Original scientific paper
Originalan naučni rad
UDK: 635.649+635.21]:581.116
DOI: 10.7251/AGREN1301041C

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Yield and Quality of Potato Varieties

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Abstract

A two-year experiment (2009-2010) included four potato varieties (Desire, Romano, Bistra and Kis Sora). Experiments were conducted in Butmir (about 500 m/ asl) and Glamoč (approximately 900 m/ asl) region. The aim was to select new varieties for our area of cultivation. Productive characteristics of potato varieties (yield, weight and number of tubers per box) were examined. In the frame of qualitative properties, dry matter content and starch were examined. Trials were performed by randomised block design with four replications, and the results were analysed using the analysis of variance. Higher average yield was achieved by Romano cultivar by 8% compared to Desire and Kis Sora. Dry matter content ranged from 21.80% in Romano to 22.20% in Desiree. Examining varieties should be continued in the upcoming period in order to determine the most favourable conditions for cultivation in the area of Bosnia and Herzegovina.

Key words: potato, varieties, yield, quality

Introduction

Potato is one of the leading crops in Bosnia and Herzegovina because of the area on which it is grown, nutritional and usage value of tubers. It is one of the most conjunctive and profitable crops, thanks to its high genetic potential of yield, agro-ecological adaptability, good nutritional value of tubers, technological solutions in the industrial processing as well as a broad consumer interest. It is grown in different environmental conditions in Bosnia and Herzegovina in all its parts with different intensities. Production of potatoes is of strategic importance from the standpoint of providing food for the population in terms of development opportunities. Production of potatoes is quite variable and uneven across regions and highly dependent on market influences.

Many authors stated technology research issues of potato production (Ćota, 2002, 2005; Jakovljević, 1995; Suvajdžić, 1975). The main focus of the research is directed towards the introduction of new varieties, whereby higher yield and technological quality of production would be increased.

This paper describes the main features of the introduced potato varieties, their productive characteristics and specific cultivation practices on the basis of research results through a network of micro trials in different environmental conditions.

Materials and methods

The experiments were conducted at the localities: Butmir (about 500 m asl), Glamoč (approximately 900 m asl) during 2009 and 2010. The tested cultivars were: Desiree, Romano, Bistra and Kis Sora. Desire and Romano are standard varieties. The "A" class of plant material was used in this research. The experiments were set up in a randomised block with 4 replications. The main plot size was 15 m^2 (1.5 x 10 m), 75x33 cm spacing with the assembly of 40,000 plants per 1 hectare. Fertilisation and other cropping measures were the same in the years of conducting the experiment. Mineral fertilisers were used in the quantity of 80-100 kg/ ha N, 100-120 kg/ ha P2O5 and 180-200 kg/ ha K2O of pure nutrients, in early spring P and K, as well as 60% of N, while 40% N was given in nutrition. One ploughing and cropping was done. Crop protection was against downy mildew pathogen (*Phitophthora infestans Mont de Bary*) and potato beetle (*Leptinotarsa decemlineata*), according to the needs. During the vegetation, a number of phenological elements were observed. Extraction of potato was carried out manually by drying the overhead mass. After removing the varieties, total mass and number of tubers per fraction was analysed on the sample of 10 plants in Butmir. In the second year of the experiment, samples were taken during the extraction of potato tubers to determine the qualitative properties of varieties. The content of dry matter and starch in potato tubers was determined by a standard method for potatoes (Rajman's scale). The obtained data on tuber yield were analysed using the analysis of variance of three factorial experiments, with an assessment of significance 5% and 1%.

Tab.1. Chemical properties of potato
Hemijske osobine krompira

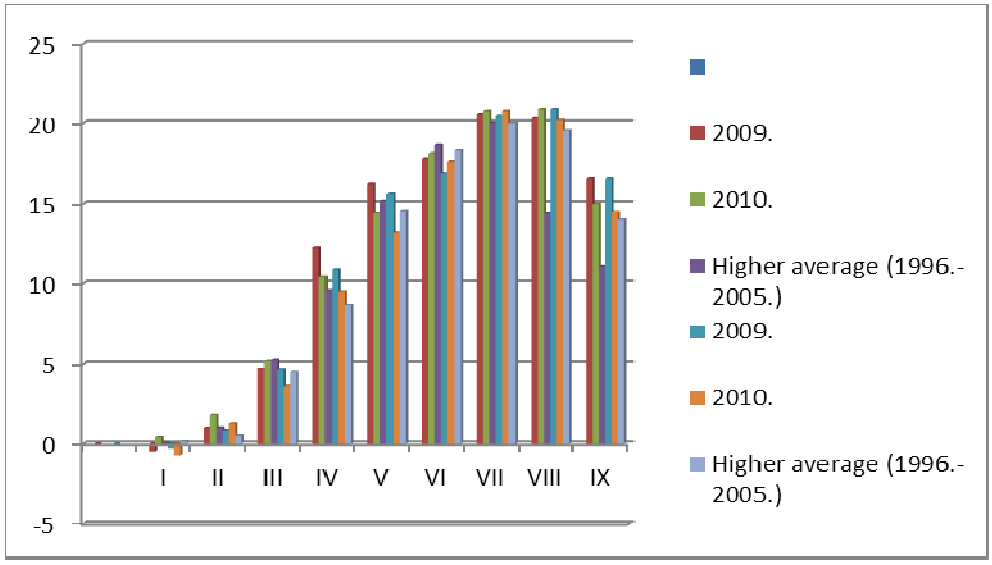
Locality *Lokalitet*	Reaction pH in *pH reakcija u*		Content in % *Sadržaj u %*			Mg in 100g soil - physiologically active *Mg u 100g zemljišta – fiziološki aktivno*	
	H_2O	KCl	Total N	$CaCO_3$	Humus	P_2O_5	K_2O
Butmir	6.27	5.40	0.13	2.75	--	4.4	18.9
Glamoč	7.55	6.82	0.19	4.16	4.00	9.9	26.8

The Butmir has brown glay soil, and Glamoč has brown, medium-deep soil on limestone and dolomite. Soil reaction is acidic. Nutrient content analysis showed that

these soils are poorly provided with phosphorus (Butmir and Glamoč). Soils at both sites were well provided with potassium (Table 1).

Climatic conditions vary from locality to locality. Butmir is characterised by cold winters and moderately warm summers, and Glamoč has cool summers and cold winters.

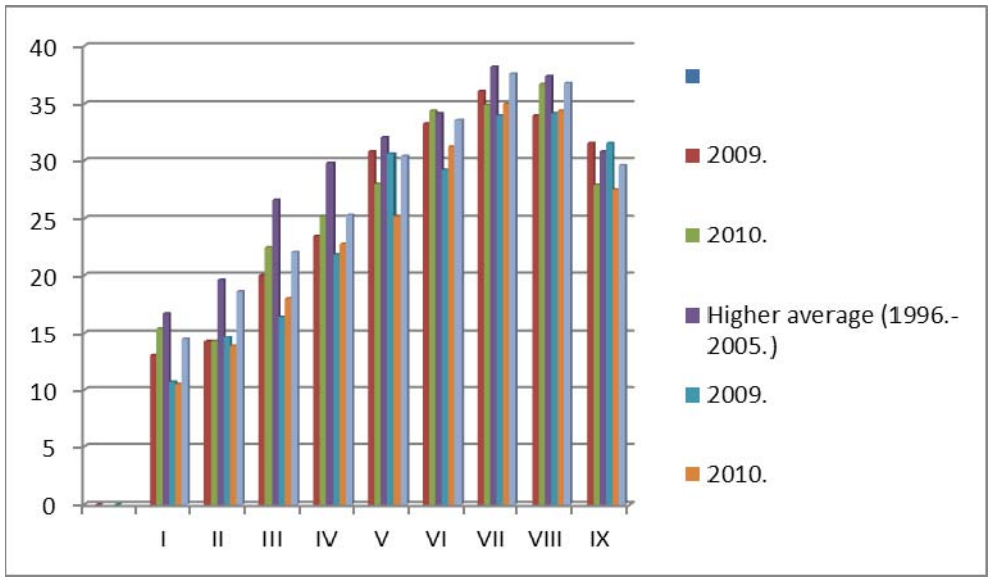
The following graph (Graph 1) provides a multi-year averages of temperature and precipitation for these sites. Data for 2008, 2009 and 2010 are from Sarajevo and Livno, as the weather station in Glamoč is not working.



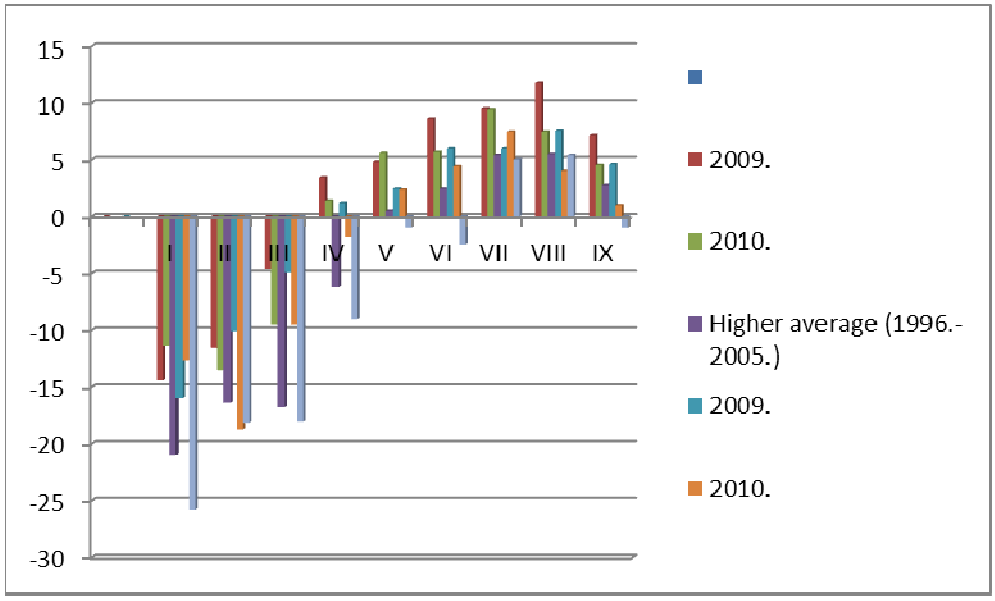
Graph 1. Averages of monthly air temperature (C°) for 2009 and 2010
Prosječne mjesečne temperature vazduha (C°) za 2009. i 2010. god.

By analysing temperature data, it can be concluded that the temperature in the period of experiment (2009 and 2010) was satisfactory for the development of potato in relation to multi-annual average. Higher than mean daily air temperature in relation to long-term average (in the vegetation of potatoes) was registered in Sarajevo and Livno, in Sarajevo, IV, VI, VII, VIII and IX (2009) and IV, VII, VIII and IX month (2010), Livno in the sixth month (2009). The maximum and minimum air temperature ranged within multi-annual average (Graphs 2 and 3).

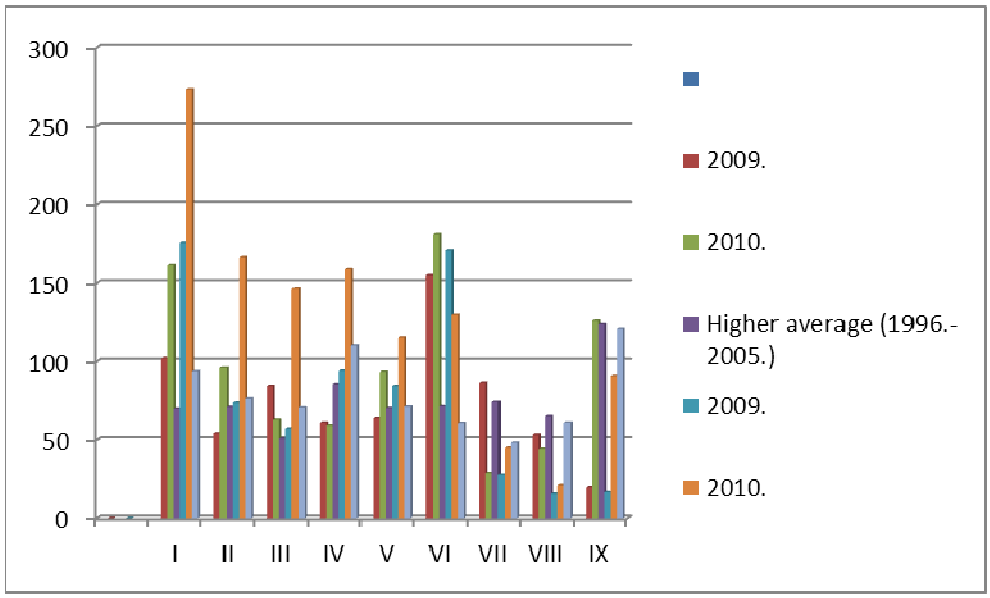
There was lack of rainfall during the growing season in April, May, August and September (2009) and IV, VII, VIII and IX (2010) in Sarajevo and VII, VIII and IX in Livno whereas there was excess of rainfall in V month and in VI month in Sarajevo and Livno during 2010 (Graph 4.).



Graph 2. Maximum monthly air temperatures (Cº) for 2009 and 2010
Maksimalne mjesečne temperature vazduha (Cº) za 2009. i 2010. god.



Graph 3. Minimum monthly air temperatures (Cº) for 2009 and 2010
Minimalne mjesečne temperature vazduha (Cº) za 2009. i 2010. god.



Graph 4. Monthly precipitation (l/m2) for 2009 and 2010
Mjesečne padavine (l/m2) za 2009. i 2010. god.

Results and discussion

The uniformity of germination, vigour, crop and length of growing season is largely influenced by external factors (Suvajdžić & Glišić, 1975). Germination was good as well as uniformity of emergence in 2009. Vigour and crop uniformity in 2009 was relatively good. Impurities within cultivars were not present (2009 and 2010). Crops were uniform in 2009 and relatively well uniform in 2010. The difference between plants within cultivars was not present. Romano had the shortest vegetation in 2009, 97 days. Bistra had the longest vegetation in 2010, 110 days (Table 2).+

The average weight of tubers varied by cultivar and years of experiments. The average weight of tubers per box ranged from 50.8 (Kis Sora) to 112.1 g/ tuber (Romano) in 2009, from 40.4 (Romano) to 66.5 g /tuber (Desiree) in 2010. Desiree had the biggest tubers (53.12%) in 2009 and Romano (60.2%) in 2010. Mean fraction was the highest in Kis Sora in 2009 (70.61%), whereas it was Desiree (55.2%) in 2010. During 2009, Kis Sora had the largest percentage of small tubers (6.45%) and in 2010, it was Bistra with 10.0%.

Number of tubers per box is a feature of a variety, but it varies under the influence of climate and growing conditions. The highest number of tubers per box in 2009 was achieved for Bistra (15.4 tubers/ box), as well as in 2010 (16 tubers/ box).

Kis Sora and Bistra had significantly higher yield during 2009 at the Butmir site as well as Bistra during 2010 compared to the standards (Table 3.).

Tab. 2. Uniformity of germination, number of impurities, uniformity of crops and vegetation length of varieties on the site Butmir
Ujednačenost klijanja, broj nepravilnosti, ujednačenost kulture i dužine vegetacije za sorte na lokalitetu Butmir

Variety *Sorta*	Uniformity of germination *Ujednačenost klijanja*		Number of impurities *Broj nepravilnosti*		Vigour (1-5) *Porast*		Uniformity of crops(1-5) *Ujednačenost kulture*		Vegetation length (days) *Dužina vegetacije (dani)*	
	′09	′10	′09	′10	′09	′10	′09	′10	′09	′10
1.Desiree	4	4	-	-	5	4	5	4	104	104
2.Romano	4	4	-	-	5	5	5	5	97	102
3. Kis Sora	3	4	-	-	5	5	5	4	104	102
4. Bistra	4	4	-	-	5	5	5	4	104	110

Tab. 3. Yield of potato varieties by localities and years (t/ha)
Prinos sorti krompira po lokalitetu i godinama uzgoja (t/ha)

Variety *Sorta*	Locality *Lokalitet*			
	Butmir		Glamoč	
	2009	2010	2009	2010
Desiree-Standard	29.58	20.37	31.00	32.90
Romano-Standard	28.91^{-}	21.75	31.30	23.7
Kis Sora	30.90**	20.65	25.0	20.6
Bistra	30.90**	23.42**	29.4	22.3
LSD $_{P=5\%}$	0.45	0.51	0.65	2.32
LSD $_{P=1\%}$	0.61	0.68	0.89	3.13

Tab. 4. Influence of the factors on the yield (t/ha)
Uticaj faktora na prinos (t/ha)

Variety *Sorta*	Yield (t/ha) *Prinos (t/ha)*	Relativity % *Relativnost %*
Desiree (St.)	26.34	100
Romano	28.53	108
Kis Sora	26.48	100
Bistra	24.28	92
LSD $_{P=5\%}$	4.68	
LSD $_{P=1\%}$	6.65	

There were no significant differences in the yield between examined varieties (Table 4.).

Potato yields varied from locality to locality. Thus, in Glamoč the yield was higher by 4% compared to Butmir (Table 5.). This was influenced by specific climate conditions (Table 6.).

Tab. 5. Influence of the locality (L) on the yield (t/ha)
Uticaj lokaliteta (L) na prinos (t/ha)

Locality *Lokalitet*	Yield t/ha *Prinos t/ha*	%
Butmir	25.81	100
Glamoč	27.01	104
LSD $_{P=5\%}$	3.32	
LSD $_{P=1\%}$	4.72	

Tab. 6. Influence of the year on the yield (t/ha).
Uticaj godine na prinos (t/ha).

Year *Godina*	Yield (t/ha) *Prinos (t/ha)*	%
2009.	29.62**	127
2010.	23.19	100
LSD $_{P=5\%}$	3.32	
LSD $_{P=1\%}$	4.72	

There is a noticeable difference between the potato yield in 2009 and 2010. Yields were rather significantly higher by 27% in 2009 in comparison to 2010. The contents of dry matter and starch varied to a great extent. According to literature data, the content of starch depends on varieties (Quasem, 1978), day length (Jakovljević, 1995), nutrition with micro and macroelements (Potapopov, 1971), length of vegetation and other factors.

Tab. 7. Content of dry matter and starch in %
Sadržaj suhe tvari i škroba u %

Variety *Sorta*	Content in % *Sadržaj u %*	
	Dry matter *Suha tvar*	Starch *Škrob*
Desiree	22,20	17,00
Romano	21,80	16,60
Kis sora	22,40	17,20
Bistra	22,00	16,80

Ćota et al. (2005) believe that the qualitative properties of potato strongly react to the slightest changes in environmental factors and agricultural practices. So in dry

and sunny years starch content is higher (and thus crops yield better quality), while the colder and wetter years with more rainfall and cloudy days make the content of starch in potato tubers lower. The contents of dry matter and starch increase with tubers maturing later (Ćota, 2002).

Dry matter content ranged from 21.80% in Romano to 22.20% in Desiree. Starch content ranged from 16.60 % in Romano to 17.00 % in Desiree. Varieties with a higher content of dry matter and starch have a higher nutritional value (Table 7).

Conclusion

Based on the test considering Desiree, Romano, Bistra and Kish Sora potato varieties in environmental conditions of Butmir and Glamoč, the results that were obtained are useful indicators.

The tests were conducted in 2009 and 2010. Romano had the shortest vegetation in 2009 (97 days) and Bistra had the longest vegetation in 2010 (110 days).

Yields were significantly higher (by 27%) in 2009 compared to 2010. Romano achieved higher average tuber yield (by 8% compared to Desiree and Kis Sore). Higher yield of potato cultivars (on average by 4%) was obtained in Glamoč compared to Butmir.

Dry matter content ranged from 21.80% to 22.20% with Romano to Desiree. The content of starch was in the range from 16.60% to 17.00% in Romano and Desiree. Based on the measured parameters of quality, preference may be given to Romano.

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Prinos i kvalitet sorti krompira

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Sažetak

Rad obuhvata dvogodišnji pokus (2009-2010. godine) sa četiri sorte krumpira (Desire, Romano, Bistra i Kiš Sora). Pokusi su provedeni na lokalitetu Butmir (oko 500 m/ nm) i Glamoč (cca 900 m nm). Cilj je izbor novih sorti za naše područje uzgoja. Ispitivane su proizvodne osobine sorata krumpira (prinos, masa i broj gomolja po kutiji), a u okviru kvalitativnih svojstava, sadržaj suhe tvari i škroba. Pokusi su izvedeni po slučajnom blok rasporedu u četiri repeticije, a rezultati su analizirani pomoću analize varijance. Viši prosječan prinos su ostvarile sorte Romano za 8% u odnosu na Desire i Kis Sore. Suha tvar se kretala od 21,80% u Romano do 22,20% u Desiree. Ispitivanje sorata treba nastaviti u narednom razdoblju kako bi se utvrdili najpovoljniji uvjeti za uzgoj na području Bosne i Hercegovine.

Ključne riječi: krumpir, sorte, prinos, kvaliteta

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