

**UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
AND
AUBURN UNIVERSITY
ALABAMA AGRICULTURAL EXPERIMENT STATION**

NOTICE OF RELEASE OF 'AU SUNRISE' CRIMSON CLOVER

The United States Department of Agriculture, Natural Resources Conservation Service, and the Auburn University Alabama Experiment Station announces the release of 'AU Sunrise' crimson clover, (Trifolium incarnatum L.).

Earlier in this century legume cover crops were in wide use. Farmers utilized various legumes for green manure crops throughout the Southeastern United States. These crops provided excellent cover for the prevention of soil erosion and they also produced valuable nitrogen for subsequent crops. With the popularity of commercial fertilizers, the use of legumes for green manure crops declined. However, agricultural scientists have again begun to do extensive work with cool season legumes for use on southern farms in conservation tillage systems.

In fall 1983, the Jimmy Carter Plant Materials Center, formerly the Americus Plant Materials Center, started to assemble and evaluate collections of cool season annual legumes, for use as cover crops in conservation tillage systems. The center used the initial evaluation block located on orangeburg sandy loam at Americus, Georgia to screen approximately 1,000 cool season annual legume accessions. These legumes included germplasm from several genera including Lathyrus, Trifolium, Vicia, and Medicago. They were assembled from foreign, as well as naturalized populations. All foreign accessions came through the plant introduction systems. The naturalized legumes were collected and processed by the Natural Resource Conservation Service personnel in the Southeastern United States. Each accession (a documented and numbered legume) was evaluated for adaptability, growth, vigor, winterhardiness, stand, reseeding ability, flowering date, seed production, disease resistance and insect resistance.

Much of the beneficial nitrogen produced by these legumes is assimilated by the time most cool season legumes flower. Therefore, it would be advantageous to develop various legume cultivars that display the early blooming characteristics, since this would allow for flexibility in conservation tillage systems. With this in mind, the Jimmy Carter Plant Materials Center began a program to develop new early blooming and early developing cool season annual legume cultivars for conservation tillage use.

In 1987 an evaluation field was established to select early blooming and early developing lines of crimson clover. This produced three cycles of early crimson clover. These cycles were tested against several commercial crimson clovers for forage yield, protein production and bloom date. These tests were conducted in 1994-1996 at six locations (Tallassee, Americus, Prattville, Belle Mina, Marion Junction, and Brewton). After analysis of data, Cycle 2 was selected as the most superior line. This cycle was later called 'AU Sunrise'.

RELEASE OF 'AU SUNRISE' CRIMSON CLOVER

Introduction:

Scientific Name: Trifolium incarnatum L.

Common Name: Crimson Clover

Varietal Name: 'AU Sunrise'

PI Number: 561943

Origin:

Accession: Origin

9016346	Madison Co., FL
9049682	Jefferson Co., FL
9039845	Mobile Co., AL - collected by David Steward, Section 32, Twn T4S, range 4W, Troup soil, 3% slope
9053017	Lowndes Co., GA - collected by Bob Glenn, west side of I-75 at route 22 on 5% slope
9053018	Tift Co., GA - collected by Bob Glennon, west side of I-75 at Exit 10 5% slope
9053019	Turner Co., GA - collected by Bob Glennon, west side of I-75 at Intersection with Rt 159, 5% slope
9053204	Leon Co., FL - collected by Bob Glennon section 10, Twn 1N, range 2E north side of I-10, 10.2 Mi. E. of Route 319, 10% slope
9053950	Cook Co., GA - collected by Bob Glennon on west side of I-75 at Exit 10, Lenox 5% slope
9053959	Henry Co., AL - collected by Ken Rogers sec 6, twn T4N, range 29E, 1/4 mi. S. of Hwy 134 on Co. Rd. 63
9054007	Colleton Co., SC - collected by Bob Glennon in median of I-85, .8 Mi. N of Rd 34, 20% slope
9054008	Dorchester Co., SC - collected by Bob Glennon roadside of I-95, 3.5 mi. N. of Rt 78, 20% slope

Description:

An erect cool season annual legume. It has expressed good growth, vigor, disease and insect resistance. It also expressed early bloom dates compared to commercial crimson.

Plant Ht 32 cm - 62 cm

Leaf Ln 5 mm - 46 mm

Wd 10 mm - 78 mm

Leaflet number = 3

Leaflet Ln 5 mm - 50 mm

Wd 3 mm - 36 mm

Leaflet shape obovate - narrower end at base

Leaflet margin serrate

Leaf color - dark green	40%
- green	44%
- green w/red tips	04%
- green w/yellow splotches	08%
- green w/yellow splotches and red tips	04%
Stem dia 1.0 mm - 4.0 mm	
Stem Ln 215 mm - 596 mm	
Stem color - green	48%
- green w/red	52%
Plant habit erect	
Foliage open	
Leaf surface smooth/dull	
Stipule Ln 8 mm - 23 mm	
Petiole Ln 9 mm - 158 mm	
Peduncle Ln 12 mm - 126 mm	
Leaflet hairs on top many, white, fine, short	
Leaflet hairs on bottom short, white, fine, less on bottom than on top	
Stem hairs white, short, fine, completely covering stem, many	
Petiole hairs white, short, fine, many	
Calyx hairs long, straight, white, many	
Mid bloom 3/31	
Bloom color red tips, pink middle, white base	
3-31 - two plants in field were white blooms - rogued. An average of two white plants in field per week since blooming began	
Inflorescence Ln 13 mm - 80 mm	
Wd 11 mm - 30 mm	
Flower Ln 5 mm - 15 mm	
Wd 1 mm - 4 mm	
Calyx Ln 4 mm - 10 mm	
Wd 2 mm - 4 mm	
Leaflet lateral Ln 11 mm - 38 mm	
Wd 8 mm - 35 mm	
Leaflet terminal Ln 13 mm - 40 mm	
Wd 10 mm - 36 mm	
Fruit placement Ht 13 cm - 64 cm	
Fruit head color pinkish gray to light brown	
Fruit head Ln 20 mm - 80 mm	
Wd 10 mm - 22 mm	
Fruit head shape cylindrical	
Seeds per head 11 - 96	
Seed shape ovate, oval with an eye about half way	
Seed color yellow	
Seed dia. .9 mm - 1.9 mm	
Seed coat smooth	
Maturity date 5/8/92	

Method of Development:

A recurrent restricted phenotypic selection (RRPS) breeding method was employed utilizing 11 crimson clover accessions. Cycle 2 (later called 'AU Sunrise') was developed from this process with selection criteria based on vigor, growth, disease resistance and especially early bloom date.

In 1987, 11 accessions of early blooming crimson clover (*T. incarnatum* L.), were observed in the initial evaluation block at the Jimmy Carter Plant Materials Center. Seed was collected from these accessions and equally bulked. On October 19, 1987, 670 seedlings from these seeds were space planted to a three foot by three foot grid system. On March 31 1988 the 670 plants were rogued for vigor and early bloom characteristics. Two hundred plants were selected that displayed the desired phenotypic characteristics. On May 4, 1988 seed from these 200 plants were collected individually. This seed was called Cycle 1.

On October 24, 1988 seedlings from each of the 200 selected plants (lines) were planted to a stratified grid at the Jimmy Carter Plant Materials Center. Each of the 200 lines were randomly planted to five replications within the grid. This produced a total of 1,000 individual plants on a two foot by two foot spacing within the rectangular grid. The grid consisted of 40 blocks with each block containing 25 plants. Rows of 'Tibbee' crimson clover seedlings were space planted around the grid for comparison and competition.

On February 14, 1989 five plants from each 25 plant block were selected for early bloom and vigor characteristics. 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.

Superior Characteristics:

Results from two years of testing have shown 'AU Sunrise' is a cultivar that flowers 5 to 18 days earlier than 'AU Robin' and 12 to 28 days earlier than 'Tibbee' crimson clover.

Conservation Use:

The primary conservation use of 'AU Sunrise' is a cover crop in conservation tillage systems and as early green manure crop for row crop plantings.

Area of Adaptation:

This cultivar is well adapted to Alabama and Georgia. Preliminary reports indicate 'AU Sunrise' can grow into Florida and Mississippi, however, further comparison testing will be required before the complete useful range of this cultivar is determined.

Disease and Insects:

This cultivar does not have any particular resistance to disease or insects beyond those commonly found in the species.

COMPARATIVE TESTING RESULTS

Conducted by:

Dr. Jorge Mosjidis, Auburn University Alabama Agricultural Experiment Stations and the staff of the United States Department of Agriculture, Natural Resources Conservation Service, Jimmy Carter Plant Materials Center.

Introduction:

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, Tallassee) and at the Jimmy Carter PMC, Americus, Georgia.

Materials and Methods:

All locations utilized a randomized complete block design with four replications. Approximately 20 pounds of seed per acre were applied to the plots. Standard clipping procedures were used to determine dry matter.

Results:

Starting in 1994, extensive testing for maturity, forage yield, canopy height, composition, and diseases of 'AU Sunrise' was done throughout Alabama (Belle Mina, Marion Junction, Prattville, Brewton, and Tallassee) and at Americus, Georgia. Results from two years of testing have shown that 'AU Sunrise' is a cultivar that flowers 5 to 18 days earlier than 'AU Robin', the earliest crimson clover cultivar available in the market, and 12 to 28 days earlier than 'Tibbee' (Tables 1 & 2). 'AU Sunrise' would be an excellent cover crop because it has great reseeding capability in addition to an early growth. It is well adapted to Alabama and Georgia. Forage yield measured of 'AU Sunrise' compared to 'AU Robin' was 151%, 81% and about the same in 1994, 1995, and 1996, respectively (Tables 3-5). Crude protein content measured late March of 1996 was also the same in the two cultivars (about 200 g kg).

Discussion:

The results indicate that 'AU Sunrise' can be used as an early legume cover by Southeastern United States farmers in conservation tillage systems.

CRIMSON CLOVER TESTS IN 1994, 1995 AND 1996

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

Entries	Tallassee	Americus	Prattville	Marion Junction	Belle Mina*	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		0.7	
Difference between Cycle 2 and AU Robin							
	5	9	4.2	7.5		12.5	7.6

* Lost data.

Table 2. Days to 50% flowering (counted from Feb. 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							
	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.

Entries	Mean
	lb/acre
Cycle 2	725
AU Robin	480
Cycle 1	660
Cycle 3	698
Tibbee	677
Flame	524
Chief	681
Dixie	720
MSD (0.05)	117

Table 4. Yield of first cut (early March to middle April depending on the location) of eight crimson clover entries in 1995.

Entries	Mean
	lb/acre
Cycle 2	1805
AU Robin	2223
Cycle 1	1820
Cycle 3	1832
Tibbee	1919
Flame	1823
Chief	1988
Dixie	2135
MSD (0.05)	230

CRUDE PROTEIN CONTENT measured in 1995: CYCLE 2: 20.3%. AU ROBIN 20.1%.

Table 5. Yield of first cut (early March to middle April depending on the location) of eight crimson clover entries in 1996.

Entries	Tal­lassee*	Americus	Prattville	Marion Junction*	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	

* Experiment lost.

Increase and Distribution:

Auburn University and Alabama Crop Improvement Association are seeking interested companies that would like to secure exclusive rights to the new cultivar.

Submitted by:

This recommendation for joint release of 'AU Sunrise' from USDA-NRCS, was prepared by Charles M. Owsley, Manager, Jimmy Carter Plant Materials Center, Malcome S. Kirkland, Assistant Manager, Jimmy Carter Plant Materials Center, and Donald Surrency, Plant Materials Specialist, Athens, Georgia.

Documentation was gathered by Dr. Jorge Mosjidis, Auburn University and Alabama Agricultural Experiment Station, and the staff at Jimmy Carter Plant Materials Center, USDA-NRCS, Americus, Georgia.

Initial evaluation was collected through efforts of Ken Rogers, Agronomist, USDA-NRCS, Auburn, Alabama.

Technology Transfer and Marketing Process:

All publicity will equally mention Jimmy Carter Plant Materials Center, Natural Resources Conservation Service and Auburn University Alabama Agricultural Experiment Stations as the releaser of 'AU Sunrise' crimson clover. All revenue generated from sale of 'AU Sunrise' will be equally shared between the Jimmy Carter PMC and Auburn University.