11-1963

Buttonclover as a Green Manure Crop for Cotton

O. H. Long

J. R. Overton

University of Tennessee Agricultural Experiment Station

BULLETIN 370

NOVEMBER 1963

Buttonclover as a green manure crop for cotton

by
O.H.Long
and
J.R.Overton

THE UNIVERSITY
OF TENNESSEE

AGRICULTURAL
EXPERIMENT
STATION

John A. Ewing, Director

KNOXVILLE

Summary

Buttonclover turned under as a green manure crop was about as effective as 50 to 60 pounds of nitrogen in increasing yields of cotton in two experiments of 5 and 7 years' duration.

- On Pembroke silt loam in Lawrence County, as a 5-year average, the yield of seed cotton was 1,231 pounds per acre where it was not fertilized with nitrogen, 1,618 pounds where cotton followed buttonclover, and 1,661 pounds where cotton was fertilized with nitrogen at a rate of 50 pounds of N per acre.

- **On Memphis silt loam at the West Tennessee Experiment Station, Jackson, as a 4-year average, the yield of seed cotton was 1,760 pounds per acre where it was not fertilized with nitrogen, 2,559 pounds where cotton followed buttonclover, and 2,512 pounds where cotton was fertilized with nitrogen at a rate of 60 pounds of N per acre.**

- The yields reported above do not include the years a buttonclover seed crop was produced. If these years are included, considerably more cotton was produced where it was grown every year and fertilized with nitrogen.

Buttonclover As A Green Manure Crop For Cotton

by

O. H. Long and J. R. Overton[1]

Buttonclover (*Medicago orbicularis*) is a winter annual legume closely related to alfalfa, in that both belong to the same genus. In Tennessee its management and life cycle, however, is much like that of crimson clover: that is, it is seeded in late summer, grows in the fall, winter, and spring, produces seed, and dies in early summer.

Like crimson clover, buttonclover is used for pasture or green manure or both. Once a seed crop of buttonclover has been produced and incorporated with the soil, volunteer stands from this one seed crop may be expected for several years with proper management. This volunteering characteristic is due to the large percentage of hard seed.

Buttonclover's value as a pasture and hay plant has been discussed elsewhere[2]. The experiments reported in this publication were concerned with its volunteer seeding habit and its value as a green manure crop, compared with the value of ammonium nitrate as measured by their effects on cotton yields. These experiments were conducted on a Pembroke silt loam on a private farm in Lawrence County for a period of 7 years, and on a Memphis silt loam at the West Tennessee Experiment Station, Jackson, for a period of 5 years.

Experiment in Lawrence County, Farm of R. J. Webb

The experiment in Lawrence County was started in late summer of 1951 by seeding four strips of land to buttonclover. Alternating with these strips of buttonclover were four strips left bare over winter. A photograph of this experiment taken in February 1956 is shown in Figure 1. Cotton was planted on the bare strips in 1952 and every year thereafter through 1958. No cotton was grown on the buttonclover strips in 1952, since a seed crop was being produced. Cotton was grown on the entire area for 3 years (1953-55). No

[1] Professor of Agronomy, Knoxville, and Assistant Professor of Agronomy, West Tennessee Experiment Station, Jackson, respectively.

[2] John A. Ewing, *Button Clover*, Tennessee Agricultural Experiment Station Circular 104 (Knoxville, Tennessee: University of Tennessee, 1949).

J. H. Davis, E. O. Gangstad, and H. L. Hackerott, *Button Clover*, Hoblitzelle Agricultural Laboratory, Bulletin 6 (Renner, Texas: Texas Research Foundation, 1957).

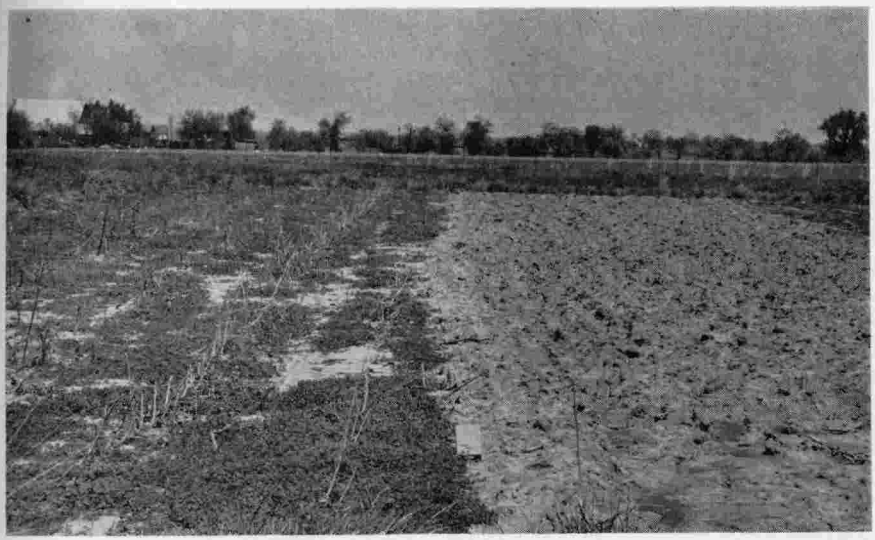

Figure 1. Left, a volunteer stand of buttonclover being saved to produce a seed crop. Right, plowed strip on which cotton is grown every year. (Photographed February, 1956.)

cotton was grown on the buttonclover strips in 1956 when a second seed crop was produced. Again cotton was grown on the entire area for 2 years (1957-58).

Phosphorus and potassium were applied annually at rates of 75 pounds of P_2O_5 (33 pounds of P) and 75 pounds of K_2O (62 pounds of K) per acre, respectively—in the row at planting for cotton or broadcast for the buttonclover seed crop. The pH of the soil was in the range of 6.3 to 6.6. Where cotton was grown continuously, it received a sidedressing of ammonium nitrate applied at two rates: 25 and 50 pounds of N per acre. There was also a no-nitrogen check. Cotton following buttonclover was not fertilized with nitrogen.

Yields of seed cotton obtained from the various treatments for the entire period, 1952-1958, are shown in Table 1. In this table both 5-year and 7-year averages are shown. The 5-year average yields do not include 1952 and 1956, the years buttonclover seed crops were being produced; the 7-year average yields include these 2 years when no cotton was produced on the buttonclover strips.

The 5-year average yield was 1,618 pounds of seed cotton per acre where the crop followed buttonclover and 1,231 pounds where buttonclover was not grown and no ammonium nitrate was applied, an increase of 387 pounds. Buttonclover was particularly beneficial in 1957 and 1958.

Where cotton did not follow buttonclover but was sidedressed with ammonium nitrate at rates of 25 and 50 pounds of N, average yields of seed cotton were 1,510 and 1,661 pounds per acre, respectively. A 430-pound increase from 50 pounds of N represents about 9 pounds of seed cotton per pound of applied nitrogen. This response agrees

Table 1.—Yields of cotton using four different treatments on Pembroke silt loam, Lawrence County, 1952-1958

(All yields are averages of 4 replications)

Treatment	Year							5-year average [1]	7-year average
	1952	1953	1954	1955	1956	1957	1958		
	Pounds of seed cotton per acre								
Cotton following buttonclover as green manure	[2]	1491	1020	1418	[2]	1645	2514	1618	1155
Continuous cotton with:									
No added N	1388	1245	931	1363	1116	1065	1552	1231	1237
25 lb. N per acre	1424	1338	1036	1743	1380	1394	2040	1510	1479
50 lb. N per acre	1486	1467	1047	1891	1498	1616	2282	1661	1612
L. S. D. (5%).....	70	79	84	98	233	132	329	....	....

[1] Excluding 1952 and 1956.

[2] No cotton grown in 1952 and 1956, the years buttonclover seed crops were being produced.

closely with that found in earlier experiments, where the response was about 10 pounds of seed cotton per pound of applied N.[3]

Cotton following buttonclover produced on the average 108 pounds more seed cotton than was obtained where cotton did not follow a green manure but was fertilized with nitrogen at the 25-pound rate; however, it produced 43 pounds less than where it was fertilized at the 50-pound N rate. Therefore, it can be concluded that the turning under of buttonclover was almost as beneficial as 50 pounds of applied N in the form of ammonium nitrate.

If the yields for all 7 years are included, the seed cotton yield following buttonclover averaged only 1,155 pounds, which is less than the average yield obtained with no nitrogen fertilizer (1,237 pounds), but where cotton was grown every year. In other words, in the 5 years cotton was grown on both areas, the increases in yield brought about by the buttonclover crop were not large enough to overcome the 2 years of no cotton production when buttonclover seed crops were being produced.

At the same time this experiment was in progress—a short distance away on the same soil—cotton was being grown in a 6-year rotation with corn, wheat, and alfalfa, the latter crop remaining in the rotation for 3 years. In this rotation cotton was fertilized with ammonium nitrate at a rate of 50 pounds of N per acre, along with 40 pounds of P_2O_5 and 50 pounds of K_2O (approximately equivalent to 50-18-42 of N-P-K). This situation permits a comparison of cotton production in continuous culture with its production in a rotation with other crops. In continuous culture, the 7-year average yield at the 50-pound N rate was 1,612 pounds of seed cotton per acre; in the rotation the average yield was 1,550 pounds.[4]

[3] O. H. Long, and Ben P. Hazlewood, "Fertilizer Experiments with Cotton," Tenn. Agr. Exp. Sta. Bul. 220, 1951.

[4] O. H. Long, "Phosphates in Crop Rotations in Lawrence County," Tenn. Agr. Exp. Sta. Bul. 328, 1961.

Experiment at West Tennessee Experiment Station, Jackson

An experiment similar to that in Lawrence County was conducted on Memphis silt loam[5] at the West Tennessee Experiment Station, Jackson, during the 5-year period, 1956-1960. Inoculated buttonclover was seeded at a rate of 30 pounds per acre on September 2, 1955. In this experiment ammonium nitrate, where applied to the cotton crop, was at the rate of 60 pounds of N per acre. In one treatment this amount of nitrogen was applied to cotton following buttonclover. Phosphorus and potassium were applied annually over the entire area at adequate rates. The pH of the soil was about 6.5. Cotton yield data are shown in Table 2.

In this experiment different methods of incorporating the buttonclover seed crop with the soil were investigated. These included: 1) disking, 2) disking followed by turning, and 3) turning followed by disking; the incorporations were made in August, 1956. Volunteer stands of buttonclover and yields of cotton in the succeeding years, however, were so similar that these treatments were combined and averaged.

Cotton following buttonclover produced an average yield of 2,559 pounds of seed cotton per acre during the 4-year period, 1957-1960. Where the crop followed buttonclover, but in addition received

Table 2.—Yields of cotton using five different treatments on Memphis silt loam, West Tennessee Experiment Station, Jackson, 1956-1960
(All yields are averages of 3 replications)

Treatment	Year					4-year average[1]	5-year average
	1956	1957	1958	1959	1960		
	Pounds of seed cotton per acre						
Cotton following buttonclover turned under as green manure crop	[2]	2423	2211	3059	2543	2559	2047
Same as above, but in addition cotton side-dressed with nitrogen at rate 60 pounds of N per acre	[2]	2338	2400	3078	2764	2645	2116
Continuous cotton with:							
Buttonclover seeded annually in cotton middles after first picking	1234	2124	1804	2574	1916	2105	1930
No added N	1372	2032	1494	1788	1724	1760	1682
60 pounds of N per acre	1358	2388	2172	2934	2552	2512	2281
L. S. D. (5%)	N.S.	181	224	294	239	....	....
(1%)	....	249	307	402	328	....	....

[1] Excluding 1956.
[2] No cotton grown in 1956, the year a buttonclover seed crop was being produced.

[5] Formerly classified as Lintonia silt loam.

a side-dressing of ammonium nitrate at a rate of 60 pounds of N per acre, the cotton yield was 2,645 pounds. This constitutes an average increase of only 86 pounds of cotton from the added nitrogen.

Where cotton did not follow buttonclover and received no nitrogen, the yield was 1,760 pounds. Thus the buttonclover crop increased the yield of cotton an average of 799 pounds. Ammonium nitrate in the absence of a buttonclover green manure crop was also effective in increasing cotton yields; 60 pounds of N produced an average yield of 2,512 pounds of seed cotton. This represents an increase of about 13 pounds of seed cotton per pound of applied nitrogen.

Attempts to obtain stands of buttonclover by seeding it in the cotton middles after the first picking were largely unsuccessful, but did result in some improvement in cotton yields over those obtained on the no-nitrogen treatment. The increase on the average was 345 pounds of seed cotton per acre.

In one treatment (not shown in the table) the buttonclover seed crop was disked into the soil in early July—about 50 days before the other incorporations — and planted immediately to grain sorghum. The yield of sorghum was 2,310 pounds of grain per acre. However, the yields of cotton in the 4 succeeding years were on the average 181 pounds less than they were where the seed crop was incorporated in August.

The 5-year average yields, which include 1956, the year the buttonclover seed crop was produced, are shown in the last column of Table 2. Yields of seed cotton following buttonclover averaged 2,047 pounds per acre and 2,116 pounds where, in addition to the buttonclover green manure crop, cotton received 60 pounds of nitrogen as a side-dressing. Both these average yields are higher than those obtained where cotton was grown every year but was not fertilized with nitrogen or where buttonclover was seeded in the cotton middles every year after the first picking. The highest average yield (2,281 pounds) was obtained where cotton was grown every year and was side-dressed with 60 pounds of nitrogen.

General Remarks

Good volunteer stands of buttonclover are not obtained every year. Satisfactory stands and growth depend mainly on moisture conditions in late summer and early fall. If these seasons are dry, few or no seed will germinate. Ample moisture in late summer followed by a dry fall will result in a stand which later may perish for lack of water. If germination is delayed until late fall, some plants may be winter-killed; even if they survive, growth is meager. With the best of growing conditions, the crop must be turned under in the spring before it has reached full growth, if cotton is to be planted at the proper time.

Buttonclover is not tolerant of acid soils; its lime requirement is probably as high as that of alfalfa. When seeded for the first time inoculation of the seed is important. Alfalfa inoculum is not satisfactory; the inoculum for the bur clovers is the one required.[6] In some instances buttonclover can become a problem if allowed to go to seed. Its very hard seed can remain in the soil for a long time, yet remain viable. When these seeds are brought to the surface they germinate readily and have been known to crowd out a seeding of alfalfa.

Perhaps the best use of buttonclover in a cotton cropping system would be to use the legume for pasture when it has made sufficient growth, turn under the residue for its green manure effect, and supplement the nitrogen supplied by the legume with nitrogen fertilizer when needed.

Buttonclover as a green manure crop for cotton might be desirable where extra acres suitable for cotton are available. In such a situation it might be worth a trial since, once a seed crop has been produced, no expenditure of money and effort is required in getting stands of buttonclover for several years thereafter.

[6] L. W. Erdman, "Legume Inoculation: What It Is—What It Does," USDA Farmers' Bul. 2003, 1959.

(4M/2-64)

THE UNIVERSITY OF TENNESSEE
AGRICULTURAL EXPERIMENT STATION
KNOXVILLE, TENNESSEE

Agricultural Committee
Board of Trustees

ANDREW D. HOLT, *President*
CLYDE M. YORK, *Chairman*
BEN DOUGLASS, HARRY M. LAUGHLIN, WASSELL RANDOLPH
W. F. MOSS, *Commissioner of Agriculture*

STATION OFFICERS

Administration

ANDREW D. HOLT, President
WEBSTER PENDERGRASS, Dean of Agriculture
J. A. EWING, Director
ERIC WINTERS, Associate Director
J. L. ANDERSON, Budget Officer

Department Heads

T. J. WHATLEY, Agricultural Economics and Rural Sociology
J. J. McDOW, Agricultural Engineering
L. F. SEATZ, Agronomy
C. S. HOBBS, Animal Husbandry-Veterinary Science
RUTH L. HIGHBERGER, Child Development and Family Relations
J. T. MILES, Dairy
M. R. JOHNSTON, Food Technology
BERNADINE MEYER, Foods and Institution Management
MYRA L. BISHOP, Home Management, Equipment, and Family Economics
B. S. PICKETT, Horticulture
R. L. HAMILTON, Information
K. L. HERTEL, Physics
J. O. ANDES, Plant Pathology
O. E. GOFF, Poultry
ANNA J. TREECE, Textiles and Clothing

University of Tennessee Agricultural Research Units

Main Station, J. N. ODOM, General Superintendent of Farms, Knoxville
University of Tennessee-Atomic Energy Commission Agricultural Research Laboratory, Oak Ridge, N. S. HALL, Laboratory Director

Branch Stations

Dairy Experiment Station, Lewisburg, J. R. OWEN, Superintendent
Highland Rim Experiment Station, Springfield, L. M. SAFLEY, Superintendent
Middle Tennessee Experiment Station, Spring Hill, E. J. CHAPMAN, Superintendent
Plateau Experiment Station, Crossville, J. A. ODOM, Superintendent
Tobacco Experiment Station, Greeneville, J. H. FELTS, Superintendent
West Tennessee Experiment Station, Jackson, B. P. HAZLEWOOD, Superintendent

Field Stations

Ames Plantation, Grand Junction
Cumberland Plateau Forestry Station, Wartburg
Friendship Forestry Field Station, Chattanooga
Highland Rim Forestry Field Station, Tullahoma
Milan Field Station, Milan