



Mutual intercropping of spring annual legumes for grain production in the Balkans*

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The superiority of intercropped annual legumes over pure stands has been attributed to the significance variations of plant morphology and leaf architecture which results in efficient exploitation of environmental resources (Cupina *et al.* 2010). Intercropping legumes proves efficient in the establishment of the forages, such as red clover (*Trifolium pratense* L.), where pea (*Pisum sativum* L.) as a companion crop has a positive impact on its development and contributes to the forage yield and quality of its first cut (Cupina *et al.* 2010). Mutual intercropping of annual legumes is a traditional practice in many countries, especially India (Jat and Ahlawat 2009), where intercrops, such as those based upon pigeonpea (*Cajanus cajan* (L.) Millsp.) offer improved production than sole cropping and ensure adequate yield of one of the crops under aberrant weather conditions (Vyas *et al.* 2006).

In a small-plot trial, carried out in 2008 and 2009, two supporting crops, that is, faba bean (*Vicia faba* L.) and white lupin (*Lupinus albus* L.), were intercropped with three supporting crops, namely pea, common vetch (*Vicia sativa* L.) and grass pea (*Lathyrus sativus* L.). The trial was set up as a split-plot randomized complete block design, with two supporting components as main plots and three supported components as subplots, with four replicates, a plot size of 10 m², a row distance of 20 cm. The pure stands were sown with 75 viable seeds m⁻² for faba bean and white lupin, 100 viable seeds m⁻² for field pea and grass pea and 120 viable seeds/m for common vetch. Each intercrop included three proportions, namely 75% + 25%, 50% + 50% and 25% + 75%, in respect to the specific sowing rate of each pure

stand. In both years, the trial was established in early March, at Rimski Sancevi, in the vicinity of Novi Sad, with a position of 45°20' N, 19°51' E and 84 m asl, on a slightly carbonated chernozem soil, with 5.61% of CaCO₃ in the sowing layer. In comparison to a long-term average, both growing seasons were warmer and with significantly more precipitations in 2010 in comparison to a long-term average.

All pure stands were harvested in full maturity of the earliest pods grains, while the intercrops were harvested when the first of two components was in the same stage. The reliability of the intercrops was determined by calculating Land Equivalent Ratio (LER) values, using the following formula: $LER = S_{d_{IC}} / S_{d_{PS}} + S_{g_{IC}} / S_{g_{PS}}$, where $S_{d_{IC}}$ is supported crop yield in intercropping, $S_{d_{PS}}$ supported crop yield in pure stand, $S_{g_{IC}}$ supporting crop yield in intercropping and $S_{g_{PS}}$ supporting crop yield in pure stand. Significance of differences was tested by the analysis of variance Statistica 8.0 software. A Fisher's LSD test was used to detect significant differences between the treatments at $P = 0.05$.

There were significant differences among the average values of grain yields in the pure stands of five examined spring annual legumes (Table 1). The highest average total grain yield and LER in the intercrops with faba bean was in 25% faba bean + 75% grass pea (4 760 and kg/ha and 1.30). The intercrop of 25% white lupin + 75% grass pea had the highest average total grain yield (5 350 kg/ha) and LER (1.31) in the intercrops with white lupin.

The performance of all five spring annual legume crops in pure stands may be considered good. The pure stands of both faba bean and white lupin had lower grain yields in comparison to previously carried out research in the same conditions (Mikic *et al.* 2010). In this research, none of the six mutual spring annual legume intercrops the highest average grain yield was achieved by a proportion of 50% + 50%, although in most cases there were no significant differences between individual proportions. The results of our study claim that the intercrop of white lupin and grass

*Short note

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Table 1 Average grain yield (kg/ha) and LER for 2008 and 2009 in the intercropping of faba bean with field pea, common vetch and grass pea

Combination	Proportion (%)	Grain yield (kg/ha)			LER
		Supporting	Supported	Total	
Faba bean	100	3 050		3 050	1.00
White lupin	100	4 250		4 250	1.00
Field pea	100		3 750	3 750	1.00
Common vetch	100		2 050	2 050	1.00
Grass pea	100		4 010	4 010	1.00
Faba bean + field pea	75 + 25	2 650	1 230	3 880	1.20
	50 + 50	1 430	2 160	3 590	1.04
	25 + 75	1 050	2 990	4 040	1.14
Faba bean + common vetch	75 + 25	2 240	810	3 050	1.13
	50 + 50	1 630	1 290	2 920	1.16
	25 + 75	930	1 520	2 450	1.05
Faba bean + grass pea	75 + 25	2 490	1 470	3 960	1.18
	50 + 50	2 010	2 010	4 020	1.16
	25 + 75	1 450	3 310	4 760	1.30
<i>P</i> < 0.05	593	0.11			
White lupin + field pea	75 + 25	3 440	1 150	4 590	1.12
	50 + 50	2 550	1 750	4 300	1.07
	25 + 75	1 950	2 080	4 030	1.01
White lupin + green pea	75 + 25	3 190	690	3 880	1.09
	50 + 50	2 570	1 030	3 600	1.11
	25 + 75	1 770	1 490	3 260	1.14
White lupin + common vetch	75 + 25	2 910	2 050	4 960	1.20
	50 + 50	2 550	2 530	5 080	1.23
	25 + 75	2 030	3 320	5 350	1.31
<i>P</i> < 0.05	742	0.10			

pea produces highest grain yields. A proportion of 50% + 50% is also often responsible for the highest LER values, such as in the case of the intercrops of two soybean cultivars (Biabani *et al.* 2008).

The research on the possibility of intercropping various spring-sown cool season annual legumes offers solid grounds for further steps in the future. As a final result, such intercrops may find their place in modern farming systems providing

them with an enhanced sustainability and an improved conservation of diverse agro-ecosystems.

SUMMARY

A two-year (2008–2009) field trial was carried out in to assess whether intercropping of spring annual legumes may increase grain yield. It included two legumes with high standing ability, faba bean (*Vicia faba* L.) and white lupin (*Lupinus albus* L.), and three legumes with poor standing ability, field pea (*Pisum sativum* L.), common vetch (*Vicia sativa* L.) and grass pea (*Lathyrus sativus* L.). Both supporting crops were combined with three supported crops at three different proportions, namely 75% + 25%, 50% + 50% and 25% + 75%, in respect to the specific sowing rate of each pure stand that were included as controls. The reliability of each intercrop was determined by calculating land equivalent ratio. The intercrop of 25% white lupin + 75% grass pea had the highest average total grain yield (5 350 kg/ha). The highest average LER (1.31) was in 25% white lupin + 75% grass pea.

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