EVALUATION OF A BLADE CULTIVATOR FOR CONSERVATION TILLAGE COTTON FOLLOWING CRIMSON CLOVER

Philip J. Bauer[1], John G. Alphin[2], James R. Frederick[3], and Gloria S. McCutcheon[4]

ABSTRACT

Shallow subsurface tillage can control weeds and maintain surface residues in conservation tillage systems. Our objective was to determine the efficacy of using subsurface tillage for weed control in cotton (Gossypium hirsutum L.) grown in a reseeding crimson clover (Trifolium incarnatum L.) winter cover production system. Treatments in the study were planting date (15 April, 29 April, and 24 May), winter cover (fallow or 'Dixie' crimson clover), and midrow weed control method (V-blade cultivator and glyphosate application). Soil type was Norfolk loamy sand (fine, loamy, siliceous, thermic, Typic Kandiudult). Weed control methods were compared in the first two planting dates in late May. At one week after treatment, weed control in the mid-rows was similar between glyphosate application and subsurface tillage in both planting dates and both winter cover treatments. Subsurface tillage reduced residue cover in the midrows by 8%. Weed control treatments were applied to all planting dates in late June. Clover successfully reseeded following both weed control methods. These preliminary data suggest that further investigation of subsurface tillage in reseeding crimson clover cotton production systems is warranted.

INTRODUCTION

Winter cover crops can be used for soil improvement and erosion control in cotton fields. Of the legume cover crops, crimson clover may be especially suitable in the southeastern USA because of its ability to provide adequate fall growth and abundant residues (Hoyt and Hargrove, 1984). Crimson clover can also provide all the N needed by a succeeding cotton crop on sandy Coastal Plain soils (Bauer et al., 1993; Touchton et al., 1984). The ability of some crimson clover cultivars to mature and reseed prior to a mid- to late-May cotton planting increases the potential for utilizing this legume in conservation tillage production systems.

Weed control in strip- or no-till systems is accomplished primarily with herbicides. In the pre-herbicide era, mechanical devices were developed to control weeds in row middles of crops growing in mulch-type cultural practice (Chase, 1942). This technology is again being evaluated for modern crop production. Cultivators are currently available to growers that will control weeds between rows when large amounts of surface residues are present.

In order for these cultivators to be most effective in a reseeding crimson clover conservation tillage system, crimson clover seeds must be left near the soil surface after cultivation. The optimal seeding depth for small seeded legumes like crimson clover is 0.5- to 1.5-cm (Decker et al., 1973). Therefore, secondary cultivation devices which cause significant soil mixing may bury clover seeds and result in reduced clover stands the following fall.

We used a set of V-blade sweeps to determine the efficacy of using this weed control method for cotton grown following crimson clover on a sandy Coastal Plain soil. In this report, we present the 1993 results from our comparison of these sweeps with a directed application of glyphosate in strip-tillage cotton grown after a crimson clover cover crop.

MATERIALS AND METHODS

Five independantly acting V-blade cultivator units were assembled. Each V-blade and a smooth coulter were attached to a lower parallel linkage frame of a Case-IH Model 183 cultivator utilizing a gauge wheel for depth control. The standard gauge wheel attachment was reversed to give the desired placement between coulter and V-blade.

[1] USDA-ARS, Coastal Plains Soil, Water & Plant Res. Cen., Florence, SC 29502.
[2] Dept. of Agricultural and Biological Engineering, Clernson Univ., Florence. SC.
[3] Dept. of Agronomy and Soils, Clemson Univ.. Florence. SC.
[4] Dept. of Entomology. Clernson Univ.. Florence, SC.

V-blade construction consisted of removing the stem from a 30 inch sweep and replacing the stem by welding a short flat bar attachment, beveled on the front, to the front portion of the sweep. The ends of the sweep were cut off to give a 26-in cutting width. The wings have a slightly beveled cutting edge. Nominal dimensions for the blade-wings are 0.25-in thick and 2-in wide.

The framework was constructed to provide a relatively simple means for accomplishing the following functions: 1. attaching to the Case-IH frame; 2. attaching the V-blade over a range of fixed distances from the Case-IH support frame with an adjustable pitch angle; 3. adjusting coulter depth; 4. aligning V-blade and coulter with each other and travel direction; 5. replacing parts for repairs and future investigations.

We evaluated this V-blade cultivator on a Norfolk loamy sand soil at Clemson University's Pee Dee Research and Education Center in Florence, SC. In this investigation, the V-blade and coulter nominal operating depths were 2 and 3 in, respectively, with the V-blade set parallel with the soil surface.

The treatments in the experiment were winter cover (crimson clover and fallow), planting date (15 April, 29 April, and 25 May). and midrow weed control method [V-blade cultivator and a directed application of glyphosate (Brewer, 1993) to the midrowsl. Experimental design was randomized complete block in split plot arrangement with the winter cover and planting date combinations as main plots and midrow weed control method as subplots. The experiment had four replicates.

In the fall of 1992, the experimental area was disked and harrowed. The cultivar 'Dixie' was seeded into the crimson clover plots at a rate of 20 lb seed ac^{-1} with a grain drill on 14 October, 1992.

At two weeks before the April planting dates, glyphosate was applied in 12-in strips to kill vegetation where the cotton rows were to be. A broadcast application of glyphosate was made at one week before the May planting date. All plots were in-row subsoiled before planting to a depth of 18 in. Cotton ('DES 119') was planted with a four row no-till planter in 38-in rows.

Total N applied to the cotton in the winter fallow plots was 70 lb ac^{-1}. No N was applied in the crimson clover plots. Lime and other plant nutrients were applied based on soil test results. Insecticides were used at planting to control thrips and in late June, late July, and early August for Heliothis virescens and Helicoverpa control. Pre- and post-emergent herbicides were applied with a directed sprayer for in-row weed control. A traveling gun irrigation system was used to apply 0.5 in of water to the plots on 29 and 30 April and again on 3 and 4 June.

Aboveground biomass of the winter covers (winter weeds in the fallow plots or the crimson clover) was determined by collecting and drying (70" C) a 10.8-ft^2 sample from each subplot on May 17. On 20 May, midrow weed control treatments were applied on the subplots in the first two planting dates. On 27 May, the amount of residue cover and live weeds in the treated areas were measured by using a' two dimensional transect. A 39-in long and 24-in wide frame was constructed from 1 inch PVC pipe. Four parallel strings were streched across the frame and attached to the 24-in sides. Six parallel strings were across the 39-in side. On each side, strings were spaced 6 inches apart. Residues and weeds [mainly crabgrass (Digitaria spp.)] were determined at the 24 intersections of the strings. Six determinations were made in each plot. The weed control treatments were applied to all three planting dates on 21 June. The cotton and weeds were severely water stressed at that time, so residue and weed determinations were not made.

Clover cover in early December was measured in two replicates of the study by using a line-transect of 45 ft with 39 evaluation points. Data was collected from midrows that had and did not have tractor wheel traffic during the growing season.

All data collected were subjected to analysis of variance. Mean separations were made by calculating a least significant difference.

RESULTS AND DISCUSSION

The biomass of the crimson clover and winter weeds on 17 May are given in Table 1. Values for clover in the first two planting dates were low, compared to the May planting date, because the clover in the crop rows was killed with glyphosate two weeks before each planting date in April. Also, wheel traffic from cotton planting and applying herbicides (in-row) in the April planting dates reduced clover production in the traffic

Table 1. Clover and winter weed biomass levels measured on May 17, 1993.

cotton Planting Date	Winter Cover Clover	Fallow
	lb/ac	
April 15	860	451
April 29	1009	243
May 24	2301	343
$LSD_{(0.05)}$	241	

midrows. Winter weed biomass was similar in the three planting dates (Table 1).

A severe drought occurred during the cotton growing season in 1993 and limited the value of our evaluation of the V-blade for weed control. The amount of weed control (measured on 27 May) at one week after treatment with the V-blade cultivator was the same as for the glyphosate application (data not shown). Both had very low live weed (mainly Digitaria spp.) populations. Like the weed control methods, neither winter cover treatment nor planting date influenced the amount of live weeds.

The amount of residue cover on 27 May was influenced by planting date, winter cover, and midrow weed control method, but interactions between these production practices did not occur. Residue cover was about 15% lower for the 29 April planting than the 15 April planting. Crimson clover provided 16% more residue cover than did winter weeds (74% for clover vs. 58% for fallow).

The V-blade cultivator exposed a small amount of soil. Residue cover in the mid-rows on 27 May was 62% in the V-blade plots and 70% in the glyphosate plots. Most of the soil exposed was in a line down the middle of the mid-row where the shank holding the V-blades entered the soil. Little or no soil was exposed near the end of the blades.

The lack of soil surface disturbance with the V-blade cultivator apparently kept enough of the clover seed in a zone where it could readily emerge and become established. In general, soil cover in the fall by live clover plants following use of the V-blade cultivator was only slightly less than when

Table 2. Reseeded crimson clover cover in non-wheel and wheel mid-rows in late November, **1993.**

cotton Planting Date	Weed Control Method	Mid-Row Non-Wheel	Wheel
		%	
April 15	V-Blade	**36**	54
	Glyphosate	57	48
April 29	V-Blade	59	62
	Glyphosate	60	63
May 24	V-Blade	90	**91**
	Glyphosate	95	95
$LSD_{(0.05)}$		**10.6**	

glyphosate was used to control weeds in the cotton row middles (Table 2). In the 15 April planting date, the amount of reseeded clover in the V-blade cultivator non-wheel mid-rows was less than the herbicide plots (Table 2). When the clover was allowed to fully reseed before planting cotton (24 May planting date), soil cover by live clover plants was greater than 90% for both the V-blade and glyphosate weed control methods (Table 2).

In summary, surface residues were retained and crimson clover successfully reseeded following the use of the V-blade cultivator for weed control in 1993. These data suggest that further investigations of the V-blade cultivator in reseeding crimson clover cotton production systems are warranted.

ACKNOWLEDGEMENTS AND DISCLAIMER

This work is a contribution of the Coastal Plains Soil, Water, and Plant Research Unit of the USDA-ARS and the South Carolina Agricultural Experiment Station, Clemson University, Clemson, SC. Mention of trademark, proprietary product, or vendor does not constitute a guarantee or warranty of the product by the USDA or Clemson University and does not imply its approval to the exclusion of other products or vendors that may also be suitable. The authors thank Bobby Fisher and Willie Davis for technical support.

REFERENCES

Bauer. P.J., J.J. Camberato, and S.H. Roach. 1993. Cotton yield and fiber quality response to green manures and nitrogen. Agron. J. 85:1019-1023.

Brewer, M.W. 1993. Chemical cultivation using shielded sprayers and roundup herbicide. pp. 62. In D.J. Herber and D.A. Richter (edsl Proc. Belt. Cotton Conf. National Cotton Council of America, Memphis, TN.

Chase, L.W. 1942. A study of subsurface tiller blades. Agr. Eng. 23:43-45 and 50.

Decker, A.M., T.H. Taylor, and C.J. Willard. 1973. Establishment of new seedings. pp. 384-395 In M.E. Heath, D.S. Metcalfe. and R.F. Barnes (eds) Forages/The science of grassland agriculture. The Iowa State University Press, Ames, Iowa.

Hoyt, G.D. and W.L. Hargrove. 1986. Legume cover crops for improving crop and soil management in the southern United States. HortScience 21:397-402.

Touchton, J.T., D.H. Rickerl, R.H. Walker, and C.E. Snipes. 1984. Winter legumes as a nitrogen source for no-tillage cotton. Soil Tillage Res. 4:391401.