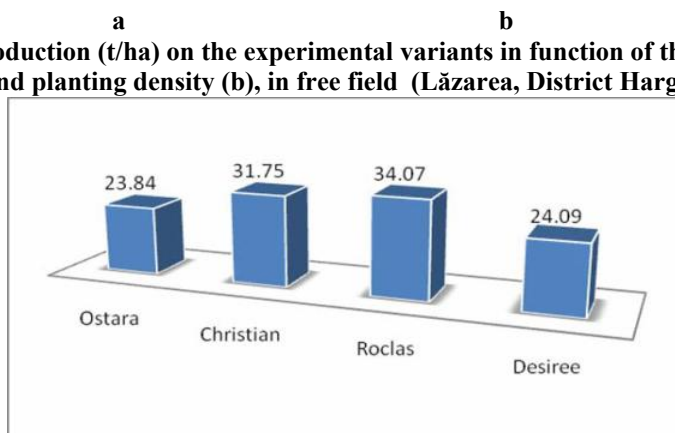


Fig . 6. Production (t/ha) achieved on experimental variants of varieties – free field (Lăzarea, District Harghita, 2009)

In 2009 experiments were carried out in the open field. Potato production varied depending on the size of planting material, the highest yields were recorded at 25-35 mm size for all varieties tested. In the case of varieties, Roclas and Christian achieved the highest production of 35.62 t / ha and 33.04 at tuber size 25-35 mm and respectively, 32.52 t / ha and 30, 45 t / ha Christian at 15-25 mm size of planting material (Fig. 5.a).

Variation of production by planting density (Fig.5.b) is different for bused varieties. For all varieties high yields, were obtained at a density of 8 tub. / linear meter, so Roclas variety reached production of 35.21 t / ha and the Christian 32.64 t / ha.

Results about average production, by variety vary from 23.84 t / ha to Ostara and 24.09 t / ha to Desiree. It shows that good yields of varieties Roclas 34.07 t / ha and 31.75 t / ha to Christian (Fig.6.).

Statistical interpretation of production results obtained

Table 5

The influence of culture technology on production (t/ha) (Lăzarea, District Harghita, 2009)

Culture technology	Production		Dif. (t/ha)	Significance
	t/ha	%		
Free field (Wt)	28,44	100,00	-	-
Tunnels "insect proof"	23,21	81,61	-5,23	000

DL 5% = 1,3552 (t/ha) DL 1%= 2,2149 (t/ha) DL 0,1%=3,5558 (t/ha)

Experience in 2009, examined both tunnels "insect proof" and free field included study of several variables.

In case of cultivation influence, shows that higher yields were obtained in open field cultivation; in the tunnels "insect proof" the difference is statistically significant negative, this is being -5.23 t / ha (Table 5).

Another factor examined was used the plant density (Table 6). If is taking into account the density of 5 tub. / linear meter (control) the results of statistical analysis indicated significant differences in density of 8 tub. / linear meter distinct significant from 6 tub. / linear meter (4.9886 and respectively 2,6386 t / ha).

Table 6
Influence of planting density on production (t/ha) (Lăzarea, District Harghita, 2009)

Planting density (number of minitub/ linear meter)	Production		Dif. (t/ha)	Signif.
	t/ha	%		
5 (Wt)	23,295	100,00	-	-
6	25,895	111,34	+2,6386	**
8	28,245	121,24	+4,9886	***

DL 5% = 1,5002 (t/ha) DL 1% = 2,1721 (t/ha) DL 0,1% = 2,7185 (t/ha)

Table 7
Influence of selected varieties on production (t/ha) (Lăzarea, District Harghita, 2009)

Variety	Production		Dif. (t/ha)	Significance
	t/ha	%		
Ostara (Wt)	22,40	100,00	-	-
Christian	28,25	126,11	+5,85	***
Roclas	28,93	129,15	+6,53	***
Desiree	23,72	105,89	+1,32	irrelevant

DL 5% = 1,7872 (t/ha) DL 1% = 2,1512 (t/ha) DL 0,1% = 3,3968 (t/ha)

Analysis of the varieties used in the experiment (Table 7) shows that the best results were obtained for Roclas with an average of 28.93 t / ha and Christian with 28.25 t / ha. The statistical interpretation of the results shows significant differences for the two varieties mentioned above (respectively 6.53 and 5.85 t / ha).

Table 8
Combined influence of technology and planting density on production (t/ha) (Lăzarea, District Harghita, 2009)

Culture technology / planting density (number of minitub/ linear meter)	Tunnels "insect proof", a1			Free field, a2			Dif. (t/ha) a2-a1
	Prod. (t/ha)	Dif. (t/ha)	Signif.	Prod. (t/ha)	Dif. (t/ha)	Signif.	
5 (Wt)	20.58	-	-	26.12	-	-	+5,54 ***
6	23.09	+2,51	**	28.70	+2,58	**	+5,61 ***
8	25.99	+5,41	***	30.50	+4,38	***	+4,51 ***

DL 5% = 1,2245 (t/ha)
DL 1% = 1,9432 (t/ha)
DL 0,1% = 2,8246 (t/ha)

DL 5% = 1,4423 (t/ha)
DL 1% = 2,6754 (t/ha)
DL 0,1% = 3,7432 (t/ha)

In case of the influence of two factors such as growing conditions and planting density differences are very significant assured and respectively distinct significant for densities of 8 and 6 tubers/linear meter because yields are higher compared with control (5.41 t / ha to the cultivation in tunnel and 4.38 t / ha for the growing on free field) for the density of 8 tubers/linear meter (Table 8).

In case of combined influence of the cultivar and tehnology conditions can be said that the production differences are very significant assured for Roclas and Christian cultivars in both types of tehnology (10.23 t / ha on free field and respectively and 7.91 t/ha) (Table 9).

Table 9
Combined influence of variety and technology on production (t/ha) (Lăzarea, District Harghita, 2009)

Culture technology / Cultivar	Tunnels “insect proof”, a1			Free field, a2			Differences (t/ha) a2-a1
	Prod. (t/ha)	Dif. (t/ha)	Signif.	Prod. (t/ha)	Dif. (t/ha)	Signif.	
Ostara, b1 (Wt)	20.98	-	-	23.84	-	-	+2,86 *
Christian, b2	24.76	+3,78	***	31.75	+7,91	***	+6,99 ***
Roclas, b3	23.78	+2,80	***	34.07	+10,23	***	+10,29 ***
Desiree, b4	23.35	+2,37	**	24.09	+0,25	irrelevant	+0,74 irrelevant

DL 5% = 0,9294 (t/ha)

DL 5% = 1,8105

(t/ha)

DL 1% = 1,5779 (t/ha)

DL 1% = 2,8752

(t/ha)

DL 0,1% = 2,3706 (t/ha)

DL 0,1% = 3,9273

(t/ha)

Table 10
Combined influence of planting density, technology and variety over production (t/ha) of tubers obtained (Lăzarea, District Harghita, 2009)

Culture technology	Planting density (minitubers number/ linear meter)	Cultivar			
		Ostara, b1	Christian, b2	Roclas, b3	Desiree, b4
Tunnels “insect proof”, a1	8, c1	27,82 22,92 -	27,82 +4,90 **	25,71 +2,79 *	27,51 +4,59 **
	6,c2	24,60 20,53 -	24,60 +4,07 **	24,51 +3,98 **	22,73 +2,20 irrelevant
	5, c3	19,50	21,87	21,13	19,80

		-	+2,37 irrelevant	+1,63 irrelevant	+0,30 irrelevant
Free field, a2	8, c1	27,37 -	32,64 +5,27 ***	35,21 +7,84 ***	26,77 -0,6 Irrelevant
	6, c2	24,26 -	31,74 +7,48 ***	34,07 +9,81 ***	24,72 +0,46 Irrelevant
	5, c3	19,90 -	30,86 +10,96 ***	32,92 +13,02 ***	20,79 +0,89 Irrelevant

DL 5% = 2,5164 (t/ha)

DL 1% = 3,8192 (t/ha)

DL 0,1% = 4,9162 (t/ha)

Statistical analysis of the three factors influence the planting density, cultivar and tehnology conditions show that results on open-field culture are very significant differences assured for Roclas and Christian cultivars. Christian cultivar made a very significant difference 4.90 t / ha for tehnology on the tunnel and Roclas cultivar recorded a very significant difference of 13.02 t / ha (Table 10).

Table 11

Production Summary for 2008-2009

Culture technology	Size fraction (mm)	Density (tubers/linear meter)	Production (t/ha)/Cultivars			
			Ostara	Christian	Roclas	Desiree
Free fields	15 - 25	8 tub./m	22,99	32,25	29,37	26,12
		6 tub./m	21,94	31,18	28,08	23,65
		5 tub./m	19,36	28,47	26,89	18,37
	25 - 35	8 tub./m	28,53	33,39	36,22	29,38
		6 tub./m	26,06	32,36	35,68	26,28
		5 tub./m	22,95	31,46	34,29	23,43
Tunnels "insect proof"	15 - 25	8 tub./m	20,44	24,83	24,23	23,89
		6 tub./m	17,42	21,74	20,08	19,79
		5 tub./m	17,11	20,58	17,44	17,49
	25 - 35	8 tub./m	23,38	31,60	27,73	29,70
		6 tub./m	22,76	28,54	28,02	24,08
		5 tub./m	19,02	23,00	23,22	21,75

Summary of results obtained on potato production in 2008-2009 (Table 11) at Ostara cultivar show that culture in the field were higher than yields obtained from culture in the tunnels. In terms of planting density on most variants tested for density of 8 tuber/ linear meter determined obtaining the highest production; in terms of dimensions used in planting the tubers with a diameter between 25-35mm recorded the largest production in both field and in the tunnel between 28.53 t / ha and 23.38 t / ha.

For Christian cultivar, high productions of potato were obtained from the field culture compared to culture in the tunnels. In terms of planting density, for all

variants of 8 tubers/linear meter, showed the highest production; in the case of tuber size at planting, good results were obtained from 25-35mm size, both on field and tunnel between 33.39 t / ha and 31.60 t / ha.

Analysis of production results achieved at Roclas cultivar on field experience shows that led obtaining the best results, for the density of 8 tubers/linear meter, also resulted in achieving high yields at 25-35mm fraction, in the field culture technology, and at the same fraction of 25-35 mm in the tunnel, but the planting density of 6 tubers / linear meter 36.22 t / ha and 27.73 t / ha.

In the case of the Desiree cultivar, the highest production was obtained in the tunnel "insect proof", the planting density of 8 tubers/ linear meter, dimension of planted tubers by 25-35mm with 29.70 t / ha and for the technology culture on free field, the highest yield was 29.38 t / ha in the same fraction and density.

CONCLUSIONS

- for Ostara cultivar, production ranged from 28.53 t / ha (free field/25-35mm/8 tubers / linear meter) and 23.38 t / ha (tunnels "insect proof"/15-25mm/5 tube / linear meter);
- for Christian cultivar, production ranged from 33.39 t / ha (free field/25-35mm/8 tubers/ linear meter) and 31.60 t / ha (tunnels "insect proof"/15-25mm/6 tubers/ linear meter);
- for Roclas cultivar, production ranged from 36.22 t / ha (free field/25-35mm/8 tubers / linear meter) and 27.73t / ha (tunnels "insect proof"/15-25mm/5 tubers / linear meter);
- for Desiree cultivar, production ranged from 29.70 t / ha (tunnels "insect proof"/25-35mm/8 tubers / linear meter) and 29.38 t / ha (free field/15-25mm/5 tubers / linear meter).

REFERENCES

1. Bozeșan I., 2003. Cultura cartofului în zonele de munte, Revista "Cartoful în România", nr.3, vol. 13, 13-16
2. Georgakis, D.N., D.I. Karafyllidis, N.I. Stavropoulos, E.X. Nianiou, and I.A. Vezyroglou. 1997. Effect of planting density and size of potato seed-minitubers on the size of the produced potato seed tubers. Acta Hort. 462:935–942.
3. Karafyllidis, D.I., D.N. Georgakis, N.I. Stavropoulos, E.X. Nianiou, and I.A. Vezyroglou. 1997. Effect of planting density and size of potato seed-minitubers on their yielding capacity. Acta Hort. 462:943–949.
4. Lommen, W.J.M., 1999. Causes for low tuber yields of transplants from *in vitro* potato plantlets of early cultivars after field planting. J. Agric. Sci., 133: 275-284.
5. Ranalli, P. 1997. Innovative propagation methods in seed tuber multiplication programmes. Potato Res. 40:439–453.
6. Ritter, E., B. Angulo, P. Riga, C. Herran, J. Relloso and M. Sanjose, 2001. Comparison of hydroponic and aeroponic cultivation systems for the production of potato minitubers. Potato Res., 44: 127-135.