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EFFECT OF SEED TUBER SIZE AND PRETREATMENT ON THE TOTAL YIELD POTATO

UTICAJ KRUPNOĆE SEMENSKE KRTOLE I PREDTRETMANA NA UKUPAN PRINOS KROMPIRA

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ABSTRACT

Investigation of the influence seed tuber size and seed tuber pre-treatment on the total yield of early potato varieties Cleopatra conducted in Badovinci (western Serbia) during the 2007 and 2008 year. Examination were carried out by planting tuber weight 40 ± 5g, 60 ± 5 g i 80 ± 5 g.

The research results indicate that the seed tuber size and preatretment very significantly affected on all investigated characteristics potatoes. In both years the highest yield of tubers was established in the variant with the application of pretreatment and planting of the largest seed size fraction mass (80 g).

Higher yields of potato tubers in moist conditions in western Serbia (Macva) of early varieties Cleopatra were achieved by planting larger mass of tubers (80 g) and removing the apical sprouts on tubers.

Key words: *potatoes, tuber, seed size, total yield.*

REZIME

Istraživanja uticaja krupnoće semenske krtole i predtretmana na ukupan prinos krompira rane sorte Cleopatra obavljena su u Badovincima (zapadna Srbija) tokom 2007. i 2008. godine. Ispitivanja su izvedena sadnjom krtola mase 40 ± 5 g, 60 ± 5 g i 80 ± 5 g. Krupnoća semenske krtole je važna osobina i merljiva komponenta kvaliteta, koja utiče na biološku sposobnost krtola, broj klica po krtoli, razvoj useva u polju i broj primarnih izdanaka (PNI) po biljci. Predtretman naklijavanja zauzima veoma značajno mesto u tehnologiji gajenja ranih sorti, ali i u proizvodnji kasnijih sorti. Naklijavanjem se doprinosi skraćenju vegetacionog perioda, bržem nicanju i porastu, obrazovanju većeg broja PNI po biljci, veće lisne površine i ukupne organske produkcije, većeg broja i krupnoće krtola, te visine i kvaliteta prinosa. Predtretman je podrazumevao uklanjanje vršne klice nakon klijanja krtola, čime se postiže formiranje većeg broja klica iz bočnih okaca. Rezultati istraživanja ukazuju da su krupnoća semenske krtole i predtretman značajno uticali na sve ispitivane osobine krompira. Najveći prinos ustanovljen je na varijanti sa primenom predtretmana i sadnjom najkrupnije frakcija mase (80 g). Primena zalamanja apikalne klice direktno je uticala na razvoj većeg broja klica po krtoli, većeg broja PNI i većeg broja krtola po biljci i većeg ukupnog prinosa. Najjači uticaj zalamanja apikalne klice na ispitivane osobine utvrđen je kod najkrupnije semenske frakcije, odnosno da uticaj predtretmana slabi sa smanjenjem krupnoće semenske krtole. U uslovima semiaridne klime u zapadnoj Srbiji (Mačvi) za postizanje većih prinosa sorte Cleopatra preporučuje se zalamanje apikalne klice i sadnja krtola mase 80 g.

Ključne reči: *krompir, krtola, krupnoća semena, ukupan prinos.*

INTRODUCTION

The total food production in Serbia, potato occupies an important place. The great economic importance of potato due to the fact that this crop is grown in 78,000 ha, with an average yield (in the period 2003-2009), which is at the level 11.5 t ha^{-1} (Statistical Yearbook Serbia, 2010). The mentioned average yield significantly inferior to yields of potatoes in Europe and in the world of 37.0 to 55.0 t ha^{-1} (FAO, 2010). Commercial production of potato is carried out in the 50.000-60.000 ha with an average yield of about 15-25 t ha^{-1}, it is still not nearly meet the standards of modern agricultural production.

Size of seed tubers is an important characteristic and measurable component of quality seed potatoes, which significantly affects the biological ability of tubers, from which depends directly on the degree of development of sprouts, number sprouts per tuber and viability *(Poštić et al., 2011b; Poštić et al., 2012a; Poštić et al., 2013b)*, development of crops in the field and the number of primary stems per plant *(Khan et al., 2004, Poštić et al., 2012a)*. Number of primary stems per plant significantly affects the development of aboveground mass and assimilation surface, the number of set of tubers per plant, and the total tuber yield *(Khan et al., 2004; Struik, 2007a; Momirović et al., 2010; Poštić et al., 2012a)*.

Pretreatment germination and preparing tubers for planting plays a very important role, especially in the technology of growing early varieties of potato, but more and more in production and other later varieties *(Momirović et al., 2000a; Bus & Wustman, 2007)*. Performing the cultural practices contributes significantly shortening the growing season, rapid germination and growth, forming a larger number of primary stems per plant, forming a larger leaf area and total organic production, greater tolerance to pests and diseases, more number and of set sized tubers, and height and quality yield *(Momirović et al., 2000; Poštić et al., 2011b; Poštić et al., 2012ab)*.

Pretreatment included the removal of apical sprouts after germination of tubers, in this way promotes the development of a larger number of sprouts from lateral buds on the tuber.

The aim of this study was to determine the effect of pretreatment and to determine the optimal of seed tubers size

which are achieved the highest yields of potatoes in the ecological conditions of the natural water regime in western Serbia.

MATERIAL AND METHOD

Research the impact of the different sized seed tubers and pretreatment to yield the most common early varieties of potatoes Cleopatra performed during 2007 and 2008 years at the the locality western Serbia (Badovinci, Bogatić), the soil of recent alluvial sediments (*Tab. 1*).

Table 1. Properties of soil at the experimental plot

Depth (cm)	Type of soil	CaCO3 %	pH		Humus %	N %	mg/100g soil	
			H2O	nKCl			P2O5	K2O
0-30	Recent alluvium	0.00	6.85	6.53	2.97	0.19	19.84	15.00

Planting material of the variety Cleopatra categories original seed size fraction 35-55 mm, calibrated and in working sample was allocated to 80 the different sized tubers (mass 40 ± 5 g, 60 ± 5 g and 80 ± 5g). The samples were placed on the sprouting, seven days later with 40 of each fraction of the tubers was removed apical sprouts (B1), while the remaining 40 tubers apical sprouts is not removed (B0). After five weeks of germination was determined by morphological characteristics of the number sprouts tuber. Planting tubers was carried out in the first week of April. Applied standard agricultural practices in potato production. During the growing season were determined by the following characteristics number of primary stems per plant, in a full physiological tuber maturity is determined by the number of tubers per plant and total yield of tubers.

The obtained experimental data were processed by a mathematical statistical procedure using the statistical package STATISTICA for windows software (Stat Soft 8.0). The differences between the treatments were determined by analysis of the variance (ANOVA) and the least significant difference test (LSD) was used for the individual comparisons.

Meteorological data during the vegetation season shown in *Tab. 2*.

Table 2. Meteorological conditions during the potato growing season (2007. and 2008. year) and longtherm data (1975-2006) for the area western Serbia

Year	Month						
	April	May	Jun	July	Aug.	Sep.	Average
		Air temperature (°C)					
2007	13.0	18.5	22.0	22.6	22.3	14.3	18.8
2008	12.9	18.3	21.7	21.7	21.5	15.4	18.6
1975-2006	11.1	16.7	19.9	20.9	20.7	16.3	17.6
	Amount precipitation (mm)						Total
2007	0	79.0	85.2	38.7	62.5	93.4	358.8
2008	52.4	42.4	58.1	61.0	22.7	76.7	313.3
1975-2006	48.5	53.4	81.9	63.3	46.8	56.2	350.1

RESULTS AND DISCUSSION

Analysis of the number of sprouts per tuber, number of primary stems per plant, number of tubers per plant and total yield of tubers (*Tab. 3*) showed highly significant differences influenced seed tuber size (factor A), and pretreatment (factor B). Impact year - the growing season (factor C) of the investigated features of potato was not statistically significant. Very significant interactions investigated factors with respect to all the studied traits potatoes were obtained only in the mutual influence of factors A x B (*Tab. 3*).

Table 3. F-values for observed factors (for the 2007-2008 period)

	Number sprouts per tuber	Number primary ground stems per plant	Number tubers per plant	Total yield
Seed tuber size (A)	**	**	**	**
Pretreatment (B)	**	**	**	**
Year (C)	ns	ns	ns	ns
A x B	**	**	**	**
A x C	ns	ns	ns	ns
B x C	ns	ns	ns	ns
A x B x C	ns	ns	ns	ns

** - significant at 0.01; * - significant at 0.05; ns - not significant

The highest average value of determined properties potatoes in early varieties Cleopatra were found in larger mass of seed tubers (weight 80 g), while the lowest values determined by the smallest seed fraction (weight 40 g).

Table 4. Effect of tuber size and pretreatment on average number sprout per tuberin 2007 and 2008 years

Seed tuber size (A)	Pretreatment (B)	
	B1	B0
80 g	8.42	5.69
60 g	6.35	5.17
40 g	5.78	4.61
$LSD_{0.05}$	0.46	
$_{0.01}$	0.80	

Statistical analysis of the average number of sprouts per tuber in the variant (B1) showed a significant difference (p = 0.01) between the largest seed fraction (weight 80 g) and smaller fractions of seed tubers (weight 60 g and 40 g). A significantly a smaller number of sprouts per tuber was found (p = 0.05) in the smallest fractions of seed (40 g weight), compared to seed fraction (weight 60 g) *Tab. 4*.

The analysis of the average number of sprouts per tuber in the variant (B0) were found highly significant difference (p = 0.01) between the most massive seed fraction (weight 80 g) and the smallest seed fraction (weight 40 g). A significantly a smaller number of sprouts per tuber (p = 0.05) were found in the seed fraction (weight 60 g), with respect to the fraction (weight 80 g). Significantly greater number of sprouts per tuber (p = 0.05) was established at fractions (weight 60 g), relative to seed (weight 40 g) of a fraction (*Tab. 4*).

Table 5. Effect of tuber size and pretreatment on average number of primary ground stems per plant in 2007 and 2008 years

Seed tuber size (A)	Pretreatment (B)	
	B1	B0
80 g	5.13	4.05
60 g	3.28	2.53
40 g	2.79	2.47
$LSD_{0.05}$	0.56	
$_{0.01}$	0.96	

The highest number of sprouts per tuber as a rule, were found in the largest seed fraction (weight 80 g). Number of sprouts per tuber decreases with the reduction of seed tubers size, and similar results had *Sturz et al., 2000; Poštić et al., 2010; Poštić et al., 2011; Poštić et al., 2012a.*

Larger seed tubers are usually higher physiological age *(Pavlista, 2004; Poštić et al., 2011)* which resulted to the formation of a significantly larger number of sprouts per tuber. It is considered that 30-45% of the total number of sprouts on the seed tuber formed primary stems (*Poštić, 2013a*).

Statistical analysis of the average number of primary stems per plant in the variant (B1) showed a significant difference (p = 0.01) between the largest seed fraction (weight 80 g) and smaller fractions of seed tubers (weight 60 g and 40 g). A significantly smaller number of stems per plant was determined (p = 0.05) in the smallest fractions of seed (weight 40 g), compared to seed fraction (weight 60 g) *Tab. 5*. Analysis of the average number of primary stems per plant in the variant (B0) showed a significant difference (p = 0.01) between the largest seed fraction (weight 80 g) and smaller fractions of seed tubers (weight 60 g and 40 g). Between seed mass fractions (weight 60 and 40 g) showed no significant differences (p = 0.05) in the number of established primary stems per plant (*Tab. 5*). Number of primary stems per plant for the most part depends of seed tubers size used for planting *(Khan et al., 2004; Struik, 2007a; Momirović et al., 2010; Poštić et al., 2012a)*.

Table 6. Effect of tuber size and pretreatment on average number of tubers per plant in 2007 and 2008 years

Seed tuber size (A)	Pretreatment (B)	
	B1	B0
80 g	10.69	8.17
60 g	6.42	6.17
40 g	5.28	4.18
$LSD_{0.05}$ 0.32		
$_{0.01}$ 0.55		

The statistical analysis of the average number of tubers per plant in both variants (B1 and B0) showed a significant difference (p = 0.01) between the largest seed fraction (weight 80 g) and smaller fraction of seed tubers (weight 60 g and 40 g). Very significantly smaller number of tubers per plant was determined (p = 0.01) in the smallest fractions of seed (weight 40 g), compared to seed fraction (weight 60 g) *Tab. 6*. These results are in agreement with results *Gulluoglu & Arioglu (2009), Poštić et al., (2012cd)*. Analysis of the total yield of tubers in the variant (B1) showed a significant difference (p = 0.01) between the largest seed fraction (weight 80 g) and smaller fractions of seed tubers (weight 60 to 40 g), which coincides with the results *Poštić et al., (2012bcd)*. Between seed fractions (weight 60 and 40 g), no significant differences (p = 0.05) in the total yield of tubers (*Tab. 7*).

Table 7. Effect of tuber size and pretreatment on average total yield tubers (t ha⁻¹) in 2007 and 2008 years

Seed tuber size (A)	Pretreatment (B)	
	B1	B0
80 g	42.73	31.00
60 g	37.75	31.55
40 g	37.30	30.30
$LSD_{0.05}$ 0.56		
$_{0.01}$ 0.68		

Statistical analysis of the total yield of the variants (B0) between seed fractions (weight 80, 60 and 40 g) showed no significant differences (p = 0.05) in the total yield of tubers (*Tab. 7*).

CONCLUSION

Based on the results of two years of research can be carried out the following conclusions: The use of pretreatment removal of apical sprouts on potato tuber directly affects the development of a large number of sprouts per tuber, a large number of primary stems per plant, increasing the number of tubers per plant and increasing the total yield of tubers.

Most powerful effect of pretreatment removal of apical sprouts on investigated characteristics were found in the largest seed fraction, the influence of pretreatment weakens with the reduction sized seed tubers respectively. In the semi-arid climate conditions in western Serbia (Macva) to achieve higher yields of early varieties Cleopatra recommended removal of apical sprouts on potato tuber and planting tuber weight 80 g.

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