Impact of the semi-leafless field pea on dry matter yield

Utjecaj bezlisnog tipa poljskog graška na prinos suhe tvari

Tihomir ČUPIĆ[1*], Svetislav POPOVIĆ[1], MarijanaTUCAK[1], Goran JUKIĆ[2] and Ivana RUKAVINA[2]

[1]Agricultural Institute Osijek, Južno predgrađe 17, 31000 Osijek, Croatia;
[2]Croatian Center for Agriculture, Food and Rural Affairs, Usorska 19, Brijest, 31000 Osijek, Hrvatska
*Author for corespodence E- mail:Tihomir.Cupic@poljinos.hr

ABSTRACT

The field pea breeding at the Agricultural Institute Osijek has primarily been aimed at continued development of new cultivar types with high yield, potential early group maturity and resistance to lodging. Letin is a new semi-leafless -winter field pea (*Pisum sativum*) with purple flowers and a mottled light brown seed coat. Semi-leafless and leafed genotypes were evaluated for plant height, lodging, maturity, forage yield and quality in two locations. The forage yield of pea genotypes has an average of 32.21 t*ha^{-1}. Higher yield was obtained from semi-leafless genotype (34.48 t*ha^{-1}). The leafed genotype has achieved better nutritive characteristics. The obtained results point to a need for new tests and the possible introduction of semi-leafless cultivars in the production as a pea-cereal mixture or as pure crops to be utilized by cutting.

KEYWORD: field pea, semi-leafless, yield, lodging

SAŽETAK

Oplemenjivački rad na poljskom grašku na Poljoprivrednom institutu Osijek prvenstveno je usmjeren na stvaranje i razvoj novih tipova kultivara s visokim potencijalom prinosa, rane grupe zrelosti i tolerantnosti na polijeganje. Letin je novi bezlisni tip ozimog poljskog graška (*Pisum sativum*) s tamnocrvenim cvijetom i šarene svijetlo smeđe sjemene ovojnice. Bezlisni i lisni genotipovi ispitani su na visinu biljaka, rezultate polijeganja, zrelost, prinos zelene mase i kvalitetu na dva lokaliteta. Prinos mase testiranih genotipova graška u prosjeku je iznosio 32,21 t*ha^{-1} , veći prinos dobiven je s bezlisnim genotipom (34,48 t*ha^{-1}). Lisni genotip ostvario je bolje nutritivne vrijednosti. Dobiveni rezultati ukazuju na potrebu za novim testiranjima te moguće uvođenje bezlisnih kultivara u proizvodnju kao mješavinu grašak-žitarice ili čistih kultura za košnju.

KLJUČNE RIJEČI: poljski grašak, bezlisni tip, prinos, polijeganje

INTRODUCTION

Genetic potential for production of green yield is increasingly becoming a limiting factor which can be slightly influenced during the breeding process. The goal of breeding and creation of new cultivars of forage peas is to realize their full exploitation of genetic value. Farmers are, first of all, interested in the yield and quality of forage and their suitability for their production systems. In the process of creation of new forage plant cultivars the attention is directed to yield and quality. Which of the two will have the advantage depends on the livestock, rearing method and nutrition (Mihailović, et al. 2007; Mikić, et al. 2003; Uher, et al. 2010). The lodging of pea plants is mainly affected by the reduction of dry matter in the whole plant, as is often the case with the leaf type pea (Uzun, et al. 2005; Zhang, et al. 2006). Lodging resistance in pea is a quantitative trait and is related to morphological traits such as stem stiffness, plant height, and leaf type (Tar'an, et al. 2003). Different agro-ecological production conditions, purposes and utilization methods impose the need for selecting new types of forage pea cultivars with specific traits (Bilgili ,et al. 2010; Stoddard, et al. 2009). However, all breeding programs include a selection according to high production and quality of forage with increased resistance to lodging (Koivisto, et al. 2003; Skubisz, et al. 2007). The obtained results in this research recommend a new type cultivar for use by farmers for production of livestock feed.

MATERIALS AND METHODS

Testing of forage plant cultivars was carried out according to standard methodology during two years (2007/08 and 2009/10) on two locations: Osijek (45º 31' 16'' N, 18º 41'11''E and 86 m latitude) and Zagreb (45º 49' 44'' N, 16º 01' 56'' E and 129 m latitude). At each location, the field experiments were arranged in a randomized complete block design with five replicates and the plots were 14 m^2 (1.4 x 10m). Both locations have continental climate, total precipitation for Zagreb is 855 mm and for Osijek it is 659 mm per year. Two cultivars of pea were tested: Maksimirski ozimi standard for VCU traits of winter peas (wild leaf type) and Letin (semi-leafless leaf type). The pea genotype Letin was improved by pea breeding programs at the Agricultural institute Osijek, Croatia. The selection criteria for improvement were: high forage yield, early maturity and loading resisted. The following characteristics were analyzed in the study: green mass (GY) ($t*ha^{-1}$) dry matter (DMY) and proteins ($kg*ha^{-1}$) per years and locations. In full flowering stage the plant heights (cm), maturity (days from germination to flowering) and lodging rate (scale 1-9) from were determined on each plot. On samples obtained in the second year the main quality parameters were determined: organic matter ($g*kg^{-1}$), content of crude proteins, ADF and NDF ($g*kg^{-1}$). The obtained results were processed using variance analysis and the statistical significance of differences was tested using the LSD test for levels of significance of 0.05.

RESULTS AND DISCUSSION

In Table 1 we present results for the new line that was tested during 2007/08 and 2009/10 crop season at multiple sites. Standard (Maksimirski ozimi) with normal maturity for Croatia, tall plants habit with low resistance to lodging which decreased yield and quality. Letin plants have a medium high growth habit and leaflets are absent and transform into tendrils (semi leafless), with large stipules. Letin is resistance to lodging and very early maturing in average 177 days after germination.

Table 1. Average values of agro-morphological traits
Tablica 1. Prosječne vrijednosti agromorfoloških svojstava

Cultivars	Year	Maturity (days)		Height (cm)		Lodging (score)	
		Os	Zg	Os	Zg	Os	Zg
Maksimirski ozimi *leaf*	2008	206	203	160	154	3	8
	2010	205	202	160	178	7	9
	Average	206	203	160	166	5	9
Letin *semi leaf*	2008	183	186	140	135	2	5
	2010	170	168	120	124	2	5
	Average	177	177	130	130	2	5

The realized average productions of investigated cultivars of field pea varied significantly (Table 2). In relation to the standard (Maksimirski ozimi), cultivar Letin with 34.84 t*ha^{-1}realized a considerably higher yield. Letin is a new cultivar which realized a higher yield on location Zagreb 36.76 t*ha^{-1}, than Osijek 32.92 t*ha^{-1}. Differences among leafed and semi-leafless genotypes for forage and dry matter yield were not consistent for experimental years. Average forage yield of our pea genotypes was clearly lower than in the previous experiment (Čupić, et al. 2010; Štafa, et al. 2002). Obtained results of dry matter yield, show that cultivar Letin realized considerably higher yields on all locations and years except in Osijek 2010 (4.79 t*ha^{-1}), and standard highly considerably higher yield (5.32 t*ha^{-1}). The cultivar Maksimirski ozimi realized a higher yield of dry matter (0.53 t*ha^{-1}) compared to cultivar Letin on location Osijek in 2010 year, which is a result of very early cutting (03.05.2010).

Table 2. Average yield of green mass and dry matter on two locations in two years
Tablica 2. Prosječni prinos zelene mase i suhe tvari na dvije lokacije u dvije godine

Cultivars	Years	GY		Means t/ha	DMY		Means t/ha
		Osijek	Zagreb		Osijek	Zagreb	
Maksimirski ozimi *leaf*	2008	30.67	31.40	31.04	6.29	5.26	5.78
	2010	25.85	31.82	28.84	5.32	5.41	5.37
	Average	28.26	31.61	29.94	5.81	5.34	5.57
Letin *semi leaf*	2008	36.07	36.50	36.29	6.81	7.39	7.10
	2010	29.77	37.02	33.40	4.79	7.99	6.39
	Average	32.92	36.76	34.84	5.80	7.69	6.75
Average	2008	33.37	33.95		6.55	6.33	
	2010	27.81	34.42		5.06	6.70	
LSD 0,05	2008	4.19	3.39	4.49	0.83	0.50	1.14
	2010	3.64	3.33		0.59	0.19	

Both cultivars showed similar results for dry matter content and organic matter (Table 3.). The tested cultivar Maksimirski ozimi realized a content of crude protein of 202.48 g*kg^{-1} DM, which is higher compared to Letin. (171.76 g*kg^{-1} DM). This relationship was expected, because semi-leafless cultivars don't have leaflets, which are one of the major protein carriers in plants which is according with the results obtained by (Čupić, et al. 2010; Uzun, et al. 2005). The cultivar Maksimirski ozimi realized a considerably lower ADF content, while Letin had a lower content of NDF. A high proportion of ADF allows upright plants and good resistance to lodging. Based on the achieved results, we confirmed that quality and yield of new breeding material of semi-leafless type field pea are improved compared to conventional winter pea types, and can be successfully used in livestock feeding.

Table 3. Average quality values of examined cultivars of Field pea
Tablica 3. Prosječne vrijednost kvalitete ispitivanih kultivara poljskog graška

Cultivars	Dry matter %	Crud protein g*kg^{-1}DM	Organic matter g*kg^{-1}DM	ADF g*kg^{-1} DM	NDF g*kg^{-1}DM
Maksimirski ozimi *leaf*	90.75	202.48	903.69	380.62	495.17
Letin *semi leaf*	90.36	171.76	908.81	444.29	486.19

CONCLUSION

The achieved average production of investigated cultivars of field pea varied significantly. Differences among leafed and semi-leafless genotypes for forage and dry matter yield were not consistent during the experimental years. The obtained results point to a need for new tests and for acknowledged cultivars to be introduced into production as pea-cereal mixtures or for pure crops to be utilized by cutting.

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