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# Annual Legumes for Conservation Tillage and Sustainable Production Systems

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## Summary

Fourteen annual forage legumes, including crimson, arrowleaf, subterranean, red, and rose clover, vetch, 'Caley' pea, and field pea, were evaluated for forage and nitrogen (N) production at Overton, Texas, in 1984, 1985, and 1986. Tibbee crimson was highest in legume forage production: 3,976 lb dry matter per acre (DM/A) in 1984, 3,943 lb DM/A in 1985, and 4,356 lb DM/A in 1986. 'Woodford' vetch produced the most total N in 1984, 108.6 lb N/A, while Hairy vetch produced 119.9 lb N/A in 1985 and 122.5 lb N/A in 1986.

## Introduction

Winter-annual forage legumes are potentially useful in conservation tillage farming systems.

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**Keywords:** clover / vetch / pea / green manure / pearl millet / nitrogen.

When grown exclusively for winter soil cover and green manure, they can provide a renewable N source for warm-season crops such as corn, sorghum-sudan hay, or pearl millet. Experiments were conducted at the Texas A&M University Agricultural Research and Extension Center at Overton to determine (1) the total production potential of winter-annual forage legumes for which the growing season terminated on April 15 and (2) the production and N utilization of hybrid pearl millet grown in rotation with forage legume green manure crops.

## Procedure

A small-plot drill with six double disk openers, spaced 9 in. apart, was used to plant the seed 0.5 in. deep. The plots were 5- x 7-ft plots in 1984 and 1985 and 5- x 10-ft plots in 1986. Fertilizer (N, phosphate [P<sub>2</sub>O<sub>5</sub>], and potash [K<sub>2</sub>O]) applied before to planting was (1) 1983: 0-90-90; (2) 1984: 0-80-80 and 200 lb/A KMAG; and (3) 1984 and 1985:

0-100-162 and 1.5 lb/A boron. The seed were inoculated with peat inoculant supplied by the Nitragin Co., at 1.6 oz. of inoculum per pound of seed, and Pelgel solution was used as an adhesive to stick inoculant to the seed.

Each experiment was arranged in a randomized complete block design with four replications. The plots were harvested on April 17, 10, and 11 in 1984, 1985, and 1986, respectively. After each harvest, a subsample (<0.25 lb, dry weight) was removed for DM determination and N analysis. The harvested forage was distributed evenly on their respective plot areas and incorporated using a rotary tiller.

Approximately 5 weeks after harvest, hybrid pearl millet was planted in this same plot area. A check plot in which no legume was grown was included each year. In 1985, check plots with added N fertilizer were included for the pearl millet production. Pearl millet was harvested approximately 4 weeks later, twice in 1984 and 1986 and only once in 1985 because of lack of soil moisture. Pearl millet forage was removed from the plots with a subsample taken for DM and N determinations.

## Results

### 1984

Forage production of the legumes ranged from 3,976 lb DM/A for Tibbee crimson to 446 lb DM/A for 'Chesapeake' red (Table 1). Although Tibbee crimson produced more forage, Woodford and

'Hairy' vetch produced more N (108.6 and 92.2 lb N/A, respectively). Pearl millet forage production and forage N content was limited by available soil N. The highest pearl millet forage production in combination with the highest forage N content was from plots where Woodford vetch, Hairy vetch, and Tibbee crimson were green manure crops.

### 1985

Forage production ranged from 3,943 lb DM/A of Tibbee crimson to 1,153 lb DM/A of Chesapeake red (Table 2). Hairy vetch produced the most total N, and Caley pea, and Woodford vetch the next highest. Chesapeake red was determined to be a later variety than needed and was deleted after this season. Pearl millet did not regrow after the first harvest, possibly because of dry conditions. Total production potential of pearl millet was not achieved.

### 1986

Tibbee crimson produced 4,356 lbs DM/A compared with Woodford vetch, which produced 933 lb DM/A (Table 3). Total N production ranged from 122 to 28 lb N/A for Hairy vetch and Woodford vetch, respectively. Forage and N production of Woodford vetch was reduced in 1986 from apparent insect damage. The insect pest was unidentified. Higher than average rain in May and June 1986 stimulated pearl millet yields and reduced differences caused by green manure crop.

**Table 1. Dry matter and nitrogen production of legumes and pearl millet in a simulated conservation tillage system at Overton, Texas - 1984.**

Entry	Legume <sup>†</sup>		Pearl millet <sup>‡</sup>	
	Yield lb DM/A	Total N lb N/A	Yield lb DM/A	Total N lb N/A
Tibbee crimson	3976 a*	83.3 ab	4062 ab	63.6 abc
Woodford vetch	3485 a	108.6 a	4750 a	81.1 a
Hairy vetch	2549 b	92.2 ab	4379 a	65.7 ab
Austrian winterpea	2097 bc	67.1 bc	3847 abc	55.7 bc
Bigbee berseem	2007 bc	41.6 cde	2980 bcd	43.8 bcd
Cahaba vetch	1493 cd	52.8 bc	3466 abc	50.0 bc
Caley pea	1218 d	38.0 de	2992 bcd	43.6 bcd
Amclo arrowleaf	1113 de	33.8 de	2960 bcd	42.3 bcd
Mt. Barker sub	899 de	30.3 de	2796 bcd	44.5 bcd
Chesapeake red	446 ef	15.5 ef	2539 cd	36.6 cd
CK (0 N)			1836 d	22.3 d
C.V.	16.9	20.8	14.9	19.2

\*Values within a column followed by the same letters are not significantly different at the 0.01 level using Student-Newman-Keuls Multiple Range Test.

<sup>†</sup> Legumes were planted in a RCB design with four replications October 10, 1983, on a prepared seedbed in 5- x 7-ft plots.

<sup>‡</sup> Hybrid pearl millet was planted in this same plot area May 21, 1984. No fertilizer was applied. Millet was harvested June 19, 1984, and July 19, 1984.

**Table 2. Dry matter and nitrogen production of legumes and pearl millet in a simulated conservation tillage system at Overton, Texas - 1985.**

Entry	Legume†		Pearl millet‡	
	Yield	Total N	Yield	Total N
	lb DM/A	lb N/A	lb DM/A	lb N/A
Tibbee crimson	3943 a*	96.3 ab	1179 abc	15.8 cd
Hairy vetch	3548 ab	119.9 a	1842 a	29.7 a
Caley pea	3243 ab	100.2 ab	1682 ab	27.4 a
Woodford vetch	3046 abc	97.8 ab	1632 ab	23.9 ab
Kondinin rose	2596 abcd	63.4 bc	649 abc	7.8 fg
Austrian winterpea	2527 abcd	75.1 bc	1423 abc	18.9 bc
Mt. Barker sub	2433 abcd	74.2 bc	1089 abc	13.0 cdef
Cahaba white vetch	2228 bcd	62.9 bc	1228 abc	15.6 cde
Segrest ball	1715 cd	39.0 c	728 abc	9.9 defg
Bigbee berseem	1661 cd	38.1 c	635 abc	6.7 fg
Amclo arrowleaf	1569 cd	42.9 c	777 abc	8.8 efg
Chesapeake red	1153 d	30.6 c	724 abc	7.3 fg
CK (27.2 N)			472 bc	6.3 fg
CK (13.6 N)			545 bc	5.9 g
CK (0 N)			362 c	3.7 g
C.V.	22.1	23.3	42.7	35.9

\*Values within a column followed by the same letters are not significantly different at the 0.01 level using Student-Newman-Keuls Multiple Range Test.

†Legumes were planted in a RCB design with four replications October 12, 1984, on a prepared seedbed in 5- x 7-ft plots.

‡Hybrid pearl millet was planted in this same plot area May 6, 1985. No fertilizer was applied. Millet was harvested June 12, 1985.

**Table 3. Dry matter and nitrogen production of legumes and pearl millet in a simulated conservation tillage system at Overton, Texas - 1986.**

Entry	Legume†		Pearl millet‡	
	Yield	Total N	Yield	Total N
	lb DM/A	lb N/A	lb DM/A	lb N/A
Tibbee crimson	4356 a*	92.2 ab	3760 a	52.5 a
Chief crimson	4164 a	89.9 ab	4590 a	60.2 a
Amclo arrowleaf	3903 ab	96.4 ab	4774 a	66.4 a
Kondinin rose	3585 ab	67.4 bc	3531 a	44.0 a
Hairy vetch	3491 ab	122.5 a	4955 a	70.6 a
Austrian winterpea	2819 abc	84.0 ab	4885 a	70.4 a
Caley pea	2512 bcd	80.8 ab	4677 a	65.3 a
Mt. Barker sub	1876 cde	53.3 bc	3859 a	55.7 a
Bigbee berseem	1472 cde	35.1 c	4209 a	49.1 a
Meteora sub	1155 de	33.4 c	4207 a	53.7 a
Woodford vetch	933 e	28.0 c	4812 a	63.5 a
CK (0 N)			952 b	9.6 b
C.V.	21.2	23.0	19.9	27.4

\*Values within a column followed by the same letters are significantly different at the 0.01 level using Student-Newman-Keuls Multiple Range Test.

†Legumes were planted in a RCB design with four replications October 16, 1985, on a prepared seedbed in 5- x 10-ft plots.

‡Hybrid pearl millet was planted in this same plot area May 22, 1986. No fertilizer was applied. Millet was harvested June 25, 1986, and July 25, 1986.

## Nitrogen Production

Although yielding less forage than Tibbee crimson, Hairy vetch produced more N per acre all 3 years (Table 4). Woodford vetch, because of poor forage production in 1986, fell below the crimson clovers in N production. Kondinin rose clover and Cahaba white vetch failed in forage production and N production because of poor winter hardiness. Chesapeake red and Segrest ball were eliminated in 1986 because their late production distribution did not fit the April 15 harvests. Hairy vetch, Tibbee, Chief crimson, Woodford vetch, and both pea varieties have potential as green manure crops in conservation tillage or sustainable production systems in East Texas.

**Table 4. Average nitrogen production of annual legumes grown at Overton, Texas, in a simulated conservation tillage system.**

Entry†	1984	1985	1986	Average
	..... lb N/A.....			
Hairy vetch	92.2	119.9	122.5	111.5
Tibbee crimson	83.3	96.3	92.2	90.6
Chief crimson	—‡	—	89.9	89.9
Woodford vetch	108.6	97.8	28.0	78.1
Austrian winterpea	67.1	75.1	84.0	75.4
Caley pea	38.0	100.2	80.8	73.0
Kondinin rose	—	63.4	67.4	65.4
Cahaba white vetch	52.8	62.9	—	57.9
Amclo arrowleaf	33.8	42.9	96.4	57.7
Mt. Barker sub	30.3	74.2	53.3	52.6
Segrest ball	—	39.0	—	39.0
Bigbee berseem	41.6	38.1	35.1	38.3
Meteora sub	—	—	33.4	33.4
Chesapeake red	15.5	30.6	—	23.1

† Harvested in mid-April each year.

‡ Some entries not included each year.