

YIELD AND QUALITY OF FORAGE TYPE PEA LINES AND WHEAT MIXTURES

Darko UHER*¹ - Zvonimir ŠTAFÁ¹ - Sanja SIKORA² – Mihaela BLAŽINKOV²

University of Zagreb, Faculty of Agriculture, ¹ Dept. of Field Crops Forages & Grasslands, ² Dept. of Microbiology

*Corresponding author: duher@agr.hr

Abstract: Peas are widely grown for hay, pasturage or silage production either or mixed with cereals. As a forage crop, pea hay and seed is rich in crude protein content, and most mineral elements. Due to their high nutritive value, peas are an important feed grain legume for animal production operations in the Croatia, where they are an alternative source of crude protein for soybeans. Four forage type pea lines were evaluated for 2 years for dry matter and crude protein yield under rainfed conditions in northwest Croatia. All the lines used in this study were forage type with indeterminate growing habit. Under humid conditions and cool temperatures in early spring, high forage production was observed in all the lines. Significant differences in dry matter and crude protein yield were found among the lines.

Keywords: forage pea lines, wheat, mixtures, crude protein

Introduction

Mixed cropping is one important element of self-sustaining, low-input agricultural systems (Altieri, 1999), while components of a mixture use limiting resources more efficiently than pure stands, thus showing resource complementarity (Bulson *et al.* 1997). Nitrogen application is an important and one of the most costly inputs in the nutrition and the production of higher plants including wheat and other cereals (Varga *et al.* 2004, Szentpétery *et al.* 2005, Svečnjak *et al.* 2007). Mixtures may be composed of different species or different genotypes of the same species. Growing legumes such as alfalfa or red clover in monoculture, and forage winter pea (*Pisum sativum* L.) in mixture with cereals, provides many benefits to cereal-based cropping systems: legume crop biologically fixes atmospheric nitrogen through symbiosis with *Rhizobium* bacteria making it available to both the legume crop and a subsequent nonlegume crop, thus reducing the need for inorganic N fertilizer inputs (Štafa *et al.* 2002, Leto *et al.* 2004, Maćešić *et al.* 2007), decrease potential diseases, weeds and pest cycles established in continuous cereal crops (Percze 2006) *etc.* Interspecific mixtures are used throughout the world for grain and forage production, often because of an assumed advantage over monocrops. Cereal and legume species are commonly intercropped for forage production, and are harvested at the early stage of the cereal component for better quality feed (Štafa *et al.* 2002), and higher biomass production compared with sole cropped (Juskiew *et al.* 2000). According to Mislevy *et al.* (1997) the stage of harvest was more important than species on the quality and yield of cereals for forage. This research was conducted to determine how forage yield and crude protein (CP) concentration of forage type pea lines and wheat mixtures (*Triticum aestivum* L.) intercrops are affected by harvest at two small grain cereals growth stages (milk and

soft-dough). An additional objective was to determine if an interaction exists between forage type pea lines and wheat crop component that are sown together.

Material and methods

A 2 year experiment was conducted in northwest Croatia at the Faculty of Agriculture University of Zagreb experimental field during 2005-2006, and a randomised complete block design in a split-plot arrangement was used. Wheat cv. Sana were grown in mixtures with the forage type winter pea lines. The base seeding rate used in this study was 100 seeds m^{-2} of forage pea in mixture with 200 seeds m^{-2} of wheat. Plots were seeded at 15 Oct. 2004 and 18 Oct. 2005. At seeding, plots consisted of 10 rows that were 12 cm apart and 10 m in length. A summary of production treatments involved: fertilisation before plowing (40 kg N ha^{-1} , 130 kg P ha^{-1} , 130 kg K ha^{-1}), plowing at 30 cm, granular topdressing 2 x 30 kg N ha^{-1} . Forage dry matter (DM) yield was determined by clipping the plots at two stages of type pea lines: early flower and early seed, while subsamples of approximately 1000 g randomly selected from each plot were dried at 60°C until a constant weight was attained. Forage pea and wheat components were separated within each subplot in m^2 area and weight. Forage crude protein (CP) concentration was determined from a subsample from each plot by standard procedures (AOAC 1990). The data within this experiment were analyzed using mixed model procedures (SAS Inst., 1997).

Results and discussions

Average DM yield of forage type pea lines and wheat mixtures and their separate components across two growing seasons (2005-2006) was shown in Table 1. In the early flowering stage of forage pea DM yield was significantly ($P=0,05$) lower than when it was cut in early seed vegetative stage.

The highest DM yield was obtained with forage type pea line L1 (ZG10) in mixture with wheat. Wheat in mixtures with forage type pea lines also significantly better yielded in early head vegetative stage compared to late boot. These results are in accordance to data given by Uher *et al.* 2007, reporting that factors affecting feed quality and yield of forage pea in mixture with cereals include plant stage at harvest, species and genotype. Wheat in mixture with forage type pea line L4 (ZG87) gained significantly the highest yield of DM among all type pea lines, and that affected in great portion total DM yield that was also significantly highest with that mixture.

Average CP yield of forage type pea lines and wheat mixtures and their separate components across two growing seasons (2005-2006) was shown in Table 2. In the early flowering stage of forage pea CP yield was significantly lower than when it was cut in early seed vegetative stage. Furthermore, differences in quality may be attributed to biomass distribution during growth period and differences between genotypes and species in their biomass distribution as reported by Juskiew *et al.* 2000.

The highest CP yield was obtained with forage type pea line L1 (ZG10) in mixture with wheat. Forage type pea lines in mixture with wheat significantly better yielded in late boot vegetative stage compared to early head.

Table 1. Winter type pea lines and wheat mixture dry matter (DM) yield ($t\ ha^{-1}$)

| Type pea lines | Pea CP yield ($t\ ha^{-1}$) | | | Wheat CP yield ($t\ ha^{-1}$) | | | Total CP yield ($t\ ha^{-1}$) | | |
|----------------|-------------------------------|------------|---------|---------------------------------|------------|---------|---------------------------------|------------|---------|
| | Stage | | Average | Stage | | Average | Stage | | Average |
| | Early flower | Early seed | | Late boot | Early head | | Late boot | Early head | |
| L 1 ZG10 | 5,90 | 8,40 | 7,15 | 9,02 | 11,80 | 10,41 | 14,92 | 20,20 | 17,56 |
| L 2 ZG56 | 4,50 | 6,60 | 5,55 | 9,49 | 13,20 | 11,34 | 13,99 | 19,80 | 16,89 |
| L 3 ZG73 | 4,10 | 7,10 | 5,60 | 10,17 | 12,30 | 11,23 | 14,27 | 19,40 | 16,83 |
| L 4 ZG87 | 5,10 | 7,80 | 6,45 | 8,27 | 11,30 | 9,78 | 13,37 | 19,10 | 16,23 |
| Average | 4,90 | 7,48 | | 9,24 | 12,15 | | 14,14 | 19,63 | |
| LSD 0,05 | | | 0,69 | | | 0,91 | | | NS |
| LSD0,05 † | | | 0,52 | | | 0,80 | | | 0,49 |
| LSD0,05 ‡ | | | 1,02 | | | 1,14 | | | 1,56 |

† values for comparing means within stages ‡ values for comparing means across stages

Table 2. Winter type pea lines and wheat mixture crude protein (CP) yield ($kg\ ha^{-1}$)

| Type pea lines | Pea CP yield ($kg\ ha^{-1}$) | | | Wheat CP yield ($kg\ ha^{-1}$) | | | Total CP yield ($kg\ ha^{-1}$) | | |
|----------------|--------------------------------|------------|---------|----------------------------------|------------|---------|----------------------------------|------------|---------|
| | Stage | | Average | Stage | | Average | Stage | | Average |
| | Early flower | Early seed | | Late boot | Early head | | Late boot | Early head | |
| L 1 ZG10 | 1220 | 1350 | 1285 | 1240 | 1150 | 1195 | 2460 | 2500 | 2480 |
| L 2 ZG56 | 890 | 975 | 933 | 1310 | 1270 | 1290 | 2200 | 2245 | 2223 |
| L 3 ZG73 | 810 | 995 | 903 | 1390 | 1200 | 1295 | 2200 | 2195 | 2198 |
| L 4 ZG87 | 950 | 1159 | 1055 | 1170 | 1101 | 1136 | 2120 | 2260 | 2190 |
| Average | 968 | 1119 | | 1278 | 1180 | | 2245 | 2300 | |
| LSD 0,05 | | | 107 | | | 87 | | | 127 |
| LSD0,05 † | | | 57 | | | 70 | | | 65 |
| LSD0,05 ‡ | | | 127 | | | 124 | | | 148 |

† values for comparing means within stages ‡ values for comparing means across stages

Conclusions:

This experiment shows that although good results could be obtained with all examined mixtures of wheat with different of forage type pea lines considering high yields of DM and CP, type pea lines selection and growth stage of crop in the time of cutting have great impact in such production. The conclusion of this research is that the highest yield of DM and CP was obtained with the mixture of forage winter type pea line L1 and wheat.

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