

REVIEW OF 'AU SUNRISE' CRIMSON CLOVER

INTRODUCTION

Since the middle of the 20th century, agriculturists have studied numerous cool season legumes for cover crops, conservation tillage, green manure, forage, and wildlife food. Many agronomists recognized the value of incorporating early developing legumes into modern farming practices. Since much of the beneficial nitrogen produced by cool season legumes is assimilated by flowering time these precocious legumes could provide added flexibility to farmers and land managers in their effort to design plans to meet the challenges of the 21st century.

In 1997, the USDA - Natural Resources Conservation Service's (NRCS) Jimmy Carter Plant Materials Center (PMC), Americus, Georgia; Auburn University, and the Alabama Agricultural Experiment Stations released 'AU Sunrise' crimson clover (*Trifolium incarnatum* L.) an early developing cultivar (Mosjidis et al., 2000).

It is anticipated that the utility and importance of 'AU Sunrise' and other cool season legume cultivars will increase with the continued rise in energy costs. When used as a cover crop, 'AU Sunrise' can provide an early maturing source of nitrogen for row production.

The cost of manufacturing and transporting nitrogen fertilizer to is expected to increase, forcing the manufactures to pass the increase onto the consumer. This trend of increased fertilizer costs and perhaps fertilizer shortages may continue for the immediate future. The use of cool season legumes such as 'AU Sunrise' can provide a source of renewable nitrogen for many farmers and land managers and may become a vital link in a future energy saving policy for the United States.

The following is a history of the methodology used by NRCS, Auburn University and the Alabama Agricultural Experiment Station in developing 'AU Sunrise' crimson clover.

METHOD OF GERMPLASM DEVELOPMENT

A recurrent restricted phenotypic selection (RRPS) breeding method was employed utilizing 11, early blooming crimson clover accessions that had been observed in initial evaluation block at the Jimmy Carter Plant Materials Center in 1987. Selection pressure was for vigor, growth, disease resistance and especially early bloom date.

Equal amount of seed was collected from these 11 elite accessions and bulked (Cycle 0). Six hundred and seventy (670) seedlings were planted on 19 October 1987 on a 3' x 3' grid system at the PMC. On 31 March 1988, the 670 plants were rouged according to selection criteria (vigor, growth, disease resistance and early bloom). Two hundred plants

were selected that displayed the desired phenotypic characteristics. Seed was collected from these 200 plants on 4 May 1988 and recognized as Cycle 1.

On 24 October 1988 seedlings from each of the 200 selected plants (lines) were planted to a stratified grid at the PMC. Each of the 200 lines was randomly planted to five replications within the grid. This produced a total of 1,000 individual plants on a 2' x 2' spacing within the rectangular grid. The grid consisted of 40 blocks with each block containing 25 plants. Rows of 'Tibbee' crimson clover seedlings were planted around the grid for comparison and as a border to keep competition equal within the block.

Five plants from each 25 plant grid were selected for early bloom, vigor, growth and disease resistance on 14 February 1989. All other plants in the grid were removed. After cross-pollination had occurred, seed from each of the selected plants (200) were harvested. After selection for seed production, seed from 180 lines constituted Cycle 2.

A similar procedure was employed in 1990 which produced Cycle 3.

COMPARATIVE TESTING IN ALABAMA AND GEORGIA

Recurrent restricted phenotypic selection produced three cycles of early blooming crimson clover. These cycles (cycle 1, cycle 2, and cycle 3) were compared to several commercial crimson clovers for bloom date, yield and crude protein content. The tests were conducted in 1994-1996 throughout Alabama (Belle Mina, Marion Junction, Prattville, Brewton, and Tallassee) and at the PMC, Americus, Georgia. These test sites range from North Alabama through Central and South Alabama and South Georgia. Test locations include Major Land Resource Areas (MLRA) of Limestone Valley and Uplands, Black Belt, Coastal Plains of Alabama and Upper Coastal Plain of Georgia. All locations utilized a randomized complete block design with four replications. Plot size was 5' x 20' and seed was broadcast applied at 20 lb/acre. Standard clipping procedures were used to determine dry matter yield.

RESULTS

Results from two years of testing have shown that cycle 2, which was released as 'AU Sunrise', flowers 5 to 18 days earlier than 'AU Robin' (an early blooming variety), and 12 to 28 days earlier than 'Tibbee' crimson clovers (Tables 1 and 2). Biomass yield of 'AU Sunrise' was 151 %, 81 % and about the same when compared to 'AU Robin' in 1994, 1995, and 1996, respectively (Tables 3-4). Crude protein content measured in 1995 was the same in the two cultivars ('AU Sunrise' 20.3% and 'AU Robin' 20.1%).

Since the release of 'AU Sunrise' several researchers have conducted work utilizing this material. 'AU Sunrise' is considered the earliest maturing of the crimson clover cultivar varieties available on the market (Mosjidis, 2001). Andrae (2004) stated 'AU Sunrise', 'AU Robin' and 'Flame' crimson clovers all tend to produce forage earlier in the season

than 'Dixie'. Tests in North-Central Texas comparing annual *Medicagos* and *Trifoliums* indicated 'AU Sunrise' was among the highest producers of acid detergent fiber at 10 cm height in 2000. It was also found to be among the highest at 2 inches and 4 inches height in 2001 (Muir et al., 2005). A preference trial utilizing cool-season annual clovers was conducted with meat-type goats in the lower Piedmont-upper Coastal Plain region of Georgia. In spring 2001, experiment #1 indicated 'Dixie' and 'AU Robin' crimson clovers were most preferred, while 'AU Sunrise' was ranked intermediate. In experiment # 2, 'AU Sunrise' and 'Dixie' were most preferred in the first cutting. Crimson clover appeared to be useful forage for winter-spring grazing of goats in the southeastern U.S. (Terrill et al., 2002). Cook and Gray (2005) list 'AU Sunrise' as one of the recommended crimson clover varieties for use in white-tailed deer food plots.

Additional research is needed to determine the suitability of 'AU Sunrise' as a cover crop in conservation tillage systems for row crop production in the southeastern U.S.

CRIMSON CLOVER TESTS IN 1994, 1995 AND 1996

Table 1. Days to 50 percent flowering (counted from Feb. 1) of eight crimson clover entries 1994.

Entries	Tallassee	Americus	Prattville	Marion Junction	Brewton	Mean
	-----days-----					
Cycle 2	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	.7	
Difference between Cycle 2 and AU Robin (days)						
	5	9	4.2	7.5	12.5	7.6

Table 2. Days to 50 percent flowering (Counted from February 1) of eight crimson clover entries in 1995.

Entries	Tallassee	Americus	Prattville	Marion Junction	Belle Mina	Brewton	Mean
	-----days-----						
Cycle 2	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	62.0	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 Cycle 2 and AU Robin (days)							
	7	5.5	11	8.5	9	18.3	9.8

Table 3. Yield of first cut (early March to middle April depending on the location) of eight crimson clover entries in 1994 and 1995.

Entry	Year	
	1994	1995
	-----lb/acre-----	
Cycle 2	725	1805
AU Robin	480	2223
Cycle 1	660	1820
Cycle 3	698	1832
Tibbee	677	1919
Flame	524	1823
Chief	681	1988
Dixie	720	2135
MSD (0.05)	117	230

Table 4. Yield of first cut (early March to middle April depending on location) of eight crimson clover entries in 1996.

Entry	Americus	Prattville	Belle Mina	Brewton	Mean
	-----lb/acre-----				
Cycle 2	2712	783	794	1595	1471
AU Robin	2811	1107	819	1610	1587
Cycle 1	2799	859	919	1627	1551
Cycle 3	2737	516	718	1834	1451
Tibbee	2940	2099	1181	1563	1946
Flame	2397	2002	1293	1054	1686
Chief	2907	2148	1199	1428	1921
Dixie	2765	1855	1361	1507	1872
MSD (0.05)	NS*	572	273	251	

* Not significant

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