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Evaluation of Lark Selection Partridge Pea and Hopefield Selection Trailing Wildbean for Use in Critical Area Seed Mixtures

Janet Grabowski and Joe Snider

ABSTRACT

Lark Selection partridge pea and Hopefield Selection trailing wildbean were tested for possible inclusion in critical area seed mixes. The main purpose of using these species was to improve wildlife habitat on critical area planting sites. Spring and fall plantings were made with each species planted alone and in combination in a mix that included recommended grass cover crop species for that planting season. Effects of mulching were also tested, with plots of each seed mix mulched with wheat straw and left unmulched. Lark Selection partridge pea demonstrated a greater potential to establish on these sites; however, both legumes were not able to persist under the dense cover crop and weed populations that occurred on the test site. Greater stands of both legume species resulted from fall planting; however, only half the spring planted seed was scarified and this probably decreased potential germination percentages. Tall fescue did not establish in the plots when planted in the fall of 1996 due to competition from other species. Bahiagrass established in the test plots when planted in spring or fall, but took two growing seasons to develop a measurable stand. Annual grasses tested for use in combination with bahiagrass were annual ryegrass for fall plantings and browntop millet for spring plantings. Both were able to stabilize the site until the bahiagrass established; however, a 40 lb/acre rate of browntop millet may decrease germination of the legume species. Mulching was beneficial for the legumes, but decreased germination of some of the grass cover crops.

INTRODUCTION

Critical areas are highly erodible and therefore difficult to establish vegetation using normal planting methods. Examples include roadsides, dams, levees, construction cuts and fills, and mine spoils. Seed mixes recommended in the field office technical guide (FOTG) (SCS, 1991) include both annual and perennial grasses and legumes that establish quickly and can stabilize the planting site. The main purpose of including legumes in the mix is to utilize their nitrogen-producing capabilities to provide a continuing source of nutrition for all species on the planting site. Historically, the legumes used in critical area seed mixes in the Southeast have been introduced species, such as clovers and lespedezas.

Partridge pea and trailing wildbean are two native annual legumes that have several advantages over many of the more commonly used legumes. The seed of both species provide excellent food sources for wildlife, especially bobwhite quail, and the persistent woody stems of partridge pea provide cover for many wildlife species (Graham, 1941). Partridge pea has been recognized as a species that is well adapted for colonizing disturbed sites (Grelen and Hughes,

Janet Grabowski is a Biologist and Joe Snider was Assistant Manager (retired) at the Jamie L. Whitten Plant Materials Center, 2533 County Road 65, Coffeeville, Mississippi 38922-2652. Phone: (662) 675-2588; FAX: (662) 675-2369.

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Homer L. Wilkes, State Conservationist
Jackson, Mississippi

1984). Both also appear to have a greater tolerance to low pH soils than many of the recommended legumes. Everitt and Heizer (1984) found that partridge pea seed germinated over a wide range of pH levels from 3 to 11, and they speculated that soil pH is not a critical factor in establishment of this species. Trailing wildbean was shown to establish and produce abundant seed without application of lime or fertilizer (Graham, 1941). Both species also have good to excellent tolerance to dry conditions (Graham, 1941; Everitt and Heizer, 1984), which is a major consideration on many critical areas.

Although both partridge pea and trailing wildbean have been recommended for use in erosion control plantings (Graham, 1941; Alderson and Cragar, 1986), they are not widely used. Prior to 1996, only one cultivar of partridge pea, 'Comanche', which originated from Texas, and no cultivars of trailing wildbean were commercially available. In 1997, the Jamie L. Whitten Plant Materials Center (PMC) released selected class accessions of these species that are well adapted to the growing conditions in the Southeast. A study was conducted to determine the compatibility of these two releases, Lark Selection partridge pea (accession 9028375) and Hopefield Selection trailing wildbean (accession 9021719), with common grass mixtures recommended for critical area plantings. This study also examined the effect of fall versus spring planting and the influence of mulch on establishment of these two legumes.

MATERIALS AND METHODS

This study was conducted at the PMC on a Loring silt loam soil with a 2 to 5 percent slope. The site was close to a tree-line, but the plots were located so that most received exposure to full sun. The study was designed as a randomized complete block with three replications and four planting dates, two fall plantings and two spring plantings. Plot size was 8 foot by 10 foot. Grass species and planting rates used (Table 1) were recommended in the FOTG (SCS, 1991) for critical area roadside mixtures, except for browntop millet. The 40 lb/acre browntop millet rate used in 1996 was determined by doubling the recommended conservation cover planting rate of 15-20 lb/acre. It was subsequently determined that this rate was too high, so in 1997 the planting rate was reduced to the FOTG critical area recommended rate of 15 lb/acre. Planting rates of Lark Selection partridge pea and Hopefield Selection trailing wildbean were based on PMC recommendations for these selections. Hereafter, these two selections will be identified simply as partridge pea and trailing wildbean.

Table 1. Species tested and planting rates for these species.

Common Name	Scientific Name	Planting Rate
Annual Ryegrass	*Lolium perenne* ssp. *multiflorum* (Lam.) Husnot	20 lbs bulk/acre
Bahiagrass	*Paspalum notatum* Fluegge	20 lbs bulk/acre
Browntop Millet	*Brachiaria ramosa* (L.) Stapf	40 lbs bulk/acre (1996) 15 lbs bulk/acre (1997)
Tall Fescue	*Lolium arundinaceum* (Schreb.) S.J. Darbyshire	20 lbs bulk/acre
Partridge Pea	*Chamaecrista fasciculata* (Michx.) Greene	5 lbs PLS/acre
Trailing Wildbean	*Strophostyles helvula* (L.) Ell.	10 lbs PLS/acre

Table 2 lists the seed mixtures that were used at each planting date. Two different fall planting mixtures were tested; annual ryegrass was used in both years to provide immediate cover, but in 1995 bahiagrass was used as the perennial grass component and in 1996 tall fescue was used for this purpose. Seed mixtures used in spring 1996 and 1997 contained the same species in both years, with browntop millet providing temporary cover and bahiagrass providing permanent cover. All planting dates included seed mixtures with partridge pea and trailing wildbean planted alone (seed mixes 1 and 2, respectively) and in combination (seed mix 3).

Germination of both species has been shown to be improved by scarification (Graham, 1941; Everitt and Heizer, 1984). However, fall planted seed was not scarified because normal weathering processes provided the necessary seed coat modification, and only one half of the spring planted seed was mechanically scarified to prevent total loss in case of a late frost. Neither of the legumes was inoculated prior to planting.

The planting site was disked thoroughly to remove existing vegetation and cultipacked prior to planting. The seed mixtures were broadcast by hand on the soil surface in each plot. Actual planting dates were November 9, 1995; May 7, 1996; September 24, 1996; and April 9, 1997. Treatments included a mulched and unmulched plot for each seed mixture. The mulch treatments used were a rate of 1.5 tons of clean straw mulch per acre that was hand broadcast over the plot. Following FOTG (SCS, 1991) recommendations for critical area plantings, each plot received 13-13-13 fertilizer at a rate of 600 lb/acre at planting. However, no lime was applied to the plots. After planting, plots were cultipacked again to lightly incorporate the seed. The plots received no further management after planting.

Table 2. Planting date and seed mixtures tested.

Planting Date	Seed Mix 1	Seed Mix 2	Seed Mix 3
Fall 1995	Annual Ryegrass Bahiagrass Partridge Pea	Annual Ryegrass Bahiagrass Trailing Wildbean	Annual Ryegrass Bahiagrass Partridge Pea Trailing Wildbean
Spring 1996	Browntop Millet Bahiagrass Partridge Pea*	Browntop Millet Bahiagrass Trailing Wildbean*	Browntop Millet Bahiagrass Partridge Pea* Trailing Wildbean*
Fall 1996	Annual Ryegrass Tall Fescue Partridge Pea	Annual Ryegrass Tall Fescue Trailing Wildbean	Annual Ryegrass Tall Fescue Partridge Pea Trailing Wildbean
Spring 1997	Browntop Millet Bahiagrass Partridge Pea*	Browntop Millet Bahiagrass Trailing Wildbean*	Browntop Millet Bahiagrass Partridge Pea* Trailing Wildbean*

* One half of the seed was mechanically scarified before planting.

Plots were evaluated monthly during the growing season in 1996 and bimonthly during 1997 and 1998, until August 1998 when the study was concluded. In 1996, an estimate of percentage of the plot area with seedlings present was taken for all species. In 1997 and 1998, estimates of plot coverage were made for each species. Because of the radically different growth forms of the legumes (partridge pea is erect or spreading and trailing wildbean is a twinning vine), the percent cover was estimated for these species based on observations of comparable coverage of stands in fields planted to each species alone, rather than on true percent ground coverage. This system offered a fairly accurate estimate of the performance of these species without bias based on growth habit. Notes on weed species were also taken throughout the study period.

Only data on the legume species was subjected to analysis of variance because the performance of these species was the objective of this study. Data from the mid-summer evaluation date was selected for analysis because this was the period of maximum stand values for these species, except for the 1996 evaluation of the spring 1996 planting, where a fall evaluation was used because excessive browntop millet growth delayed germination of the legume species. These evaluation dates were July 24, 1996 (Fall 1995 planting); October 4, 1996 (Spring 1996 planting); July 23, 1997 (all plantings); and June 8, 1998 (all plantings). Two sets of analyses were performed. To compare the effect of mulch versus no mulch and stand persistence, data from all evaluation years was analyzed, with each species, planting date, and evaluation year analyzed separately. To determine the effect of planting date, data on each species from the first evaluation (establishment) year was averaged across mulch treatments with species analyzed separately. A mean separation test was not required, because in all cases, only two means were compared.

RESULTS AND DISCUSSION

Grass cover crop establishment - The fall and spring cover crops did not behave similarly in both planting years. In the fall 1995 plots, annual ryegrass did not become well established due to the late planting date, but it became well established in 1996. Also the mulch treatment appeared to suppress annual ryegrass growth in the fall 1995 plots and favored weed growth. Fall ratings in 1995 showed only a 5 to 15 percent stand and winterkill was noted. Spring ratings ranged from less than 5 to 30 percent stands, with the increase probably due to some late germination. In 1996, seed was planted earlier and establishment was much better. Fall ratings showed a 100 percent stand in all plots and spring ratings ranged from 80 to 90 percent. As would be expected, annual ryegrass was not found in the plots in significant numbers in subsequent evaluation years.

Two different perennial grasses were tested in the fall plantings, so there is only one set of data for each species. Bahiagrass planted in 1995 did not become established in the plots until 1997, when stands ranged from 0 to 10 percent. Ratings in 1998 ranged from 0 to 40 percent; however, weed growth was quite dense in these plots in that year and probably suppressed establishment of bahiagrass. None of the tall fescue planted in 1996 became established in the plots. This is probably due to intense competition from the annual ryegrass and other species present in the plots. Billingsley and Grabowski (1996) found that tall fescue initially became established, but subsequently succumbed to competition in similarly unmanaged plots. Bahiagrass appears to be much better suited for use in fall seed mixtures for critical area plantings such as these that will receive no mowing or weed control; however, an annual species to provide temporary cover is critical to prevent erosion and limit weed growth until the bahiagrass becomes established.

In the spring 1996 planting, browntop millet stands ranged from 50 to 100 percent, with 100 percent stands in more than 70 percent of the plots. As mentioned previously, this dense growth delayed germination of the legume species. The browntop millet stands were much lower in the 1997 planting due to the reduced planting rate. Stand percentages taken in the summer of 1997 ranged from 3 to 40 percent, with half the plots containing less than a 5 percent stand. As expected, establishment of the legumes was not affected by browntop millet in this planting year. Browntop millet was not found in any plots in subsequent evaluation years. In 1996, mulch did appear to have a slightly adverse effect on germination of browntop millet; however, in 1997 stands were better on the mulched than on the unmulched plots. Possibly there was a lack of adequate moisture for germination in 1997 that was somewhat ameliorated by the mulch treatment. These results indicate that the lower planting rate of 15 lb/acre was more desirable because it allowed earlier establishment of the legume species.

As was found for the fall planted plots, bahiagrass did not become established in the plots until the year following spring planting (second growing season). Fall 1997 ratings of the 1996 planting did show that bahiagrass was present in a few of the plots. Mid-summer ratings in 1998 ranged from 0 to 30 percent stand, with a majority of the plots in the 10 to 20 percent range. The spring 1997 planting showed a similar trend, however, bahiagrass stands developed more quickly in these plots. Ratings taken in late summer of 1998 ranged from 5 to 50 percent stands, with most falling in the 20 to 30 percent range. One trend that was apparent was that plots with denser stands of bahiagrass had a lower number of the tested legumes that were able to become reestablished in subsequent years. With the stands of cover crops and weed growth present, soil erosion was not noted on any of the plots.

Weed growth - Weed species recorded were those that would be expected in the study area. Because the test site did not experience the extreme soil disturbance typical of many critical area planting sites, weed diversity and populations may have been greater than those which would have developed in a normal critical area planting. In the establishment year following soil disturbance, the main weeds were crabgrass (*Digitaria* spp.) and common ragweed (*Ambrosia artemisiifolia* L.). The fall planted plots also had some winter annuals, such as chickweed (*Stellaria* spp.) and cranesbill (*Geranium carolinianum* L.). In later evaluation years, ragweed was often still present, but goldenrod (*Solidago* spp.), sericea lespedesa [*Lespedeza cuneata* (Dum.-Cours.) G. Don], and joe-pye weed (*Eupatorium* spp.) began to become prevalent. By the summer of 1998, the 1995 fall planting had a dense stand of these weeds which was 4 to 6 feet tall.

Legume establishment - Table 3 shows the effect of mulch versus unmulched treatments. In the establishment year there was a trend towards greater stands of both legume species in the mulched plots, although this trend was not significant, except for the trailing wildbean percentages for the fall 1995 planting of seed mixture 2. Billingsley and Grabowski (1996) found that partridge pea germination was not improved by straw mulch; however, the amount of mulch used in that study was three tons, twice the rate used in this study. It appears that this lower rate of mulch did have a beneficial effect on establishment of these legumes. Since soil erosion and potential seed washing were not apparent on these plots, the beneficial effect can probably mainly be attributed to improved moisture conditions in the mulched plots. Everitt and Heizer (1984) found that germination of partridge pea seed was sensitive to moisture stress. Mulch treatments also decrease temperature fluctuations in the underlying soil, which may have had some beneficial effect on germination of the legumes. The negative effect of the mulch on the annual cover crop species could also have contributed to the increased legume populations. This beneficial effect of mulching noted for the legumes was still somewhat evident in the second year after planting. It is not known if this was caused by the mulch itself or by the fact that the greater number of plants in those plots in the previous year created a larger potential seed bank.

By the third evaluation year, stands of both species from the fall 1995 and spring 1996 planting had decreased markedly. This can be attributed to the dense weed growth noted above. This indicates that these legumes cannot persist without some form of management to allow seedling reestablishment. Graham (1941) stated that trailing wildbean cannot withstand competition from other species and he noted that germination of partridge pea is improved by light disking. In later evaluation years, trailing wildbean stands were much higher in the alleyways that were mowed periodically than in the adjacent plots. This indicates that carefully timed mowing is a possible management technique to improve persistence of these legumes and improve wildlife benefits of the planting. Partridge pea seed germination has also been shown to respond positively to burning (Grelen and Hughes, 1984). Another technique that could possibly be used on large-sized plantings to improve germination of these species and improve wildlife habitat without significantly increasing erosion potential is strip disking, where a few widely separated narrow strips are disked within the field to provide potential legume germination sites (Stewart and Burger, 1996).

Partridge pea stand ratings were generally higher than those of trailing wildbean. This result is not unexpected because partridge pea is an early succession colonizing species (Grelen and Hughes, 1984) well adapted to this type of planting situation. Mixing both species in seed mixture 3 did appear to have a somewhat negative effect on trailing wildbean germination, which again can probably be attributed to the competitive effect of the larger partridge pea. Partridge pea also has a greater capability to increase its distribution throughout the planting site, due to its greater seed production and explosive dehiscence. In later evaluation years, partridge pea was often found invading plots in which it was not originally planted, but wildbean did not spread as far from its initial planting site, especially in areas where there was a great deal of competition from other plants.

Table 3. The effect of mulch (M) versus unmulched (U) treatments on partridge pea (CHFA2) and trailing wildbean (STHE4) percentage of plots with seedlings present or percent plot coverage for three seed mixtures throughout the study period.

Plant Year	Season	Eval. Year	Seed Mix 1		Seed Mix 2		Seed Mix 3			
			CHFA2		STHE4		CHFA2		STHE4	
			U	M	U	M	U	M	U	M
			% seedlings in plot							
1995	Fall	1996	7	17	4b	9a*	5	22	5	7
			% cover							
		1997	41	60	14	3	34	45	1	3
		1998	5	4	1	0	16	2	0	0
			% seedlings in plot							
1996	Spring	1996	6	2	1	4	4	1	0	1
			% cover							
		1997	37	50	10	12	43	35	6	6
		1998	10	21	8	8	7	11	13	9
			% cover							
1996	Fall	1997	43	33	53	47	43	38	33	37
		1998	47	38	3	0	63	43	5	5
			% cover							
1997	Spring	1997	14	32	6	13	17	30	3	12
		1998	27	22	4	7	37	33	2	3

*Treatment means in the same row and pair of columns that are followed by different letters are significantly different at P≤0.05.

Tables 4 and 5 show the effect of planting season on these legumes. Fall planting resulted in greater stands of both species, which was significantly different for several of the seed mixtures and planting dates. This result was unexpected because Everitt and Heizer (1984) found that partridge pea germination was sensitive to temperature and it germinated best at daytime temperatures of 20°C or above. They suggested that because of these results, partridge pea should be planted in mid to late spring for best germination. The optimum germination temperatures for trailing wildbean have not been documented, but production experience at the PMC has shown that this species should also be planted in the spring. The fact that only half of the seed lot was scarified before planting may be the most likely reason that stands were lower for the spring planting treatments. The fall planting treatment would have had ample time for the entire seed lot to naturally scarify in the soil due to weathering processes. Whether late frosts would have caused more damage to plant stands if the entire seed lot for the spring plantings had been scarified is not known.

Table 4. Comparison of spring and fall planted partridge pea (CHFA2) and trailing wildbean (STHE4) percentage of plot with seedlings present for three seed mixtures.

Plant Year	Season	Seed Mix 1	Seed Mix 2	Seed Mix 3	
		CHFA2	STHE4	CHFA2	STHE4
		% seedlings in plot			
1995	Fall	12	7	13	6a*
1996	Spring	4	3	3	1b

*Treatment means in the same column followed by different letters are significantly different at P≤0.05.

Table 5. Comparison of spring and fall planted partridge pea (CHFA2) and trailing wildbean (STHE4) percent plot coverage for three seed mixtures.

Plant Year	Season	Seed Mix 1	Seed Mix 2	Seed Mix 3	
		CHFA2	STHE4	CHFA2	STHE4
		------% cover------			
1996	Fall	38	50a*	41a	35a
1997	Spring	23	10b	24b	8b

*Treatment means in the same column followed by different letters are significantly different at $P \leq 0.05$.

CONCLUSIONS

The results of this study indicate that either or both of these legumes can be utilized for spring or fall critical area plantings. For maximum germination, spring plantings should be made after danger of frost is past and the seed should be scarified before planting. Of the two legumes tested, partridge pea is probably the best suited for low input critical area plantings. However, both species will function only as short-term components of the planting mixture unless some management techniques are utilized to allow reseeding. Tall fescue was not able to become established in these plots and probably should not be recommended for inclusion in fall seed mixes on sites where excessive plant competition is anticipated. Bahiagrass is slow to establish, but will provide suitable erosion control when planted in either spring or fall with a companion annual grass species. The FOTG recommended critical area planting rate for browntop millet of 15 lb/acre should be used for spring seed mixes, because higher rates can prevent germination and establishment of these legumes. Annual ryegrass in the fall seeding mixture did not have a noticeable effect on germination of the legume species. The straw mulch used in this study did appear to be beneficial for establishment of the legumes, but suppressed germination of some of the grass cover crops.

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