Legume Cover Crop Development by NRCS and Auburn University

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ABSTRACT

Winter-season legume cover crops are an essential component of crop management practices such as conservation tillage and organic farming systems. Hairy vetch *(Vicia villosa* L.) and crimson clover (*Trifolium incarnatum* L.) are among the best known species used as cover crops. Caley pea (*Lathyrus hirsutus* L.) is a cool-season annual legume that can be successfully grown in areas too wet or too calcareous for most annual clovers, but is also tolerant of mildly acid soils. The objective of this work was to develop and release new cultivars from early flowering selections of hairy vetch and crimson clover and a caley pea adapted to the lower South. Plant material selected was originally collected by NRCS in the southeastern USA. The hairy vetch cultivar AU EarlyCover was released in 1994. It flowers 23 to 36 days earlier than common hairy vetch. The crimson clover cultivar AU Sunrise was released in 1997. It is a cultivar that flowers 5 to 18 d earlier than AU Robin, the earliest crimson clover cultivar available in the market, and 12 to 28 d earlier than Tibbee. The caley pea cultivar AU GroundCover was released in 1994. AU GroundCover yielded as much forage as common hairy vetch.

KEYWORDS

Cover crops, early maturity, dry matter yield, crop rotation

INTRODUCTION

For many decades farmers in the Southeastern United States have utilized legumes in crop rotations to increase organic carbon and nitrogen content in the soil, thus improving soil fertility and water-holding capacity. However, beginning in the 1960's, the availability of relatively inexpensive chemical fertilizers contributed to the decline in the use of forage legumes as a nitrogen source. More recently, there has been renewed interest in these plants due to use as mulches for organic farming (Teasdale and Abdul-Baki, 1997), economic pressure to improve animal performance and lower nitrogen costs in forage/livestock production, and because of the soil and water conservation benefits observed in systems that use conservation tillage for grain production.

Winter-season legume cover crops are an essential component of crop management practices such as conservation tillage and organic farming systems. Hairy vetch and crimson clover are among the best known species used as cover crops. Hairy vetch is a winter annual legume which is extensively used as a cover crop because of the soil and water conservation benefits it provides, and because it is an inexpensive source of nitrogen in conservation tillage systems. However, a major limitation in its use in the lower South (South of the Tennessee border with Alabama, Mississippi, and Georgia) was that the types commercially available mature (bloom) in late spring. Hence, a substantial portion of its potential is not realized because row crop land must be sprayed with a herbicide or turned well before maximum vetch dry matter yields have been attained. Crimson clover is also a winter annual particularly well adapted to the lower South. There has been a growing interest in planting early flowering types because of their reseeding potential and subsequent reduction in seeding costs (Reeves, 1994).

Caley pea, also called wild winter pea, singletary pea, or roughpea, is a cool-season annual legume introduced from the Mediterranean region. For many years this plant has been used in the southeastern U.S.A. as a livestock forage as well as a cover crop despite the fact that no cultivars have been commercially available. When farmers have been able to locate a commercial source of seed, it has most commonly been a mixture of vetch and caley pea.

Caley pea is mostly grown on heavy clays of the lower Mississippi Delta and on calcareous clays of the Alabama and Mississippi Black Belt areas, where it is superbly well adapted and has readily reseeded. Research has shown that when caley pea is seeded into johnsongrass in the autumn, the following season's growth of johnsongrass greatly benefits from the nitrogen fixed by the legume. Forage

IN E. van Santen (ed.) 2002. Making Conservation Tillage Conventional: Building a Future on 25 Years of Research. Proc. of 25th Annual Southern Conservation Tillage Conference for Sustainable Agriculture. Auburn, AL 24-26 June 2002. Special Report no. 1. Alabama Agric. Expt. Stn. and Auburn University, AL 36849. USA.

yield of johnsongrass is much higher when grown with caley pea than with other cool-season legumes, and the forage production season is lengthened by the legume (Scarsbrook *et al*., 1963). Also, caley pea has been successfully grown for silage.

Caley pea can be successfully grown in areas too wet or too calcareous for most annual clovers, but is also tolerant of mildly acid soils. It is useful as a temporary ground cover and green manure crop on land, which is to be replanted to another crop in mid to late spring as a source of nitrogen and spring forage in johnsongrass and dallisgrass hayfields or pastures and as a wildlife plant. The objective of this work was to develop and release new cultivars from early flowering selections of hairy vetch and crimson clover and a caley pea adapted to the lower South.

MATERIAL AND METHODS

Hairy vetch

Accession 9053961 collected in Henry County Alabama was used as the base population from which 33 plants were initially selected because they were earlier blooming and had higher vigor and uniformity. Recurrent restricted phenotypic selection was utilized to improve the population. The main selection criterion during the three cycles of selection was early flowering date. Additional traits considered during the selection process were vigor, pest resistance, and uniform morphological traits. Three populations, selected after progeny testing, were used to create this composite.

Extensive testing for forage yield, maturity, canopy height, composition, and diseases of selected hairy vetch populations was conducted throughout Alabama (Winfield, Belle Mina, Marion Junction, Monroeville and Tallassee) and in Americus, Georgia.

Crimson clover

The crimson clover cultivar was developed using recurrent restricted phenotypic selection from a population consisting of 11 crimson clover accessions collected in Alabama, Florida, Georgia, and South Carolina. The population was subjected to three cycles of selection but cycle 2 was eventually released. The main selection criterion during the selection cycles was early flowering date. Additional traits considered during the selection process included vigor (plant size and overall health) and uniformity of morphological traits.

Starting in 1994, extensive testing for maturity, forage yield, canopy height, protein content, and disease susceptibility of AU Sunrise was conducted throughout Alabama (Winfield, Belle Mina, Marion Junction, Prattville, Brewton and Tallassee) and at Americus, Georgia.

Caley pea

The new cultivar had its beginning in 1983 when a collection of caley pea and other legume cover crops was assembled at the Americus Plant Material Center for initial screening. Starting in 1989, extensive testing for forage yield, maturity, canopy height, composition, and diseases of selected caley pea ecotypes was conducted throughout Alabama (Winfield, Belle Mina, Marion Junction, Monroeville and Tallassee) and in Americus, Georgia.

A randomized complete block design with four replications was used in all field experiments. Data were subjected to ANOVA.

RESULTS AND DISCUSSION

Hairy vetch

The three populations performed quite well in clipping trials at each location. Thus, they were pooled to create the cultivar AU EarlyCover, which was released in 1994. This cultivar is an excellent cover crop because of its early growth (Table 1). When AU EarlyCover is harvested or incorporated into the soil as a green manure on or around April 1 (about the time when many lower South farmers get ready to plant corn), it has a dry matter yield comparable or superior to the common type hairy vetch (Table 2). By mid-February, when common hairy vetch has little accumulated growth, AU EarlyCover can have 150 to 200 lb. per acre of dry matter; therefore, it can be turned earlier than common hairy vetch.

AU EarlyCover could also be a better choice in many cases when hairy vetch is used for forage purposes. It is a common practice for hairy vetch to be used as a legume companion with small grain, which is to be cut for silage or hay. AU EarlyCover will work better in such a situation

Table 1. Canopy height and forage dry matter yield of vetches grown at Tallassee and Americus and harvested February 15, 1993.

	Tallassee		Americus	
Cultivar	Canopy Height	Dry matterYield	Canopy Height	Dry matterYield
	-- inch --	-- lbs acre^{-1} --	-- inch --	-- lbs acre^{-1} --
AU EarlyCover	10.6	206.3	13.3	153.6
Common	5.5	11.6	3.9	48.2
$MSD_{0.05}$	3.0	82.2	1.6	55.4

Table 2. Forage dry matter yield of AU EarlyCover and common type hairy vetch at six locations around April 1 in 1992 (mean of 3 lines) and 1993.

	1992		1993	
Location	AU EarlyCover	Common	AU EarlyCover	Common
	---------- lbs DM acre^{-1} ----------			
Tallassee	808	763	910	605
Americus	1288	1090	1118	722
Winfield	582	431	†	†
Belle Mina	1560	2571	2706	2653
Marion Junction	1339	806	1234	834
Monroeville	3071	1965	2084	2740
Average	1456	1271	1611	1446

† Plants were killed by frost, except for the common type that was not killed but was damaged.

because its maturity (and thus the optimum harvest date) better matches that of the small grains. If hairy vetch is to be used in a pasture, AU EarlyCover would be a better choice when early grazing is desired.

AU EarlyCover flowers 23 to 36 days earlier than common hairy vetch (Table 3). Nitrogen content of AU EarlyCover is about 270 g kg^{-1} (dry matter basis) on or near April 1. AU EarlyCover has longer leaflets than common hairy vetch. Its stems are pubescent (covered with short soft hair) at the seedling stage, whereas common hairy vetch has glabrous (no hair) stems. AU EarlyCover is well adapted to the Central and Southern part of Alabama and Georgia.

Crimson clover

Cycle 2 was found to be better than AU Robin and was released as AU Sunrise in 1997. Results from two years of testing showed that AU Sunrise is a cultivar that flowers 5 to 18 d earlier than AU Robin, the earliest crimson clover cultivar available in the market, and 12 to 28 d earlier than Tibbee (Tables 4 and 5). AU Sunrise would be an excellent cover crop because of its early growth. It is well-adapted to Alabama and Georgia. Forage yields across all locations of AU Sunrise compared to AU Robin were 151%, 81%, and about the same in 1994, 1995, and 1996, respectively. Crude protein content measured in late March of 1996 was the same in both cultivars (about 200 g kg^{-1}). This cultivar did not show any particular resistance to diseases beyond those typical of the species.

AU Sunrise plants are erect and the canopy is open. Leaflets have serrate margins and are obovate in shape, with the narrower end at the base. Stems are completely covered by white, short, fine hairs. Approximately half of the plants have green stems, whereas the remaining plants have stems that are green with some red. The population has ovate, yellow seeds.

Caley pea

Several accessions performed very well in clipping trials at each location. Thus, the cultivar AU GroundCover was released in 1994. AU GroundCover yielded as much forage as common hairy vetch (Table 6) (differences were not significant). This new cultivar has a crude protein content of about 20% at flowering time. AU GroundCover and common hairy vetch flower at about the same time. AU GroundCover plants have purplish flowers, light green foliage and develop a canopy nearly 30 inches tall at flowering time. Hard seed coats allow natural reseeding when stands are not heavily grazed during the seed production period. Initial stand establishment should be done with scarified seed.

Table 3. Number of days to 75% bloom (counted from March 1) at Tallassee and Americus in 1992 (mean of 3 lines) and 1993.

Cultivar	Tallassee	Americus	Average
	---------- days after March 1 ----------		
1992			
AU EarlyCover	46.4	32.3	39.0
Common	69.5	68.8	69.1
1993			
AU EarlyCover	42.3	32.5	36.7
Common	74.0	†	74.1

† Plots were lost

Table 4. Days to 50% flowering of eight crimson clover entries in 1994 (counted from Feb. 1)
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Entries	Tallassee	Americus	Prattville	Marion Junction	Belle Mina	Brewton	Average
	---------- days after February 1 ----------						
AU Sunrise	58.0	42.0	55.5	60.7	†	37.0	50.6
AU Robin	63.0	51.0	59.7	68.2	†	49.5	58.2
Cycle 1	58.0	42.0	56.7	63.0	†	42.0	52.3
Cycle 3	58.0	42.0	54.7	61.5	†	37.0	50.6
Tibbee	70.0	61.5	70.5	74.0	†	56.5	66.5
Flame	70.0	59.0	70.5	71.5	†	54.0	65.0
Chief	70.0	61.5	70.5	72.0	†	55.5	65.9
Dixie	70.0	62.7	70.2	72.5	†	55.7	66.2
MSD $_{(0.05)}$	0.1	2.1	1.0	1.7		0.7	
Difference between AU Sunrise and AU Robin							
	5	9	4.2	7.5		12.5	7.6

† Lost Data.

Table 5. Days to 50% flowering of eight crimson clover entries in 1995 (counted from Feb. 1) .

Entries	Tallassee	Americus	Prattville	Marion Junction	Belle Mina[1]	Brewton	Average
	---------- days after February 1 ----------						
AU Sunrise	51.0	49.5	55.0	45.0	55.0	33.7	48.2
AU Robin	58.0	55.0	66.0	53.5	64.0	52.0	58.0
Cycle 1	51.0	50.5	55.0	45.5	55.0	34.2	48.5
Cycle 3	51.0	50.0	55.0	43.0	55.0	31.0	47.5
Tibbee	76.0	65.0	69.0	65.5	69.0	61.7	67.7
Flame	76.0	63.2	68.5	66.2	69.0	62.2	67.5
Chief	76.0	66.0	69.0	64.5	69.0	64.0	68.0
Dixie	76.0	65.0	69.0	66.0	69.0	63.7	68.1
MSD $_{(0.05)}$	0.1	1.9	0.3	2.6	0.1	0.8	
Difference between AU Sunrise and AU Robin							
	7	5.5	11	8.5	9	18.3	9.8

Table 6. Mean forage dry matter yield of the five accessions that make up AU GroundCover and of common hairy vetch at six locations in 1992 and 1993.

Entry	1992	1993
	----- lbs acre^{-1} ------	
AU GroundCover	3169	3159
Common hairy vetch	3748	2837
$MSD_{0.05}$	NS	NS

CONCLUSIONS

Plant material selected was collected in the Southeast has potential for producing superior cultivars. The hairy vetch cultivar AU EarlyCover released in 1994 flowers 23 to 36 days earlier than common hairy vetch. The crimson clover cultivar AU Sunrise released in 1997 is a cultivar that flowers 5 to 18 d earlier than AU Robin, the earliest crimson clover cultivar available in the market, and 12 to 28 d earlier than Tibbee. The caley pea cultivar AU GroundCover released in 1994 yielded as much forage as common hairy vetch.

LITERATURE CITED

Mosjidis, J. A., C. M. Owsley, M. S. Kirkland, and K. M. Rogers. 1995. Registration of 'AU EarlyCover' Hairy Vetch. Crop Science 35:1509.

Mosjidis, J. A., C. M. Owsley, M. S. Kirkland, and K. M. Rogers. 1996. Registration of 'AU GroundCover' Caley Pea. Crop Science 36:207.

Mosjidis, J. A., C. M. Owsley, M. S. Kirkland, and K. M. Rogers. 2000. Registration of 'AU Sunrise' Crimson Clover. Crop Science 40:290.

Reeves, D.W. 1994. Cover crops and rotations. p. 125-172. *IN* J.L. Hatfield and B.A. Stewart (eds.). Crops residue management. Lewis Publishers. Boca Raton, Florida.

Scarsbrook, C.E., L.A. Smith, and H.W. Grimes. 1963. Nitrogen - Profitable for johnsongrass. Highlights of Agriculture Research 10:4.

Teasdale, J.R. and A.A. Abdul-Baki. 1997. Growth analysis of tomatoes in black polyethylene and hairy vetch production systems. HortScience 32:659-663.