Nitrogen Management of Tropical Corn in a Reseeding Crimson Clover Conservation-tillage System

D.W. Reeves[1]

Introduction

Despite the known benefits of growing corn following a winter legume, the practice is currently not sufficiently economically advantageous for growers to adopt due in large part to the cost of annual reseeding of the legume (1). New corn hybrids, originally bred for the tropics, can be planted late enough to allow a winter legume cover crop to mature seed (3, 5). These hybrids, known to farmers as tropical corn, could therefore be grown in a conservation-tillage system with winter annual legumes without incurring the yearly costs of establishing the winter legume cover crop.

Few studies have addressed the response of tropical corn hybrids to N fertilizer management (4). Although winter annual legumes like crimson clover *(Trifolium incarnatum* L.) can supply 60 to 90 lb or more N A^{-1} to a corn crop, the N released is generally not available until tasseling for temperate hybrids (2). It is likely, however, that the late planting date for tropical hybrids is more synchronized with the N release from a winter legume cover crop than the planting window of temperate hybrids.

The objectives of this field study were: to determine if tropical corn, with its late planting date, can be grown with a reseeding winter annual legume; to determine the optimum N rate and application time for tropical corn hybrids grown following a winter legume; and to determine the feasibility of this cropping system as an alternative for grain/silage production.

MATERIALS AND METHODS

The study was initiated in 1989 at the Alabama Agricultural Experiment Station's substation at Crossville, AL. Crossville is located in the northeastern region of the state, in the Appalachian Plateau; the soil type is a Hartsells fine sandy loam (Typic Hapludult). In 1990, the study was also established on a Norfolk sandy loam (Typic Kandiudult) at the E. V. Smith Research Center in east-central Alabama. 'Tibbee' crimson clover was seeded into the experimental area in the fall prior to initiation of studies at each location (1988 and 1989, at Crossville and E. V. Smith, respectively). The clover has naturally reseeded every year since then. A Bush Hog Ro-till'' was used to subsoil in the row prior to planting tropical corn hybrids. A John Deere Flex planter with cone planters was used to seed the tropical corn into the strip-tilled area. Paraquat, atrazine and metolachlor were applied at recommended rates immediately following planting of the corn. Planting dates were June 28, June 5, and June 5 in 1989, 1990, and 1991, respectively, at Crossville, and May 31 and June 4 in 1990 and 1991, respectively at E.V. Smith. Three weeks after planting, stands were thinned to final plant populations of 18,000 A' in 1989 and 1990. Stands were thinned to 26,000 plants A^{-1} in 1991. The higher population was chosen in 1991 in order to better determine silage as well as grain yield potential of the hybrids.

The experimental design was a strip-split design of 4 replications. Horizontal plots were mulch cover, either winter fallow or reseeded crimson clover. Vertical plots were N rates of 0, 45, 90, or 180 lb A^{-1}. Subplots within the mulch cover and N rate plots were a factorial arrangement of tropical corn hybrids and N application time. Nitrogen application times were either all N applied at planting or N split

[1]USDA-ARS National Soil Dynamics Laboratory, P. O. Box 3439, Auburn, AL. 36831-3439 and Alabama Agricultural Experiment Station, Auburn University.

(1/3 at planting and the remainder when corn was 12-16 inches tall, 5-6 wk after planting), Tropical corn hybrids used in 1989 and 1990 were Pioneer hybrid 304C and Dekalb hybrid 678C. The hybrids used in 1991 were Pioneer hybrids 304C and 3072. These two hybrids were chosen because recent research in Alabama and Florida identified Pioneer hybrid 304C as a top silage producer while Pioneer hybrid 3072 was identified as a top grain producer.

RESULTS AND DISCUSSION

In 1989 at Crossville, yields were reduced due to severe drought in July and September, and the earliest frost ever recorded. The frost stopped development of grain when it was at 1/3 milk line. Grain yields averaged 57 bu A" for the Dekalb hybrid regardless of N application time. Pioneer hybrid 304C averaged 50 bu A^{-1} when all N was applied at planting, and 57 bu A^{-1} when N was split ($LSD_{0.10}$ = 4.1 bu A^{-1}). In the clover system, N application time was not critical, averaging 60 and 62 bu A^{-1}, respectively, when N was applied at planting or split. In the fallow system, however, yields were reduced from 53 to 46 bu A^{-1} when N wa applied at planting rather than as a split application ($P \leq 0.14$). The beneficial effect o f the clover mulch on both grain and silage yield: is seen in Table 1. Equivalent grain and silage yields were obtained with 45 lb N A^{-1} following clover as compared to 180 lb N A^{-1} following winter fallow.

Table 1. Effect of applied N and crimson **cover** cover **crop,** averaged over hybrids **and** N **application** time, on **grain** and silage yield **of tropical corn at** Crossville, *AL* **in 1989.**

	N (lb A^{-1})			
Cover **Crop**	*0*	45	90	180
	grain, bu A^{-1}			
Clover	**45**	**59**	60	**64**
Fallow	**11**	**39**	**51**	**59**
$LSD_{0.10}$ = 5.8 bu A^{-1}				
	silage', **tons** A^{-1}			
Clover	**14.5**	**17.8**	**17.7**	**18.7**
Fallow	**7.1**	**12.6**	**15.9**	**16.4**
$LSD_{0.10}$ = 1.1 tons A^{-1}				

*35% *dry* **matter**

In 1990, a severe drought and heavy infestations of fall armyworm *(Spodoptera fugiperda* J. E. Smith) caused crop failures at both E. **V.** Smith and Crossville. Ear development was so poor that grain yields were not determined at either location. Silage yields were determined at Crossville, but the crop was so poor at E. V. Smith that no data were taken. At Crossville, Dekalb® hybrid 678C yielded 13.8 tons A' and Pioneer® hybrid 304C yielded 12.4 tons A^{-1} ($LSD_{0.10}$ = 0.94 tons A^{-1}). The severe drought negated any N responses, however, silage yields were increased from 11.9 tons A^{-1} following fallow to 14.2 tons A^{-1} following clover ($LSD_{0.10}$ = 1.78 tons A^{-1}). This increase was likely the result of improved soil moisture under the clover mulch.

In 1991, timing of N application did not affect grain production for either hybrid at E. V. Smith or Crossville. Silage production for Pioneer® hybrid 3072 was similar to PioneeP hybrid 304C in 1991. Maximum yield (35% dry matter) was 24.8 tons A^{-1} for both hybrids at Sand Mountain. At E. V. Smith, maximum yields were 18.3 tons A' for Pioneer@304C and 19.7 tons A^{-1} for Pioneer® 3072. Averaged over both locations, Pioneer@ 304C yielded more silage when N was split applied (20.7 tons A^{-1}) rather than applied at planting (19.1 tons A^{-1}) while yields of Pioneer® 3072 were greater when N was applied *at* planting (20.8 tons A^{-1}) rather than split (18.9 tons A^{-1}) ($P \leq 0.11$).

Pioneer@ hybrid 3072 had a higher grain yield potential than the widely commercially available hybrid Pioneer® 304C (Fig. 1). At both locations, Pioneer® hybrid 3072 increased grain yield with N rate up to 180 lb A^{-1}. Pioneer® hybrid 304C, however, did not respond to N fertilizer as well as Pioneer® 3072,

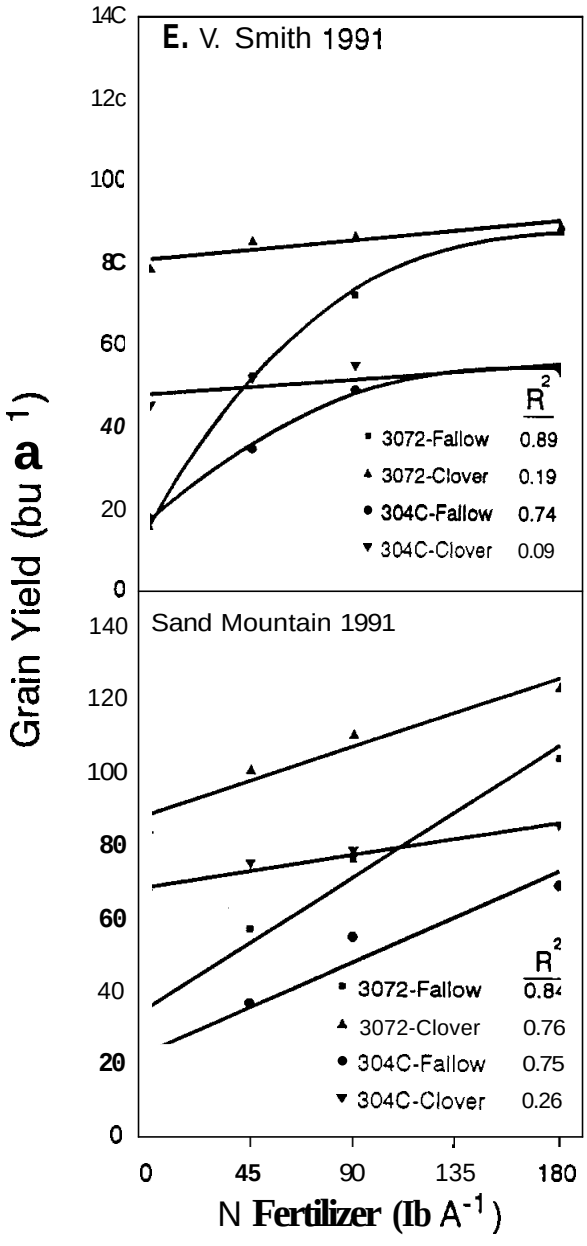

Fig. 1. Grain yield response of tropical corn hybrids to applied N as affected by cover crop, averaged over N application time.

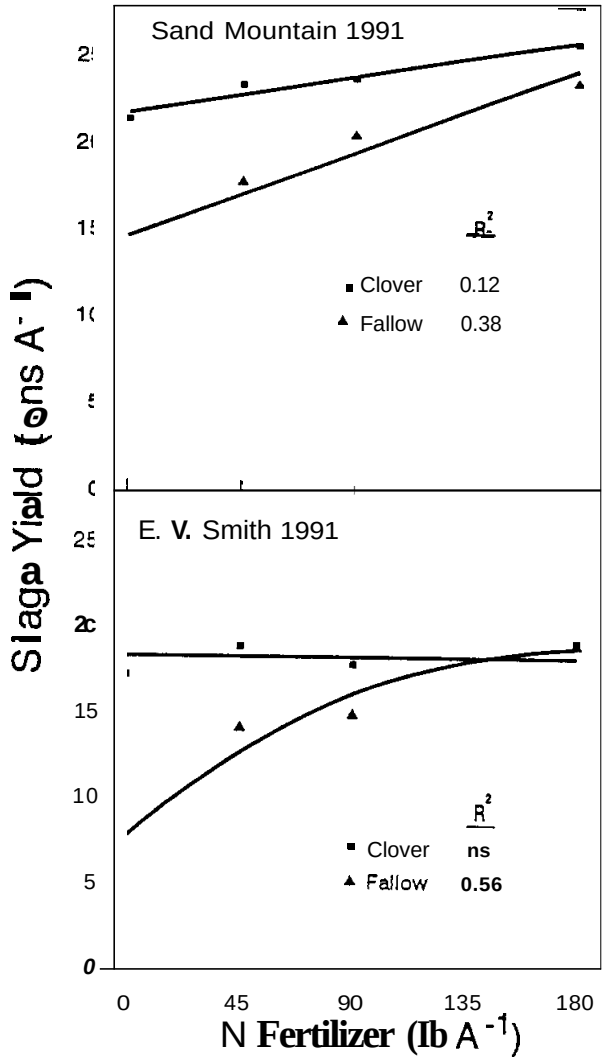

Fig. 2. Silage yield (35% dry matter) response of tropical corn to applied N as affected by cover crop, averaged over N application time and hybrids.

especially at E. V. Smith.

The reseeded crimson clover increased grain yield of both hybrids from 32 to 69% (Fig. 1). The response of Pioneer@ hybrid 3072 to the cover crop, however, was greater than that of Pioneer@hybrid 304C. At both locations, 45 lb N A^{-1} following clover produced equivalent or greater grain yields as 180 lb N A^{-1} following fallow. Silage yield following clover was similar for both hybrids. Yield following clover increased only 2 and 11% at E. V. Smith and Sand Mountain, respectively, when applied N increased from 45 to 180 lb A^{-1} (Fig. 2). Following winter fallow, however, silage production increased 35% at E. V. Smith and 35% at Sand Mountain when N fertilizer was increased from 45 to 180 lb A^{-1}.

Although more research is needed for control of fall armyworm in tropical corn, grain yields obtained with newer hybrids like Pioneer® 3072, as well as the silage yield potential of other hybrids, shows that tropical corn has great potential in conservation-tillage systems with reseeding winter annual legumes like crimson clover. Respectable grain and silage yields in such a system can be obtained with as little as 45 lb N A^{-1}. Such a system should provide an economical alternative for growing a late season grain or silage crop that meets soil conservation guidelines.

REFERENCES

1. **Allison, J. R. and S. L. Ott. 1987.** Economics of using legumes as a nitrogen source in conservation tillage systems. p. 145-150. *In* J. F. Power *(ed.)* The Role of Legumes in Conservation Tillage Systems. Proc. **of** a national conference, University of Georgia, Athens,, GA April 27-29, 1987. Soil Conservation Society of America.

2. **Huntington, T. G., J. H. Grove,** and **W. W. Frye.** 1985. Release and recovery of nitrogen from winter annual cover crops in no-till corn production. Commun. in Soil Sci. Plant Anal. 16(2):193-211.

3. **Mask P. L. and D. W. Reeves. 1991.** Tropical corn in Alabama. p. 27. *In* I. D. Teare (ed.) Proc. of the Southern Regional Tropical Corn Symposium . Quincy, FL. June 27-28, 1991. PPI/FAR Technical Bulletin 1991-3.

4. **Reeves, D. W., D. L. Wright, and G. L.** Mullins. Soil fertility and no-tillage management of tropical corn. p. 55-58. *In* **I.** D. Teare (ed.) Proc. of the Southern Regional Tropical Corn Symposium . Quincy, FL. June 27-28, 1991. PPI/FAR Technical Bulletin 1991-3.

5. **Wright, D. L., R. N. Gallaher, and I. D. Teare.** Tropical corn as a grain crop. p. 28. *In* I. D. Teare (ed.) Proc. of the Southern Regional Tropical Corn Symposium . Quincy, FL. June 27-28, 1991. PPI/FAR Technical Bulletin 1991-3.