Reseeding Potential of Crimson Clover in No-Till Corn

J.L. Myers and M.G. Wagger[1]

Introduction

In recent years, research and interest in the use of winter annual cover crops for various conservation tillage systems has received considerable attention due to environmental concerns and the rising cost of fertilizer nitrogen. Cover crops have been attributed with reducing soil erosion and weed pressure (4), as well as improving infiltration and retention of rainfall (5). In addition, leguminous cover crops may provide substantial quantities of biologically-fixed nitrogen (N) to summer crops such as corn and sorghum, making supplemental fertilizer nitrogen unneccessary or minimal (3,6,9,10).

Despite these beneficial qualities, the widespread acceptance of leguminous cover crops for conservation tillage production may depend on resolving a couple of management problems. First, the annual fall establishment of the legume is costly and may be unsuccessful if climatic conditions are not favorable. Based on current fertilizer N prices, the legume must provide at least 80 lb of N to offset establishment costs (7). Secondly, growth of winter annual legumes is most rapid in late spring, during which most of the dry matter and nitrogen production occurs. This rapid growth period

[1]Dept. of Crop Science, North Carolina State Univ.. Raleigh, NC. 27695.

generally coincides with optimal planting dates for corn, and may, in relatively dry springs, have a detrimental effect on corn seedling growth due to soil moisture depletion (2).

Crimson clover is well-adapted to the southeastern United states and demonstrates good reseeding ability (1). In the Piedmont region of North Carolina, corn is often grown continuously for silage and would therefore fit into a self-reseeding cover crop system. With these factors in mind, the objective of this research was to investigate the self-reseeding potential of crimson clover and its effects on corn yield compared to annual fall planting of crimson clover.

Materials and Methods

The experiment was conducted in 1987 and 1988 at the Upper Piedmont Research Station, Reidsville, NC. The soil type was a Pacolet sandy loam (clayey, kaolinitic, thermic, Typic Hapludult) and is representative of southern Piedmont soils.

Four cover crop treatments were evaluated with four fertilizer N rates in a 4x4 factorial randomized complete block design with four replications. The cover crop treatments consisted of 1) fallow, where there was no cover crop grown; 2) direct-seeded, planted each fall with complete burndown at corn planting; 3) early-reseeded, also burned down completely at corn planting but potentially with enough viable seed to ensure stand establishment in the fall; and 4) strip-reseeded, at corn planting 18" bands over the corn row were burned down with 2 0 left between each row to mature. Fertilizer N rates were 0, 45, 90, and 135 Ib/A, respectively.

Crimson clover ('Tibbee') was broadcast seeded at 15lb/A on September 22, 1986 to establish the experimental area. The various crimson clover treatments were accomplished with a lpt/A 2-4,D amine and 2pt/A Paraquat mixture at corn planting. Corn ('Funks 4522') was planted in May (5-14-87 and 5-9-88) at approximately 25,000 plants/A in 3 8 rows using a John Deere Max Emerge no-tillage planter. Residual weed control was provided with an herbicide mix of 1.5 qt/A AAtrex and 2.5 qt/A Lasso surface broadcast at planting. The respective fertilizer N rates, as ammonium nitrate, were applied approximately 3 weeks after corn planting.

Crimson clover dry matter production and N concentration were determined on samples taken just prior to corn planting. Seed head samples were collected from representative plots at the same time and ten days later to determine percent germination and seed production. Corn grain yield (adjusted to a 15.5% moisture basis), along with corn earleaf and grain N concentration. were also measured.

Results and Discussion

Crimson clover dry matter production and N concentration just prior to corn planting in 1988 are shown in Table 1. Dry matter yields and N concentration were unaffected by N rate, however, cover crop management did have a significant effect on both parameters (p >.001). Early-reseeded and strip-reseeded treatments produced similar dry matter yields. In contrast, the direct-seeded treatment averaged only 26% of the biomass produced in the reseeding treatments. The fall of 1987 was very dry after planting the direct-seeded treatment, resulting in poor establishment of crimson clover. Greater seed quantities (data not presented) available with the reseeding treatments may have provided more flexibility with regard to time of germination. If one group of germinating seeds failed to coincide with adequate rainfall there would be more to follow later, as a certain percentage of clover seeds break dormancy on a gradual basis (8). The lower N concentrations observed for the reseeding treatments compared with the direct-seeded treatment reflect a dilution effect due to the nearly four-fold increase in dry matter production.

Germination tests indicated only a small percentage of seeds were viable at the time of crimson clover burndown and corn planting (Table 2). Ten days later, however, seed viability in the strip-reseeded plots had increased dramatically. Seed heads from the early-reseeded plots had already fallen from the plants, consequently samples could not be obtained. Nevertheless, those seeds appeared to mature enough after the complete burndown to produce viable seeds and adequate stand the following fall. Alternately, the 20% determined viable on the earlier sampling date may have been sufficient to develop a uniform stand, as was observed

Table 1. Dry matter production and N concentration of crimson clover as affected by N rate and clover management in 1988.

Clover mgt.	N rate (lb/A) 0	45	90	135	Cl. mgt. mean
		Dry matter (lb/A)			
Direct-seeded	2425	2789	1077	1448	1935
Early-reseeded	8340	7640	6103	8264	7587
Strip-reseeded	7135	5258	7105	7839	6834
N rate mean	5967	5229	4762	5850	
Treatment effects					
Cover management (C)		**			
N rate (N)		NS			
C X N		NS			
		N concentration (%)			
Direct-seeded	2.48	2.45	2.54	2.58	2.51
Early-reseeded	1.97	2.22	2.31	2.11	2.15
Strip-reseeded	2.08	2.42	2.27	2.27	2.26
N rate mean	2.17	2.36	2.38	2.32	
Treatment effects					
Cover management (C)		**			
N rate (N)		NS			
C X N		NS			

**Significant at the 0.01% level of probability
NS Not significant

Table 2. Effect of maturity on seed viability of crimson clover.

Sampling date	% germ.	% im.	% dor.
1987			
14 May (planting)	20	74	6
24 May	*66*	2	32
1988			
9 May (planting)	1	99	0
20 May	*52*	16	32

in 1988. At the later sampling date the percentage of dormant seeds increased, providing a more flexible window of germination time.

Corn grain yields were not significantly affected by fertlizer N rate either year (Table 3). These results are not surprising given the relatively dry growing season conditions that prevailed at this site in 1987 and 1988. Under limited rainfall conditions, corn uptake of N is often restricted. Grain yield, however, was influenced by the presence of a cover crop, indicating a mulch effect both years. Under a supposedly non-limiting N statue (i.e. 135 lb/A), orthogonal contrasts revealed significantly higher grain yields for all crimson clover treatments compared to the fallow system. The positive effects of the mulch were readily apparant in the field, as plant water stress symptoms were commonly observed in the fallow treatment.

Ear leaf nitrogen concentrations varied significantly between N rates, but as corn growth proceeded and soil moisture remained limiting, differences became obscured so that grain and stover nitrogen concentrations were unaffected by N rates (data not presented).

In 1988, the early-reseeding and strip-reseeded resulted in higher grain yields than the direct-seeded treatments. The failure in 1988 of the direct-seeded treatment to perform as well as the other two crimson clover treatments was due to its poor establishment the previous fall. Given the dry weather that prevailed both years, these results also suggest that N from crimson clover was sufficient for the yield potential that existed.

Table 3. Influence of crimson clover management and N rate on corn grain yield.

	N rate (lb/A)							
	0	45	90	135	0	45	90	135
	bu/A							
Clover mgt.	**1987**				**1988**			
Direct-seeded	60†	62	71	65	71	75	***64***	67
Early-reseeded	---	---	---	---	98	98	116	107
Strip-reseeded	---	---	---	---	108	**113**	119	117
Fallow	43	43	50	**25**	52	59	64	44
Treatment effects								
Cover mgt. (C)	**				**			
N rate (N)	NS				NS			
C X N	NS				NS			

[1]Mean values for all crimson clover treatments since reseeding treatments were not fully established until the second year.

**Significant at the 0.01% level of probability.

NS Not significant.

Conclusions

During years of limited rainfall, a crimson clover cover crop can be beneficial to yield of corn by providing a mulch which conserves oil moisture and enhances infiltration. Allowing crimson clover to mature before chemical burndown and corn planting, or leaving strips of crimson clover between corn rows to produce seed, are both potential methods for cutting seed costs and reducing the risk of cover crop establishment. Under extremely dry summer conditions, as occurred in this study, there may be no difference in these two reseeding methods, However, if rainfall is limited at corn planting time, benefit may be derived from killing crimson clover early in strips. This practice could minimize competition for soil moisture with the corn seedlings and yet produce sufficient seed for fall reestablishment of crimson clover.

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