TRAILING AND SMOOTH-SEEDED WILD BEANS: NATIVE ANNUAL WARM SEASON LEGUMES FOR TEXAS

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Summary and Application

Adapted, native herbaceous legumes are needed for rangeland reseeding, indigenous prairie and woodland restoration, and cultivated pasture in drier regions of the Southern Plains. Annuals have the potential for supplying large numbers of seed for native birds as well as stand reseeding. Trailing wild bean [*Strophostyles helvula* (L.) Elliott] and smooth-seeded wild bean [*Strophostyles leiosperma* (Torr. & A.Gray) Piper] were collected in north-central Texas and evaluated at three locations in Texas. Trailing wild bean yielded up to 3.9 lb forage dry matter (DM) plant^{-1} year^{-1} at one location, out-producing smooth-seeded wild bean by a factor of 1.8 to 3.4, depending on location and growing conditions. In contrast to trailing wild bean that produced most of its seed in the autumn (2.22 oz plant^{-1} year^{-1} at the best site), smooth-seeded wild bean responded to light defoliation by increasing seed yields during the growing season (from 0.74 to 2.01 oz plant^{-1} year^{-1}). Crude protein (CP) values tended to be higher in the finer-stemmed smooth-seeded wild bean, reaching more than 22% in plants defoliated throughout the season. Both species declined in CP concentration (down to 8%) when not defoliated during the growing season. Results suggest these wild bean species are suitable candidates for rangeland reseeding, wildlife feed and perhaps even cultivated pasture in north-central Texas.

Abbreviations: CP, crude protein; DM, dry matter; LSD, least significant difference.

Introduction

Smooth-seeded wild bean and its close relative, trailing wild bean, are annual, warm-season legumes native to Texas that often colonize open, disturbed sites (1). Both are common in the Cross Timbers region of north-central Texas and are aggressive and productive when sod-forming grasses are not dominant (2). Preliminary observations in north Texas indicated that forage and seed production of both species show promise for wildlife plantings, prairie restoration, native range reseeding and, eventually, cultivated pastures based on native germplasm.

Since no exotic annual, warm-season legumes with widespread adaptation have been widely cultivated in drier regions of southern U. S., wild beans could become important both as forage for domestic and wild herbivores as well as seed for game birds. The objectives of this study were to evaluate adaptation potential of trailing and smooth-seeded wild bean to contrasting environments in Texas, determine quality and anti-quality indicators of the forage, and evaluate forage and seed production potential under a range of defoliation regimes.

Methods and Materials

The experiment was conducted during

2001 at three sites in Texas: Stephenville, San Angelo and Vernon. Seeds of trailing and smooth-seeded wild beans were collected in the Cross Timbers area of Texas during the summer of 2000. In March 2001, these seeds were scarified, inoculated with a general "cowpea" *Rhizobium* inoculant, and germinated in containers and then transplanted in April of 2001 at each location in plots consisting of three rows of three plants each spaced at 1.5 by 1.5 ft. between plants. Rainfall was well below average during the growing season at all three locations and irrigation was applied whenever monthly rainfall fell below 30-year averages. Combined rainfall and irrigation totals from March to October 2001 were: Stephenville 19.7 in. vs. 23.4 in. long-term average; San Angelo 14.6 in. versus a long-term average 16.7 in.; Vernon 12.9 in. vs. a long-term average 23.5 in.

Defoliation was initiated whenever the majority of plots were covered by the viney growth of wild bean plants. Defoliation treatments consisted of an unclipped control, plants clipped at 4-in. length or 8-in. from the base. Defoliation was repeated whenever plants regrew to fill in the plots while unclipped plots were harvested only once, just prior to the first frost in autumn. Total aboveground DM production was estimated by summing forage yields from the inner plant of that plot during the growing season. Representative forage sub-samples were analyzed for crude protein.

Seedpods were collected just prior to shatter from the inner plant only and batched by plot over the season. These pods were then air-dried and the seeds removed to estimate seed yield and number.

Plots at all locations were arranged in a randomized complete block design with four replications. Location, species and defoliation regime were used as independent variables in the model and analyzed for interactions and, where appropriate, main effects, using analyses of variance and actual *P* values are reported. Means were compared by the pairwise multiple comparison test (LSD) at the probability level of 0.05.

Results and Discussion

Forage Yield

Defoliation regimes did not affect forage yield (data not presented). There were, however, significant yield differences between species at each site (species by site interaction $P<0.05$; Table 1).

Table 1. Forage yield of smooth-seeded and trailing wild beans at three locations in Texas (species by location interaction *P*=0.001) pooled over three defoliation regimes.

	Stephenville	Vernon	San Angelo
Wild Bean	----lb forage plant^{-1} season^{-1}----		
Smooth-seeded	1.1 a† A	1.2 a B	0.1 b A
Trailing	3.9 a B	2.2 b A	0.3 c A

† Means followed by the same lower case letter (rows) or upper case letter (columns) are not different according to least significant difference test at the probability level of 0.05.

The San Angelo site was the least productive, and, despite similar precipitation, both entries produced more forage at Vernon than at San Angelo. Trailing wild bean was more productive where soil moisture conditions were better. At Stephenville, it yielded greater forage than smooth-seeded wild bean by a factor of 3.4 (3.9 lb and 1.1 lb DM plant^{-1} year^{-1}, respectively) while at Vernon its yield was 1.8 that of the smooth-seeded wild bean. These results indicate that smooth-seeded wild bean may have reached its maximum

yield potential at two locations whereas the trailing wild bean may produce even greater yields with increasing soil moisture.

Seed Yield

Differences in rainfall and irrigation totals at each experimental site affected not only forage yields but seed production as well. Seed yields (Table 2) of trailing wild bean were greatest at Stephenville (2.22 oz plant^{-1} year^{-1}) while those of the smooth-seeded wild bean were highest at San Angelo (3.03 oz plant^{-1} year^{-1}; species by location interaction P=0.001). The high seed yield of smooth-seeded wild bean at San Angelo, despite very low rainfall, reflects a capacity for early-season seed production prior to the onset of moisture-stress. As an indeterminate annual, photoperiod insensitive smooth-seeded wild bean appears to partition nutrients to seed production as early as possible and maintain vegetative (and reproductive) growth only when soil moisture is adequate and herbivory removes leaf area.

Delaying defoliation until autumn considerably increased seed production of the trailing wild bean but appeared to decrease seed yield in the smooth-seeded wild bean (species by defoliation regime interaction P=0.06). Seed yield of smooth-seeded wild bean harvested throughout the season at 8-in. clipping height was nearly 2.01 oz plant^{-1} year^{-1}, 2.7 times greater than seed production by control plants.

Due to growing condition differences, San Angelo had no autumn harvest of either forage or seed (defoliation regime by location interaction P=0.06). In contrast, Stephenville's rainfall and irrigation total, nearly double that of the other two locations, favored greater autumn seed yields. The more severe defoliation regime (4-in. clipping height) resulted in lower seed yields than the 8-in. defoliation height only at San Angelo.

Table 2. Seed yields of smooth-seeded and trailing wild bean at three locations in Texas as a function of defoliation intensity (species by location interaction *P* = 0.001; species by defoliation interaction *P* = 0.06; defoliation by location interaction *P* = 0.06).

Wild Bean	Stephenville	Vernon	San Angelo
	----------oz seed plant^{-1} yr^{-1}----------		
Smooth-seeded	0.53 b† B	0.42 b A	3.03 a A
Trailing	2.22 a A	0.28 b A	0.42 b B
	Control	4-in. height	8-in. height
Smooth-seeded	0.74 b B	1.20 ab A	2.01 a A
Trailing	1.87 a A	0.35 b A	0.67 b B
	Stephenville	Vernon	San Angelo
Control	2.75 a A	0.39 b A	0.00 b C
4-in. height	0.74 b B	0.32 b A	1.65 a B
8-in. height	1.00 b B	0.35 b A	2.68 a A

† Means followed by the same lower case letter (rows) or upper case letter (columns) are not different according to least significant difference test at the probability level of 0.05.

Crude Protein

Forage levels of CP varied with species, harvest and location (species by location by harvest interaction *P*=0.001; Table 3). Except for smooth-seeded wild bean at Stephenville, CP concentrations were much higher in plants defoliated throughout the season compared with control plants and higher in plants defoliated at 4-in. height then at 8-in. height. At Vernon and Stephenville in the autumn, plants had green foliage with low CP concentrations reaching 8% CP in smooth-seeded wild bean at Vernon. Annual legumes tend to lose leaf biomass and CP concentration late in the growing season so their greatest contribution will be to early-season grazing and late-season seed for birds.

Conclusion

Trailing wild bean forage was more productive where soil moisture conditions permitted season-long growth. At Stephenville, yields were equivalent to 3.2 tons acre^{-1} year^{-1} (assuming a plant population of about approximately 4 plants yard^{-2}) compared to 0.9 tons acre^{-1} year^{-1} for smooth-seeded wild bean at the same plant population. Smooth-seeded wild bean may have reached its maximum yield potential at both Stephenville and Vernon, indicating lower growth response to increasing soil moisture.

In general, the less plant material removed from trailing wild bean plants, the greater the seed yields, reaching an equivalent 190 lb acre^{-1} year^{-1} in control plots. Smooth-seeded wild bean, by contrast, appeared to respond to moderate defoliation by increasing seed yields, 204 lb acre^{-1} year^{-1} in plots clipped at 8-in. This indicates that moderate herbivory of smooth-seeded wild bean during the growing season could stimulate seed production for game birds and subsequent season stand regeneration from seeds. In contrast, if trailing wild bean seed production is the main objective, forage removal should be kept to a minimum. Trailing bean appears to be photoperiod sensitive; both herbivory and moisture stress in late summer negatively affect autumn seed set.

Table 3. Crude protein (CP) of smooth-seeded and trailing wild bean at three locations in Texas in response to defoliation intensity (species by location by defoliation interaction *P* = 0.001).

Location	Wild Bean	4-in. height	8-in. height	Control
		----------% CP in Forage----------		
Stephenville				
	Smooth-seeded	16.8 a† A	16.5 a A	14.5 b A
	Trailing	16.4 a A	14.2 b B	10.1 c B
San Angelo				
	Smooth-seeded	20.2 b A	22.7 a A	
	Trailing	15.3 b B	16.7 a B	
Vernon				
	Smooth-seeded	14.1 b A	15.2 a A	8.0 c A
	Trailing	11.4 b B	12.3 a B	9.2 c A

† Means followed by the same lower case letter (rows) or upper case letter (columns within locations) are not different according to least significant difference test at the probability level of 0.05.

The CP values measured in whole-forage samples were much higher in plants defoliated throughout the season compared with control plants. This indicates that forage stockpiled for late autumn or winter will have limited nutritive value for wildlife. Annual legumes tend to lose leaf biomass and CP concentration late in the growing season so their greatest contribution will be to early-season grazing and late-season seed production.

Acknowledgement

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Literature Cited

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Fig. 1. Smooth-seeded wild bean [*Strophostyles leiosperma* (Torr. & A.Gray) Piper]

Fig. 2. Trailing wild bean [*Strophostyles helvula* (L.) Elliott]