AGRONOMY OF *LATHYRUS* SPECIES IN SOUTH AUSTRALIA

M.S. Miyan[1] and W.D. Bellotti[1]

[1]Department of Agronomy and Farming Systems, University of Adelaide

Abstract

The effect of legume species and legume utilisation on the growth of a subsequent wheat crop was investigated in a rotation experiment located on the Roseworthy Campus of the University of Adelaide. Four legumes, *Lathyrus cicera* (Lath BC), *Lathyrus sativus* (ACC 80504), *Pisum sativum* cv. Alma (peas) and *Vicia sativa* cv. Blanchefleur (vetch) were utilised either as a grain, forage or green manure crop and the effect of these legumes on wheat yield in the following year was measured. *Pisum sativum* produced the highest legume biomass and *Vicia sativa* produced the lowest biomass in 1996. Despite this, *L. cicera* produced the highest legume grain yield followed by *L. sativus*. Wheat grain yield following lathyrus was significantly increased after green manure treatment as compared with forage or grain harvesting treatments. Averaged over the three utilisation treatments, wheat grain yield was highest following peas, and lowest following vetch, with the two lathyrus species intermediate. In 1997 peas (Phase II) produced the highest biomass followed by Lath BC. Despite these differences there were no significant differences in the grain yield of legume crops in 1997.

Key words: Lathyrus, forage legume, grain legume, low rainfall, agronomy

Introduction

Lathyrus is a genus of legumes containing more than 160 species and 45 subspecies (1) and divided into 13 sections (4). *Lathyrus* has been cultivated for centuries as human food in the Mediterranean region, Ethiopia, West Asia, Indian sub-continent and China. A number of *Lathyrus* species have potential as grain and forage legumes for the Australian wheatbelt. In particular, *Lathyrus* species are adapted to low soil fertility and low rainfall (<300mm) (6). *Lathyrus* species have potential as a grain, forage and green manure crop. On the Indian subcontinent, *L. sativus* grain is used for human consumption and also as a fodder crop due to its high nutritional value, its capacity to fix large amounts of nitrogen and drought tolerance (5). It has been recognised that adoption of grain legumes (pulses) in farming systems can significantly increase cereal yields in the following year (3). The benefit of growing leguminous crops in a cereal rotation include better weed control, nutrient recycling, soil structural benefits, erosion control and nitrogen nutrition for following crops (2). While the benefits of growing legumes in a crop rotation are well established, little information is available on the utilisation of lathyrus as grain, forage or green manure for low-rainfall southern Australian farming systems. This paper presents research on the effect of four legume species and three utilisation treatments on the grain yield of wheat in the following year.

Materials and methods

The trial was conducted on Roseworthy Campus, the University of Adelaide, South Australia in 1996 and 1997. The experiment consists of a 2-course rotation (Table 2).

Table 1. Explanation of phases in the 2-course (legume-wheat) rotation.

?	1996	1997	1998
Phase I	Legume	Wheat	?
Phase II	?	Legume	Wheat

The first course (legume) was sown in 1996 (phase I) and the same treatments were sown on adjacent plots in 1997 (phase II). Wheat was sown over the 1996 legume plots in 1997 (phase I) and will be sown in 1998 over the 1997 legume plots (phase II).

The three legume utilisation treatments are described in Table 2 and are referred to as Grain, Forage, and Green Manure throughout the paper.

Table 2 . Description of legume utilisation treatments imposed in 1996 (phase I) & 1997 (phase II).

Utilisation Treatment	Description
1. Grain	Plots harvested for grain yield at maturity
2. Forage	Crop dry matter harvested and removed at 50% flowering
3. Green Manure	Crop sprayed with Roundup @ 2.5 L/ha at 50% flowering and left to decompose on soil surface without further soil incorporation.

The experiment included four legume species; *L. sativus* acc. 80504, *L. cicera* acc. Lath BC, *Pisum sativum* cv. Alma (peas) and *Vicia sativa* cv. Blanchefleur (vetch). The legumes were sown in a split plot design, where the main plots were utilisation treatments, and subplots were legume species. The plots were 10 m long and 2.72 m wide (8 rows, 17 cm apart). Legumes were inoculated shortly before sowing with E-group inoculum. Sixty seeds/m^2 were sown with an 8-row cone seeder at a depth of 3-4 cm on June 12 1996 and June 4 1997. Fertiliser was applied as triple superphosphate at 100 kg/ha in 1996 and 1997. Trifluralin was sprayed at the rate of 1.5 L/ha and incorporated before sowing in both years In 1996, Spinnaker? was sprayed twice at the rate of 250 ml/ha at pre-emergence and post-sowing and post-emergence on June 13, 1996, and August?13, 1996. In 1997, Lexone was sprayed at the rate of 200 g/ha at post sowing and post emergence on July 4, 1997. Targa was also used to control weeds at the rate of 300 ml/ha on July 24, 1996 and July 18, 1997.

Above ground biomass production was recorded at 50% flowering in a 0.5m^2 quadrat at 2 positions in each plot. Samples were dried at 80^{o}C for 48 hours and weighed. In 1997, the wheat variety Janz was sown on June 10, 1997 at 100 kg/ha over the 1996 legume treatments with no chemical fertilisers. Soils were collected on June 9, 1997 to measure nitrate-N at two depths, 0-10 and 10-40 cm. At maturity the experiment was machine harvested on December 22, 1997. Plant dry matter and yield data were analysed in Genstat 5 for Windows.

Results and discussion

Legume biomass and grain yield in 1996 and 1997.

There were significant differences in dry matter production between the four legumes but no significant differences between the three utilisation treatments (Table 3). In 1996 (phase I) peas produced the highest biomass production (5.1 t/ha) followed by Lath BC (3.6 t/ha), while vetch produced the lowest (3.1 t/ha). On the other hand highest grain yields were recorded in Lath BC (2.5 t/ha) followed by ACC 80504 (2.2 t/ha) and peas (2.2 t/ha). The lowest grain yield was recorded in vetch (0.71 t/ha) which was related to sensitivity to the herbicide Spinniker?.

Table 3: Dry matter production (kg/ha) at 50% flowering and grain yield (kg/ha) at maturity of grain legumes from the grain yield treatment

?	1996		1997	
?	Dry matter	Grain yield	Dry matter	Grain yield
Lathyrus cicera (Lath BC)	3623	2454	4150	1700
Lathyrus sativus (Acc 80504)	3150	2202	3900	2109
Vicia sativa (cv. Blanchefleur)	3057	708	4068	1833
Pisum sativum (cv.Alma)	5082	2193	5217	1967
l.s.d.(0.05)	1106.6	225.8	895.5	448.3

In 1997 (Phase II), peas produced the highest biomass at 50% flowering (5.2 t/ha) followed by Lath BC (4.2 t/ha), while ACC 80504 produced the lowest (3.9 t/ha). Despite these differences, there were no significant differences in the grain yield of legume crops in 1997.

Trends in soil nitrate - N

Soil nitrate (mg NO_3/kg soil) was measured from 0-10 cm and 10-40 cm at the time of sowing the wheat (June 9 1997) (Fig. 1). Soil nitrate was highest following green manuring, particularly at the 0-10 cm depth. Soil nitrate following vetch was lower than the other legumes, most likely a consequence of the lower yield of vetch in 1996.

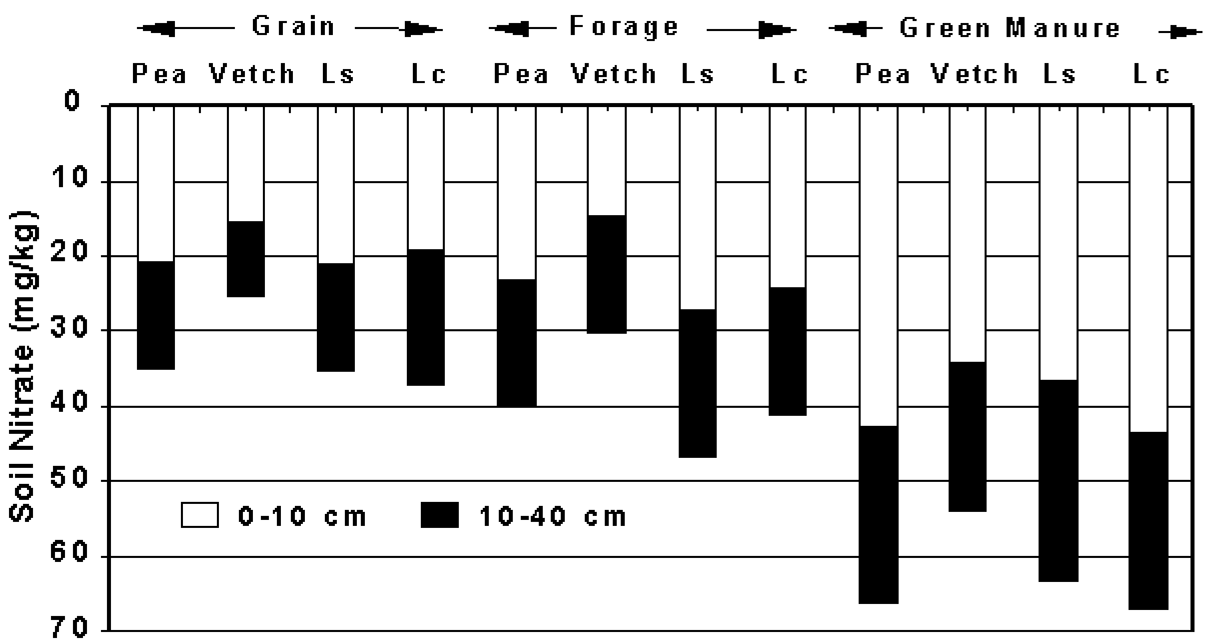

Figure 1. Soil nitrate (mg NO_3/kg soil) at sowing of wheat (June 9 1997) following legume treatments in 1996 (Ls= *Lathyrus sativus*), Lc= *Lathyrus cicera*).

Wheat dry matter and grain yield in 1997.

Legumes grown in 1996 had a significant effect on wheat dry matter and grain yield production (Table 4). There was no significant interaction between legume species and utilisation treatment. There were significant increases in dry matter at anthesis and grain yield of wheat grown after green manure treatment as compared with wheat following forage or grain treatments. Averaged over all legume utilisation treatments peas produced the highest grain yields of wheat followed by Lath BC and ACC 80504. The lowest wheat grain yield was recorded in the vetch treatment which most likely was associated with the low vetch yield in 1996. There were no significant differences in wheat anthesis dry matter or wheat grain yield between the forage and grain utilisation treatments.

Table 4: Main effects of legume species and utilisation treatment on wheat dry matter production at anthesis and grain yield (kg/ha) in 1997 following legumes in 1996.

?	Dry matter	Grain yield
Legume species	?	?
L. cicera (Lath BC)	5927	4280
L. sativus(Acc80504)	5653	4341
V. sativa (cv.Blanchefluer)	5475	4058
P. sativum (cv. Alma)	6447	4957
l.s.d.(<0.05)	545.9	282.0
?	?	?
Utilisation treatment	?	?
Grain	5427	4124
Forage	5632	4177
Green manure	6567	4925
l.s.d. (<0.05)	388.9	412.5

Conclusion

Peas produced the highest dry matter of the four legumes at flowering in both years. However, legume grain yields were not significantly different, although there was a trend for higher legume grain yield in *L.*

cicera (Lath BC) in 1996 and *L. sativus* (ACC 80504) in 1997. Other research conducted by the authors has identified even higher grain yield potential in a number of accessions of *L. cicera* and *L. sativus*.

Grain yield of wheat following legumes was highest after green manuring compared to when the legumes were harvested either for forage or grain. The higher wheat grain yield following green manuring was most likely associated with greater soil nitrate availability at sowing. Averaged over the three utilisation treatments, wheat grain yield was highest following peas, and lowest following vetch, with the two lathyrus species intermediate. These responses are consistent with a general relationship between higher legume biomass, increased soil nitrate, and higher subsequent wheat grain yield.

Acknowledgments

This research is supported by the Grains Research and Development Corporation of Australia.

References

1. Allkin, R., Macfarlane, T.D., White, R.J., Bisley, F.A. and Adey, M.E. 1985. *Vicieae Database Project Publication No. 6.*

2. Chatel, D.L., and Rowland, L.C. 1982*. J. of Agric. Western Australia*. **23**, 92-95.

3. Doughton, J., Strong, W.M., Harbison, J., Mackenzie, J., Nelson, R., and Hall, B. 1981. *Qld Wheat Res. Rep.* (Qld Wheat Res. Inst.)

4. Kupicha, F.K. 1983. *Notes Royal Botanic Gardens Edinburgh* **41**, 209-244.

5. Purseglove, J.W. 1968. Tropical crops-Dicotyledons. (*Longman*, London.)

6. Saxena, M.C., Moneim, A.M. and Ratinam, M. 1992. *Proc. Workshop on the breeding and selection of Vicia and Lathyrus for grain production.* CLIMA, University of Western Australia, Perth. pp. 2-9.