

## RESEARCH ON THE INFLUENCE OF CULTURE TECHNOLOGY, FOR CERTAIN POTATO CULTIVARS IN LĂZAREA - HARGHITA COUNTY, ROMANIA

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### Abstract

Our goals were to increase the coefficient of seed potato, using different calibration classes for next cultivars: Ostara, Christian, Roclas, Desiree; development of planting material with high biological value from the fraction <25 mm (minitubers) compared with 25-35mm fraction; elaboration of differentiated technological variants (including sequence of technology culture and pest control performance); obtaining virus-free planting material (without infection) and a bigger amount of seed. Minitubers size 25-35mm planting influenced obtain higher yields than 15-25mm size, both in open field cultivation and in the tunnel. The research was conducted over two years, and watched the production of potato seed obtained, by planting minitubers to different planting densities and applying two technologies culture, open field and tunnel in insect proof. Planting density of 8 tubers / linear meter determined obtaining the highest yields of potato varieties

**Key words:** minitubers, free field, tunnels "insect proof", planting density, planting size

To improve seed production system, as a technological novelty in the last 20-30 years, Europe has started production and use of minitubers.

In Romania, the current technology for seed potato production, provides minitubers production from vitroplants, transplanters in protected areas (areas, insect-proof) to produce pre-basic material (Chiru, Nicoleta and colab., 1997), on substrate composed of soil and peat, which will be used to obtain clonal material for the following links (to the field of clonal Lăzarea, Harghita County).

Research carried out were made due to the need of finding solutions and new methodological concepts to fix a bridge between the potato crop in Romania (as well as crop with a very large impact on economic and social) and exposed standards in EU .

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 W.J.M, 1999); (Ritter E. and colab. 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 P., 1997). More minitubers and yield per area are expected in high planting densities in contrast with low densities (Lommen W.J.M, 1999). Another study showed that increasing planting densities reduces

the proportion of large minitubers in favor of more small minitubers (Georgakis D.N. and colab., 1997).

### MATERIAL AND METHOD

In 2008 and 2009 years, was done in Lazarea, District Harghita a study on the production of seed potato (both in free field 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/m<sup>2</sup> (8 minituber/ linear meter); - c2- 86.058 minitubers / ha (70 x 16.6) = 8.6 pl/m<sup>2</sup> (6 minituber/ linear meter); - c3 - 71.428 minitubers / ha (70 x 20.0) = 7.1 pl/m<sup>2</sup> (5 minituber/ linear meter);

Experimental factor d: Minitubers size used in planting, with two graduations:

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- d1: <25 mm;
- d2: 25 - 45 mm.

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

Other materials: minitubers of the two size fractions, fertilizers, herbicides, fungicides, insecticides, aficide and 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 virus diseases propagation (Bozesan I, 2003).

## RESULTS AND DISCUSSIONS

The assessment of production results obtained in 2008 from culture in tunnels "insect proof", of the different varieties used (fig.1a)

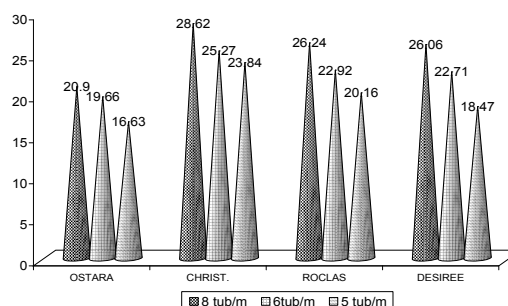
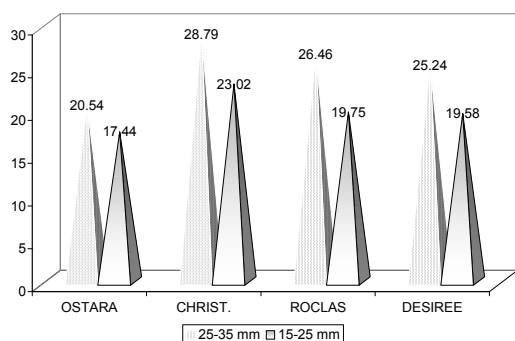
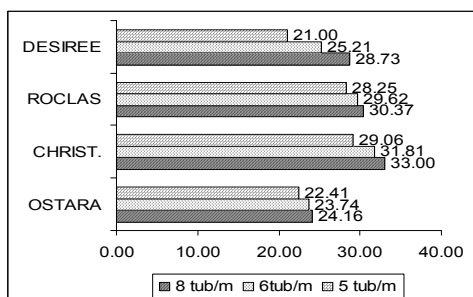


Figure 1.a, b. The total production (t/ha) obtained from culture in the tunnels "insect proof" depending on planting density (a) and size of planted tubers (b) (Lăzarea, 2008)

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 followed by Roclas with 30.37 t / ha and Desiree with 28.73 t / ha.

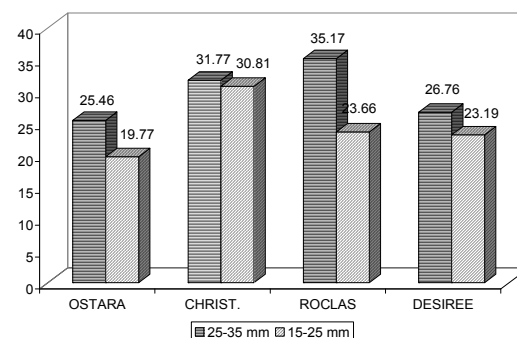


Figure 2 The total production of tubers (t/ha) obtained from culture in the open field, depending on planting density (a) and the size of planting material (b) (Lăzarea, 2008)

In terms of varieties, yield was scored as follows: Christian comes first, followed by and Roclas and Desiree variety 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.

Examining the results obtained in the tunnels on the average "insect proof, and in the open field (tab. 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.

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) (tab. 2).

Statistical analysis of the combined size of plant material and technology used shows (tab. 3) 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 /

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, should be used for planting, material larger (25-35mm) for both culture technology. The species best adapted to both culture was Christian variety (tab. 4).

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		Difference (t/ha)	Significance
	t/ha	%		
In free field (Ct)	27.07	100.00	-	-
In tunnels "insect proof"	22.61	83.52	-4.46	ooo

LSD 5% = 1.5521 t/ha      LSD 1%= 1.9657 t/ha      LSD 0.1%=2.7235 t/ha

Table 2  
**Influence of varieties tested for the total production of tubers produced in tunnels "insect proof" and open field (Lăzarea, 2008)**

Variety	Prod.		Difference (t/ha)	Significance
	t/ha	%		
Ostara (Ct)	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	**

LSD 5% = 1.9802 t/ha      LSD 1%= 2.5925 t/ha      LSD 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, a/ plant material size(mm)	Tunnels „insect proof”, a1			Free field, a2			Dif. a1-a2
	Prod. (t/ha)	Dif. (t/ha)	Signif	Prod. (t/ha)	Dif. (t/ha)	Signif	
15-25 (Ct)	19.95	-	-	24.36	-	-	-4.41 ooo
25-35	25.26	+5.31	***	29.79	+5.43	***	-4.53 ooo

LSD 5% =2,8706 (t/ha)

LSD 1%= 3,6317 (t/ha)

LSD 0,1%=4,7706 (t/ha)

LSD 5% =1,8850 (t/ha)

LSD 1%=2,7464 (t/ha)

LSD 0,1%= 3,8384 (t/ha)

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, a	Plant material size (mm)	Production (t/ha)/Cultivar, b			
		Ostara	Christian	Roclas	Desiree
Tunnels "insect proof"	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	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 ***

LSD 5% =1.6920 t/ha

LSD 1%= 2.8378 t/ha

LSD 0.1%=3.2102 t/ha

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 was the highest yield with 27.20 t / ha in variant where the

planting material used was from fraction 25-35 mm (fig.3 a).

Another factor considered is the density of planting; density of 8 tuber / linear meter determined for experimental variants high yields,

most production is 27.82 t / ha of Christian cultivar and 27.51 t / ha for Desiree cultivar (fig.3 b).

Examination of average production, 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 respectively) (fig. 4).

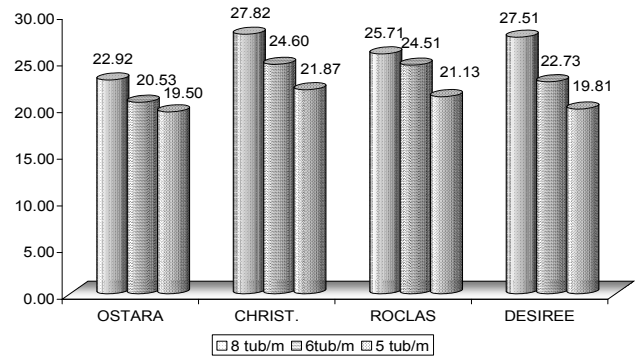
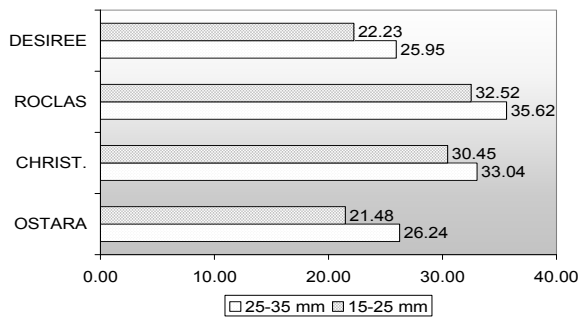


Figure 3.a, b. Production (t/ha) achieved in the experimental variants in function of planted tuber size (a) and planting density (b), in the tunnels "insect proof" (Lăzarea, District Harghita, 2009)

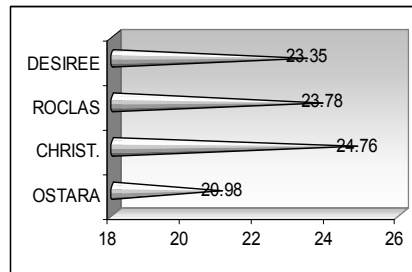


Figure 4 Production (t/ha) achieved on the four varieties tested in tunnels "insect proof" (Lăzarea, District Harghita, 2009)

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 of 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 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 per variety vary from 23.84 t / ha (Ostara) and 34.07 t / ha (Roclas) (fig. 6).

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 (tab. 5).

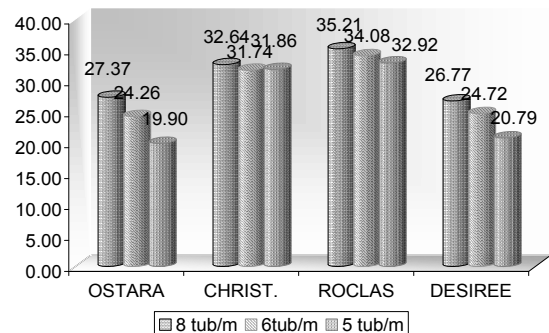
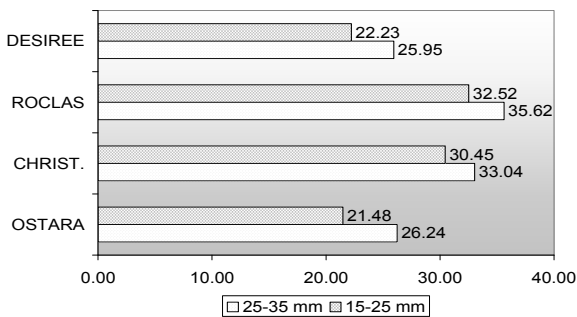


Figure 5.a, b Production (t/ha) on the experimental variants in function of the planted tuber size (a) and planting density (b), in free field (Lăzarea, District Harghita, 2009)

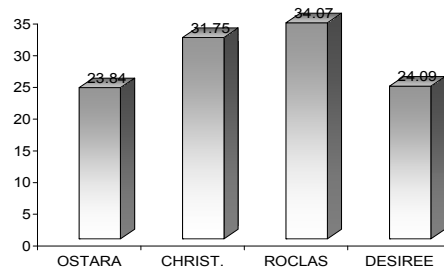


Figure 6. Production (t/ha) achieved on experimental variants of varieties in free field (Lăzarea, District Harghita, 2009)

Another factor examined was used the plant density (tab. 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).

Analysis of the varieties used in the experiment (tab. 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 (+6.53 and +5.85 t / ha), statistically assured.

In case of the influence of two factors such as growing conditions and planting density, differences were very significant assured and distinct significant for densities of 8 and 6 tubers/linear meter because yields were higher compared with control (5.41 t / ha to the

cultivation in tunnel and 4.38 t / ha for the growing in free field) for the density of 8 tubers/linear meter (tab. 8).

In case of combined influence of the cultivar and technology conditions can be said that the production differences are very significant assured for Roclas and Christian cultivars in both of technology types (+10.23 t / ha in free field and +7.91 t /ha respectively) (tab. 9). Statistical analysis of the three factors influence the planting density, cultivar and tehnology conditions show that results in open-field culture were 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 with +13.02 t / ha, on free field and planting density of 5 minituber per linear meters (tab. 10).

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 (Ct)	28.44	100.00	-	-
Tunnels "insect proof"	23.21	81.61	-5.23	ooo

LSD 5% = 1.3552 (t/ha)      LSD 1%= 2.2149 (t/ha)      LSD 0.1%=3.5558 (t/ha)

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

Planting density (number of minitub/ linear meter)	Production		Difference (t/ha)	Signif.
	t/ha	%		
5 (Ct)	23.295	100.00	-	-
6	25.895	111.34	+2.6386	**
8	28.245	121.24	+4.9886	***

LSD 5% = 1.5002 (t/ha)      LSD 1%= 2.1721 (t/ha)      LSD 0.1%=2.7185 (t/ha)

Table 7

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

Variety	Production		Difference (t/ha)	Significance
	t/ha	%		
Ostara (Ct)	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

LSD 5% = 1.7872 (t/ha)      LSD 1%= 2.1512 (t/ha)      LSD 0.1%=3.3968 (t/ha)

Table 8

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

Culture technology/ planting density	Tunnels "insect proof"			Free field			Dif. (t/ha) a2-a1
	Prod. (t/ha)	Dif. (t/ha)	Sign.	Prod. (t/ha)	Dif. (t/ha)	Sign.	
5 (Ct)	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 ***

LSD 5% =1.2245 (t/ha)  
LSD 1%= 1.9432 (t/ha)  
LSD 0.1%=2.8246 (t/ha)

LSD 5% =1.4423 (t/ha)  
LSD 1%=2.6754 (t/ha)  
LSD 0.1%=3.7432 (t/ha)

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			Dif. (t/ha) a2-a1
	Prod. (t/ha)	Dif. (t/ha)	Sign.	Prod. (t/ha)	Dif. (t/ha)	Sign.	
Ostara, b1 (Ct)	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

LSD 5% =0.9294 (t/ha)  
LSD 1%= 1.5779 (t/ha)  
LSD 0.1%=2.3706 (t/ha)

LSD 5% =1.8105 (t/ha)  
LSD 1%=2.8752 (t/ha)  
LSD 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, a	Planting density, c	Cultivar, b			
		Ostara	Christian	Roclas	Desiree
Tunnels "insect proof"	8	22.92 -	27.82 +4.90 **	25.71 +2.79 *	27.51 +4.59 **
	6	20.53 -	24.60 +4.07 **	24.51 +3.98 **	22.73 +2.20 irrelevant
	5	19.50 -	21.87 +2.37 irrelevant	21.13 +1.63 irrelevant	19.80 +0.30 irrelevant
Free field	8	27.37 -	32.64 +5.27 ***	35.21 +7.84 ***	26.77 -0.6 Irrelevant
	6	24.26 -	31.74 +7.48 ***	34.07 +9.81 ***	24.72 +0.46 Irrelevant
	5	19.90 -	30.86 +10.96 ***	32.92 +13.02 ***	20.79 +0.89 Irrelevant

LSD 5% =2.5164 (t/ha)      LSD 1%= 3.8192 (t/ha)      LSD 0.1%=4.9162 (t/ha)

## CONCLUSIONS

The highest yield per hectare in 2008 was obtained for Christian cultivar with 28.60 t / ha (average between the two technologies of culture) with a very significant positive difference +7.80 t / ha to control Ostara; in 2009 the highest yield is obtained for Roclas cultivar with average production between the two culture technologies, of 28.93 t / ha giving a very significant positive difference, statistically assured by + 6.53 t / ha to control Ostara.

As a general conclusion we try to increase the production and phytosanitary quality for the potato seed in the first links in the field to Produce the Clone Material from Lăzarea, Harghita County, profitable and competitive domestic and international; implementation of protected areas within the fields of clonal purse „insect-proof "against aphids, as technology improved variants of cultivation and pest control; validation of results regarding the minitubers behavior directly in the field and determining the size and density required rapid multiplication and hence, strongly emphasizing the role of modern techniques used in achieving program production and rapid

multiplication and expansion of valuable indigenous varieties in Romania, in a very short time.

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