A COMPARISON OF DRYLAND GRASSPEA (*Lathyrus sativus* L.) AND ADMIRAL PEA (*Pisum sativum* L.) GROWN UNDER DIFFERENT ROW SPACINGS.

Calderón, F.J., M.F. Vigil, D.C. Nielsen, J.G. Benjamin, and M. Mikha.
Central Great Plains Research Station, USDA-ARS, Akron, Colorado.
francisco.calderon@ars.usda.gov (970) 345-2259

ABSTRACT

Grasspea (GP) is a drought-tolerant legume grown for forage and grain in Europe and the Middle East. It has potential value to be used as a nitrogen-fixing crop in rotation with common grain crops in the High Plains. However, the agronomics of GP for our region have not been investigated to date. We carried out a field experiment to compare the growth of GP and Admiral Pea (AP) in 76 cm rows vs. 19 cm rows. The growth, yield, grain N content, phenology, and water utilization was measured throughout the growing season and at harvest. Our results show that the grain yields were comparable for both the legume species. The 19 cm row treatment out-yielded the 76 cm row treatment in both legume species. Biomass at harvest was similar for both legumes, although the AP matured faster than the GP. The GP accumulated more nitrogen in shoots and seed compared to the AP. Both legumes reduced significant amounts of soil moisture only above 30 cm, suggesting that water-related yield drag after these legumes should not be a major concern.

INTRODUCTION

Grasspea has been produced in Europe, the western Asia, and Africa (Osman and Nersoyan, 1986). Grasspea is notoriously drought resistant (Palmer et. al., 1989), and during years of sparse precipitation it is often the one of the few crop species yielding a harvestable crop. As a legume, GP have the capacity of symbiotic nitrogen fixation, a feature that will become important as chemical fertilizers become expensive concomitant with the price of fuel. Fertilizer price increases will make crop rotations with nitrogen fixing legumes more desirable in the future. Because of this, it will be important for farmers to have several species of adapted legumes available in order to increase rotation diversity. While GP has been grown successfully in the northern and southern plains (Rao et al., 2005), no studies about the agronomics of GP have been carried out in the high plains of the Colorado Plateau. Other pea species such as *Pisum sativum* L. are grown in 19 cm row spacing in the high plains in order to achieve quick canopy development and the exclusion of weeds. However, GP seed suppliers recommend 76 cm row spacing, which may be more suited to the northern plains rather than the central plains.

In order to explore the feasibility of growing GP in our region of the high plains, we have started a multi-year experiment, comparing GP to the more common AP in two row spacings (19 cm and 76 cm). Biomass, soil profile moisture and phenology were measured periodically, and yields and tissue nitrogen concentration were measured at harvest.

MATERIALS AND METHODS

The GP and AP were planted in 4.5 x 9 m plots. There were two row spacing treatments (19 cm and 76 cm). There were four replicate plots, two row spacings and two crop species for a total of 16 experiment replicates. The seeds were coated with rhizobial inoculant, and a minimal amount of N fertilizer was applied at planting. The seeds were sown in May 2007, and the plots were harvested in July 2007. In-row plant density after germination was 14 plants m^{-1} in the 19 cm rows, and 31 plants m^{-1} in the 76 cm rows. Soil profile moisture to 1 m depth was measured throughout the growth season. Biomass and growth stage were measured periodically, and the tissue N in shoots and seeds was quantified at harvest.

RESULTS AND DISCUSSION

Soil moisture

The 2007 summer was somewhat drier than normal for the region, with the Akron weather station receiving 14.2 cm of rain for the months of May, June, and July. The GP was more capable than the AP of exploiting soil moisture between 200 to 600 mm depth. The soil moisture difference between the first and last samplings of the season for the 200-600 mm depth range were slightly but consistently more in the GP plots than in the AP (Table 1), indicating more water extraction at those depths in the GP than in the AP.

Table 1. Average soil moisture difference between the June 1st and July 24th samplings at 100 mm depth increments. Data in m^3 water m^{-3} soil. n=4.

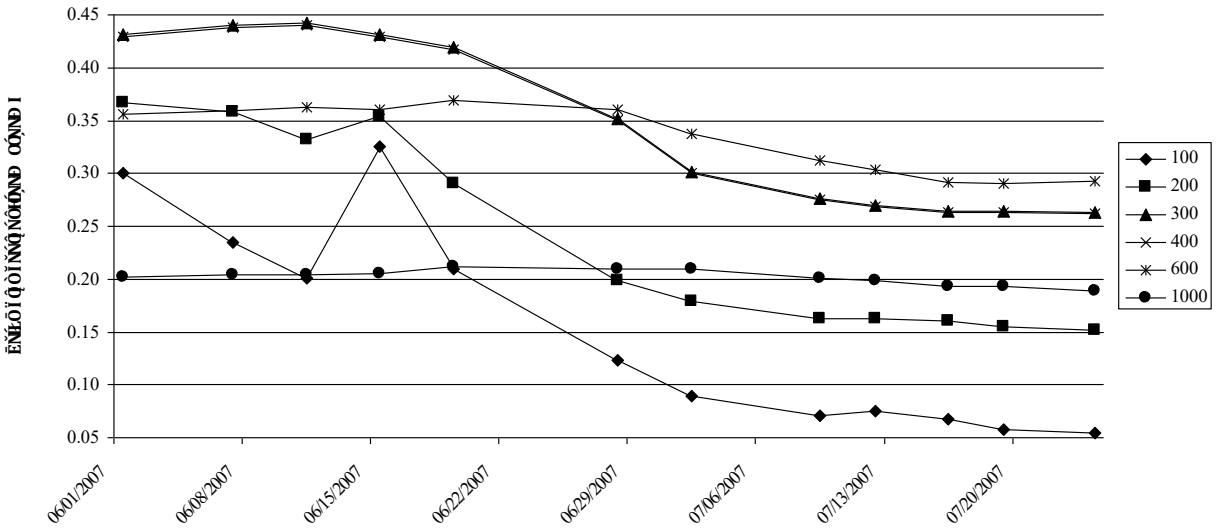
Crop species	Row Spacing	100 mm	200 mm	300 mm	400 mm	600 mm	1000 mm
Admiral pea, *Pisum sativum* L.	76	0.22	0.12	0.11	0.11	0.05	-0.01
Admiral pea, *Pisum sativum* L.	19	0.22	0.16	0.11	0.11	0.08	0.01
Grasspea, *Lathyrus sativus* L.	76	0.21	0.16	0.12	0.12	0.09	0.01
Grasspea, *Lathyrus sativus* L.	19	0.25	0.22	0.17	0.17	0.06	0.01

The GP soil moisture difference for the growth season is higher in the narrow row spacing than in the wide row spacing (Table 1). Note, however, that the moisture readings were taken in the planted row, so the moisture left towards the middle of the 76 cm rows is not known.

The weekly soil moisture samplings show that both legume species had equal impact on the soil moisture at 1000 mm depth.

The GP grown at 19 cm row spacing was the most effective treatment at the uptake of soil water. The soil water dynamics in the 19 cm GP treatment shows how moisture increased temporarily around the 15th of June due to precipitation (Fig. 1). The moisture in the top layers was depleted more markedly than in the bottom layers, and there was a period of high soil water uptake in the last two weeks of June. There was little or no water decline in soil depths larger than 600 mm in any of the treatments (data not shown).

Figure 1. Average soil moisture content at different times throughout the growth season in the Grasspea plots. The probes were installed in the center of the row. n = 4.



Grain yield

Yields were similar between pea species, but there were marked treatment differences between row spacings (Table 2). There was a 75-86 percent increase in grain yield in the 19 cm row spacing relative to the 76 cm row spacing. The GP had a 20-26 percent increase in grain nitrogen content relative to the AP, resulting in more grain nitrogen uptake per hectare (Table 2). Field observations showed that the GP had more nodulation in the roots than the AP, although the difference was not quantified. This leads us to hypothesize that the greater N concentration in the GP occurred because the GP fixed more N than the AP.

Table 2. Grain yield and grain nitrogen content at harvest for the legumes grown under different row spacings. n=4.

Crop species	Row spacing (cm)	Kg grain ha^{-1}	Percent grain N	Kg grain N ha^{-1}
Admiral pea, *Pisum sativum* L.	76	996.4	3.8	38.2
Admiral pea, *Pisum sativum* L.	19	1849.6	3.9	72.1
Grasspea, *Lathyrus sativus* L.	76	1053.5	4.8	50.3
Grasspea, *Lathyrus sativus* L.	19	1843.0	4.7	85.8

Biomass

The GP and AP had marked differences in the timing of biomass accumulation (Figure 2). Grasspea had a longer growth season than the AP, and GP accumulated biomass for nearly two weeks after the AP had matured and dried. Figure 3 is a photograph taken at the time of maturity for the AP, and it shows the dried AP plants surrounding a plot of actively growing GP. However, biomass production occurred at a slower pace in GP, so the ending biomass at maturity was only slightly higher for the GP than the AP. Figure 2 shows how the narrower 19 cm row spacing was more productive in terms of biomass than the 76 cm row spacing. The AP grown in the 19 cm row spacing had twice the production of biomass of the AP grown in 76 cm rows. The GP grown in 19 cm rows had 87 percent more biomass production than the GP in 76 cm rows.

Figure 2. Average plant biomass of the different treatments. n=4. Grasspea, 76 cm row spacing (▲); Admiral Pea, 76 cm row spacing (♦); Grasspea, 19 cm row spacing (×); Admiral Pea, 19 cm row spacing (■).

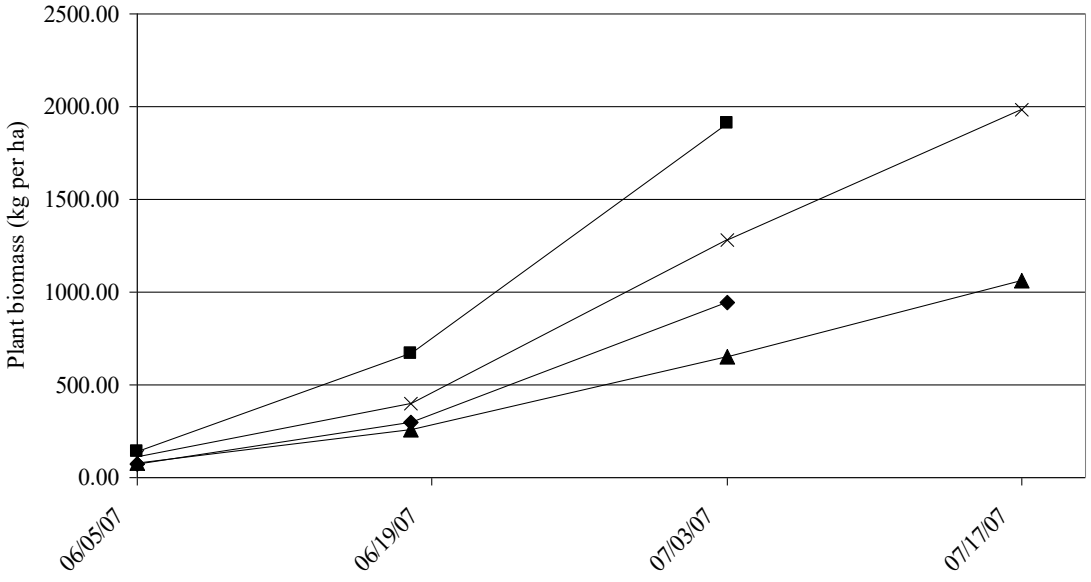


Figure 3. Photograph of the research plots taken in early July, showing the senesced (lighter Admiral Peas surrounding a plot of immature GP (darker).

CONCLUSIONS

Our research clearly shows that GP is a legume species well adapted to the climate of the Colorado Plateau, with comparable yields but longer season than the more common AP. Grasspea had more N accumulation in the biomass and grain than AP, suggesting better N fixing capacity than AP. Our results show that the 30 inch (76 cm) row spacing recommended by the GP seed suppliers leads to low yields and biomass production in our geographic area. We have demonstrated that a 19 cm row spacing is more productive and suitable.

REFERENCES

Osman, A.E., and N. Nersoyan. 1986. Effect of the proportion of species on the yield and quality of forage mixers, and on the yield of barley in the following year. Exp. Agric. 22:345–351.

Palmer, V.S., A.K. Kaul, and P.S. Spencer, 1989, International network for the improvement of Lathyrus sativus and the eradication of Lathyrism (INILSEL):ATWMRF initative. p. 219–223. In P. Spencer (ed.) The grasspea: Threat and promise. Proc. Of the Intl. Net- work for the improvement of *Lathyrus sativus* the eradication of lathyrism. Third World Medical Research Foundation, New York.

Rao S. C., B. K. Northup, and H. S. Mayeux, 2005, Candidate Cool-Season Legumes for Filling Forage Deficit Periods in the Southern Great Plains. Crop Sci. 45: 2068-2074.