VARIETY RESPONSE OF STRIP-TILL COTTON INTO WINTER COVER CROPS AT GAINESVILLE, FLORIDA

R.N. Gallaher[1]

AUTHOR: [1]Professor of Agronomy, PO Box 110730, Agronomy Department, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611-0730; E-mail: rng@gnv.ifas.ufl.edu.. No endorsements or registrations implied herein.
REFERENCE: J. E. Hook (ed.) *Proceedings of the 22nd Annual Southern Conservation Tillage Conference for Sustainable Agriculture*. Tifton, GA. 6-8 July 1999. Georgia Agriculture Experiment Station Special Publication 95. Athens, GA.

ABSTRACT. Upland cotton (*Gossipium hirsutum*) is an old crop that is becoming increasingly new and important to Florida farmers. The objective of this research was to determine best yielding cotton varieties in north Florida using strip-till management in three different cropping systems. Fourteen varieties were tested in 1998 in three identical randomized complete block experiments that differed only in location and cropping history on the University of Florida Green Acres Agronomy Field Research Laboratory near Gainesville, Florida. Experiment one had a history of growing ‘Hairy’ vetch (*Vicia villosa*) as the winter crop every year for the past 22 years. Experiment two had a history of growing ‘Dixie Reseeding’ crimson clover (*Trifolium incarnatum*) as the winter crop every year for the past 15 years. Experiment three had a history of growing ‘Wren’s Abruzzi’ rye (*Secale cereale*) as the winter crop every year for the past 15 years. Yields following rye were as high as 2.75 bales lint cotton/acre. Most glyphosate tolerant varieties ranked in the top group for yield. Yields among varieties varied from 90 % to 120 % depending upon the cropping system. Seed cotton ranged from a low of 43 % to a high of 49 % lint. Percent lint varied widely suggesting that care should be given to this adjustment for accurate determination of yield among varieties. Lint yield was positively correlated with N concentration in diagnostic leaf and petiole, r = 0.91 and r = 0.71, respectively. The suggested N sufficiency range in diagnostic leaves, under these conditions, is suggested to be between 4.50 % and 5.00 %.

INTRODUCTION

Upland cotton (*Gossypium hirsutum* L.) acreage has significantly increased in Florida over the past 20 years. This has helped to offset the loss in acreage and farm income from other field crops such as soybean (*Glycine max* L. Merr) and corn (*Zea mays* L.) (Gallaher and Brecke, 1999). Data show that cotton is an important crop in Florida, contributing to the stability of farm income and newly developed glyphosate resistant varieties are likely to help improve management, yields and profits for growers (Brecke, 1997). Utilizing strip-till management has proven highly successful for many row crops which provide numerous conservation benefits (Gallaher and Hawf, 1997). For these reasons it is important to determine management requirements, cropping systems and best performing varieties for strip-till cotton, under north Florida conditions. Therefore the objective of this research was to determine best yielding varieties for strip-till cotton in three different cropping systems.

MATERIALS AND METHODS

Three identical experiments were conducted in 1998 under similar soil type and at the same location. However, each experimental site had a different cropping history. Experiments were conducted at the "Green Acres Agronomy Field Research Laboratory " 12 miles west of Gainesville, Florida. Experiment one had a history of continually growing ‘Hairy’ vetch (*Vicia villosa* L.) as the winter crop every year for the past 22 years. Experiment two had a history of continually growing ‘Dixie Reseeding’ crimson clover (*Trifolium incarnatum* L.) as the winter crop every year for the past 15 years. Experiment three had a history of continually growing ‘Wren’s Abruzzi’ rye (*Secale cereale* L.) as the winter crop every year for the past 15 years.

Soil type was an Arredondo fine sand (Sandy Siliceous Thermic Paleudult) (Anonymous, 1994), and consists of 95 % to 97 % sand and only 3 % to 5 % silt plus clay. Cotton was strip-till (Brown-Harden in-row subsoil no-till planter) planted directly into the residue of each of the previous winter crops on 18 May 1998, at a rate of 6 seed per linear foot of row. Seed hoppers were John Deere Flexie 71 units.

Experiments were in randomized complete block designs, replicated five times in 30 inch wide rows, two rows per plot and 20 feet long rows. Two border rows were planted on each side of the varieties being tested. Treatments consisted of 14 cotton varieties (Table 1).

A preemergence application of 0.75 lb a.i. Prowl (plendimethalin), 1.0 lb a.i. Meturon (fluometuron), and 2 lb a.i. Roundup Ultra (glyphosate) was made on 20 May. Additional weed control included post direct application of

1.5 pints Gramoxone (paraquat)/acre two times, 2 July and again 10 July. A fertilizer blend was applied beside the row two times. The blend was 13-5-29-1-2.5 (N-P_2O_5-K_2O-Mg-S) and 460 lb/acre was applied on 3 June and 460 pounds/acre was applied a second time on 6 July. Insecticides included the application of labeled rates of Lannate (methomyl) and Baythoid (cyfluthrin) four times on 10 July, 4 August, 14 August, and 24 August. Irrigation was by stationary guns to ensure a minimum of 1.25 acre inches of water if rainfall was not sufficient from 11 July to 20 August. Labeled rate of Harvade-5F (dimethipin) was applied on 2 October. In addition 1.5 pints Gramoxone/acre was applied to complete defoliation on 6 October. Both rows of cotton were hand picked beginning 12 October.

Each plot of harvested cotton was stored in a metal building for one month to allow equilibration before being weighed. Approximately ½ pound subsamples were ginned using a laboratory cotton gin (Porter Morrison & Sons 20 saw laboratory cotton gin, Dennis Mfg. Co., Inc.), lint and seed weighed, dried in a forced air oven at 70 C and reweighed. This procedure allowed calculation of percent dry matter, percent lint, and adjustment of varieties to the same moisture for accurate yield comparisons.

Diagnostic leaves and petioles were collected from the youngest mature leaves on 4 August during the active bloom and boll set stage in order to assess sufficiency levels of N (Jones, 1974). A total of 20 leaves and petioles were collected per variety, on three replications per experiment. Leaves and petioles were washed (Gallaher, 1996), dried at 70 C in a forced air oven, ground to pass a 2 mm stainless steel screen and stored for microKjeldahl N analysis. All ground samples were redried prior to weighing for analysis. A 100 mg sample was weighed into Pyrex test tubes and digested (digest mix was 3.2 g 90% K_2SO_4: 10% $CuSO_4$ plus 10 ml of concentrated H_2SO_4) (Gallaher, et al., 1975). Nitrogen was determined colorimetrically by autoanalysis.

Field and laboratory data was recorded in QUATTRO PRO (Anonymous, 1987) spreadsheets for tabulation, transformations, and making ASCII files. Analysis of variance was completed for a randomized complete block design using MSTAT statistical software (Anonymous, 1985). If yield and related data were significant among varieties at the 0.05 level of probability means were separated using Duncan's New Multiple Range Test. If N concentration data was significant at the 0.10 level of probability means were separated using Duncan's New Multiple Range Test.

RESULTS AND DISCUSSION

Yield

Some cotton varieties provided yield as much as twice that of others (Table 1). Data show that variety selection in north Florida will be extremely important to the economy of cotton farmers. Assuming lint cotton to be 480 pounds/bale, then lint yield was as high as 2.75 bales/acre (Table 1). Glyphosate tolerant varieties of cotton were very competitive and four of the six glyphosate tolerant varieties were among the highest yielding (Table 1).

Data also show that cropping history is important in the production of cotton. Although statistical comparisons are not mathmatically legal, it is important to point out that all three studies were conducted within 50 yards of each other, on the same soil type and with identical management. The three sites differed only in cropping history as described earlier. It can be noted that cotton following a history of rye as the winter crop provided the highest yield values, and there appears to be a slight advantage of following crimson clover over hairy vetch (Table 1). Others have reported similar yield advantage for cotton following a wheat (*Triticum aestivum* L.) grass crop in succession compared to a succession with hairy vetch (Holman, et al., 1997). Previous research has shown cropping history on these sites to have differential nematode infestations, with the two legume sites being highly infested in root-knot nematode compared to the rye site (McSorley and Gallaher, 1997). However, there is no indication that root-knot nematode is a problem for these cotton varieties. On the other hand some unknown disease and other problems may have increased in the legume sites compared to the grass site that may explain why cotton did better following a long term history of growing winter rye.

Varieties differed in percent lint (Table 2). On a air dried equilibrated basis percent lint ranged from about 42% to over 47%. On a dry matter basis differences among varieties generally maintained their position but ranged from a low of about 43 % to a high of over 49 %. Based on communication with cotton research colleagues, these values are much higher than what is generally used to calculate lint yield from seed cotton yield. Some researchers apparently use a figure of about 36 % to 38% lint to calculate lint yield in variety trials. Based on my research reported here, using such a factor among varieties would result in erroneous reporting and erroneous differences among varieties. Generally, it appears that the highest lint yielding varieties had a lower percent lint compared to the low lint yielding varieties (Table 2).

Generally varieties maintained their ranking in lint and seed yield when based on a specific dry matter (Table 3) when compared to air dried seed cotton yield (Table 1). However, on an equal dry matter basis five of the six glyphosate tolerant varieties were in the top lint yielding group, while four of the six were in the top seed yielding group (Table 3).

Nitrogen Analysis

Nitrogen concentrations in diagnostic leaves and petioles were consistently higher for cotton following rye (Table 4). Among varieties following rye there was a positive correlation between lint yield (Table 3) and both leaf N and petiole N ($r = 0.84$ for leaf; $r = 0.74$ for petiole) (Table 4). When lint yield for all varieties and all three locations were correlated with leaf N concentration, a positive correlation of 0.91 was found. For these same yield data and petiole N the correlation coefficient was 0.71. All correlations were positive between leaf N and yield in all three experiments or combinations of all experiments. Because highest lint yields were positively correlated with leaf N concentration it can be assumed that N values of 4.50% to 5.00% are needed under conditions of these studies, especially for some of the glyphosate tolerant varieties, in order to maximize yield. This is in contrast to lower values suggested by Jones (1974) who reported that upper mature leaves on vegetative stems prior to or at first bloom or when first squares appear should have a sufficiency range for N of between 3.75 % and 4.50 %. Because N concentrations were much lower than this range for cotton following a history of crimson clover or hairy vetch, it can be assumed that there may be some factor interfering with the absorption of N at these site. One could assume that the legume sites should have had more N available for cotton to absorb compared to the rye site. This is because there should be N available from the previous legume crop, as well as the same N fertilizer application made at all three sites.

ACKNOWLEDGMENTS

This research was partially funded by a grant from Cotton Incorporated. The author appreciates the assistance of Mr. Howard Palmer, Mr. Walter Davis, Mr. Jim Chichester, Mr. Scott Tubbs, and Ms. Jackie Greenwood in conducting this research. Appreciation is also extended to Dr. David L. Wright who provided seed he obtained from industry sources.

LITERATURE CITED

Anonymous. 1985. Users Guide to MSTAT, Version 4.0. Michigan State University, Lansing, MI.

Anonymous. 1987. QUATTRO PRO, Ver. 4.0. A Spreadsheet Software Program, Scotts Valley, CA: Borland International, Inc.

Anonymous. 1994. Official soil series description for the Arredondo series. United State Government Printing Office, Washington, DC.

Brecke, B.J. 1997. Weed management in no-till Roundup tolerant soybean and cotton. pp. 233-237. *In* R.N. Gallaher and R. McSorley (eds.). Proceedings of the 20th Annual Southern Conservation Tillage Conference for Sustainable Agriculture. Special Series SS-AGR-60, University of Florida, Gainesville, FL.

Gallaher, R.N., C.O. Weldon, and J.G. Futral. 1975. An aluminum block digester for plant and soil analysis. Soil Sci.Soc. Amer. Proc. 39:803-806.

Gallaher, R.N. 1995. Comparison of Zn Nutritional spray treatments for citrus leaf Zn adsorption and absorption. Agronomy Research Report AY-95-02. Agronomy Dept. IFAS, Univ. of Florida, Gainesville, FL.

Gallaher, R.N., and B.J. Brecke. 1999. Base paper for field crops. University of Florida, IFAS Strategic Planning Conference, FLORIDA FIRST, May 20-21, 1999, Safety Harbor Resort and Spa, Safety Harbor, Florida. IN PRESS.

Gallaher, R.N., and L. Hawf. 1997. Role of conservation tillage in production of a wholesome food supply. pp. 23-27. *In* R.N. Gallaher and R. McSorley (eds.). Proceedings of the 20th Annual Southern Conservation Tillage Conference for Sustainable Agriculture. Special Series SS-AGR-60, University of Florida, Gainesville, FL.

Holman, E.M., A.B. Coco, and R.L. Hutchinson. 1997. Cover crop and tillage for cotton production on alluvial soils of northeast Louisiana. pp. 208-110. *In* R.N. Gallaher and R. McSorley (eds.). Proceedings of the 20th Annual Southern Conservation Tillage Conference for Sustainable Agriculture. Special Series SS-AGR-60, University of Florida, Gainesville, FL.

Jones, J.B., Jr.,. 1974. Plant Analysis Handbook for Georgia. Bulletin 735. Cooperative Extension Service, Univ. of Georgia College of Agriculture, Athens, GA.

McSorley, R., and R.N. Gallaher. 1997. Nematode population levels on vegetable crops following two winter crops. pp. 96-99. *In* R.N. Gallaher and R. McSorley (eds.). Proceedings of the 20th Annual Southern Conservation Tillage Conference for Sustainable Agriculture. Special Series SS-AGR-60, University of Florida, Gainesville, FL

Table 1. Three-week Equilibrated Field Weight Cotton Yield for Varieties Strip-tilled and Double Cropped in 1998 at Gainesville, Florida.

Cotton Variety	Rye	Clover	Vetch
	Pounds Seed Cotton/Acre		
Deltapine DP 4.58 BR	3076 a	2416 a	1251 ab
\Deltapine DP 5415 RR	2850 ab	2257 ab	1758 a
Deltapine DP 5690 RR	2802 ab	2456 a	1772 a
Sure-Grow 501	2690 abc	2196 abc	1681 a
Deltapine DP 655 BG/RR	2644 abcd	1297 e	1661 a
Paymaster H 1560	2524 abcde	2054 abcd	1772 a
Sure-Grow 125	2588 bcde	1913 bcde	1479 a
Stoneville LA 887	2463 bcde	1679 bcde	1483 a
Paymaster PM 1220 BG/RR	2452 bcde	2241 ab	1477 a
Paymaster PM 1220 RR	2281 bcde	2107 abcd	1573 a
Deltapine Nucoton 33 B	2185 cde	1576 cde	1549 a
Stoneville ST 47	2082 de	1508 de	1528 a
Stoneville BXN 47	2033 ef	1815 abcde	1697 a
Stoneville ST 373	550 f	1485 de	0744 b
	Pounds Lint Cotton/Acre		
Deltapine DP 4.58 BR	1317 a	1051 a	0545 ab
DeltapineDP 5415 RR	1188 ab	0989 ab	0743 a
Deltapine DP 5690 RR	1185 ab	1036 a	0747 a
Sure-Grow 501	1157 abc	0903 abcd	0729 a
Deltapine DP 655 BG/RR	1146 abd	0548 e	0720 a
Paymaster H 1506	1073 abc	0874 abcd	0744 a
Sure-grow 125	1047 bc	0823 abcd	0631 a
Stoneville LA 887	1032 bc	0720 bcd	0646 a
Paymaster PM 1220 BG/RR	1091 abc	0946 abc	0634 a
Paymaster PM 1220 RR	1022 bc	0901 abcd	0697 a
Deltapine Nucotn 33 B	0922 c	0678 cde	0644 a
Stoneville ST 47	0983 bc	0691 cde	0689 a
Stoneville BXN 47	0952 bc	0828 abcd	0759 a
Stoneville ST 373	0673 d	0648 d	0333 b

Values in columns not followed by the same letter are significantly different at the 0.05 level of probability according to Duncan's New Multiple Range Test. Lint was determined from ginned subsamples from each plot.

Table 2. Percent Lint in Seed Cotton for Varieties Strip-tilled and Double Cropped in 1998 at Gainesville, Florida.

	Rye	Clover	Vetch
	Percent Lint Based on Three Week Equilibration		
Deltapine DP 458 BR	42.8 cdef	43.5 b	43.6 abcd
Deltapine DP 5415 RR	41.7 g	43.8 b	42.3 de
Deltapine DP 5690 RR	42.3 defg	42.2 bc	42.2 de
Sure-Grow 501	43.0 cde	41.1 c	43.4 c

Deltapine DP 655 BG/RR	43.2 cd	42.3 c	43.4 abcd`
Paymaster H 1560	42.5 cdefg	42.6 bc	42.0 de
Sure-Grow 125	42.1 efg	43.0 b	42.7 cde
Stoneville LA 887	41.9 fg	42.9 b	43.5 abcd
Paymaster PM 1220 BG/RR	44.5 b	42.2 b	43.0 cde
Paymaster PM 1220 RR	44.8 b	42.8 b	44.3 abc
Deltapine Nucotn 33 B	42.2 defg	43.0 b	41.6 e
Stoneville ST 47	47.2 a	45.8 a	45.1 a
Stoneville BXN 47	46.8 a	45.6 a	44.7 ab
Stoneville ST 373	43.4 c	43.6 b	44.8 ab
	Percent Lint Based on Dry Matter		
Deltapine DP 458 BR	44.4 cde	44.6 cd	43.5 abcd
Deltapine DP 5415 RR	43.3 f	44.5 cd	41.9 defg
Deltapine DP 5690 RR	43.9 def	43.1 d	42.2 cdefg
Sure-Grow 501	44.6 cd	45.3 bc	43.1 abcdef
Deltapine DP 655 BG/RR	44.6 cd	43.1 d	41.6 efg
Paymaster H 1560	44.3 def	43.9 cd	41.4 fg
Sure-Grow 125	44.0 def	44.0 cd	42.4 bcdefg
Stoneville LA 887	43.6 ef	44.1 cd	41.3 abcde
Paymaster PM 1220 BG/RR	46. b	43.2 d	42.6 abcdefg
Paymaster PM 1220 RR	46.4 b	43.5 d	43.8 abc
Deltapine Nucotn 33 B	44.0 def	44.1 cd	41.3 g
Stoneville ST 47	49.4 a	46.4 a	44.3 a
Stoneville BXN 47	49.1 a	46.9 a	44.4 a
Stoneville ST 373	45.3 c	44.7 cd	44.1 ab

Values in columns not followed by the same letter are significantly different at the 0.05 level of probability according to Duncan's New Multiple Range Test. Percent line was determined from grinned subsamples for each plot.

Table 3. Moisture Adjusted Lint and Seed Yield of Cotton for Varieties Strip-tilled and Double Cropped in 1998 at Gainesville, Florida.

Cotton Variety	Rye	Clover	Vetch
	----------------Lint Yield at 93.5% Dry Matter, Pounds/Acre-----------		
Deltapine DP 458 BR	1346 a	1038 a	0542 ab
Deltapine DP 5415 RR	1211 ab	0974 ab	0738 a
Deltapine DP 5690 RR	1212 ab	1021 a	0740 a
Sure-Grow 501	1179 ab	0891 abcd	0721 a
Deltapine DP 655 BG/RR	1174 ab	0544 e	0717 a
Paymaster H 1560	1096 ab	0867 abcd	0738 a
Sure-Grow 125	1071 b	0812 abcd	0628 a
Stoneville LA 887	1055 b	0710 bcde	0641 a
Paymaster PM 1220 BG/RR	1119 ab	0935 abc	0633 a
Paymaster PM 1220 RR	1047 b	0889 abcd	0690 a
Deltapine Nucotn 33 B	0945 b	0667 cde	0641 a
Stoneville ST 47	1006 b	0680 cde	0681 a
Stoneville BXN 47	0974 b	0819 abcd	0752 a
Stoneville ST 373	0688 c	0637 de	0331 b
	------------- Seed Yield at 92% Dry Matter, Pounds/Acre --------------		
Deltapine DP 458 BR	1758 a	1334 a	0743 ab
Deltapine DP 5415 RR	1664 ab	1242 ab	1052 a
Deltapine DP 5690 RR	1622 ab	1390 a	1065 a
Sure-Grow 501	1530 abc	1267 ab	0986 a
Deltapine DP 655 BG/RR	1509 abc	0734 e	0983 a
Paymaster H 1560	1458 abc	1154 abcd	1067 a
Sure-Grow 125	1436 bc	1064 abcde	0881 a
Stoneville LA 887	1433 bc	0938 bcde	0870 a
Paymaster PM 1220 BG/RR	1362 bcd	1270 ab	0878 a
Paymaster PM 1220 RR	1261 cd	1181 abc	0913 a
Deltapine Nucotn 33 B	1266 cd	0876 cde	0942 a
Stoneville ST 47	1099 de	0796 e	0873 a
Stoneville BXN 47	1077 de	0963 bcde	0976 a
Stoneville ST 373	0876 e	0817 de	0428 b

Values in columns not followed by the same letter are significantly different at the 0.05 level of probability according to Duncan's new Multiple Range Test. Percent lint was determined from grinned subsamples for each plot.

Table 4. Nitrogen Concentration in Diagnostic Leaves and Petioles of Cotton for Varieties Strip-tilled and Double Cropped in 1998 at Gainesville, Florida.

Cotton Variety	Rye	Clover	Vetch
	----------Leaf N, %----------		
Deltapine DP 458 BR	4.98 ab	4.10 ab	3.81 abc
Deltapine DP 5415 RR	5.01 a	3.70 abc	3.93 abc
Deltapine DP 5690 RR	4.60 abcde	3.72 abc	3.95 abc
Sure-Grow 501	4.70 abcd	4.10 ab	4.17 a
Deltapine DP 655 BG/RR	4.66 abcd	3.95 abc	4.06 ab
Paymaster H 1560	4.45 bcde	4.16 a	4.19 a
Sure-Grow 125	4.43 bcde	3.75 abc	3.59 bc
Stoneville LA 887	4.30 cde	3.64 bc	3.55 c
Paymaster PM 1220 BG/RR	4.63 abcde	4.15 a	3.79 abc
Paymaster PM 1220 RR	4.77 abc	4.16 a	4.13 a
Deltapine Nucotn 33 B	4.20 de	3.91 abc	4.09 a
Stoneville ST 47	4.68 abcd	3.66 bc	3.72 abc
Stoneville BXN 47	4.21 de	3.90 abc	4.14 a
Stoneville ST 373	4.10 e	3.63 c	3.73 abc
	---------- Petiole N, % ----------		
Deltapine DP 458 BR	2.12 a	1.36 ab	1.26 bcde
Deltapine DP 5415 RR	1.83 abcd	1.18 b	1.33 bcde
Deltapine DP 5690 RR	2.05 a	1.41 ab	1.48 bc
Sure-Grow 501	1.59 bcde	1.34 ab	1.37 bcde
Deltapine DP 655 BG/RR	1.89 abc	1.54 ab	1.51 bc
Paymaster H 1560	1.85 abcd	1.52 ab	1.89 a
Sure-Grow 125	1.92 ab	1.19 ab 0	1.08 e
Stoneville LA 887	1.79 abcde	1.23 ab	1.21 cde
Paymaster PM 1220 BG/RR	1.52 bcde	1.45 ab	1.10 e
Paymaster PM 1220 RR	1.77 abcde	1.55 a	1.34 bcde
Deltapine Nucotn 33 B	1.46 cde	1.47 ab	1.56 ab
Stoneville ST 47	1.84 abcd	1.22 ab	1.26 bcde
Stoneville BXN 47	1.44 de	1.48 ab	1.45 bcd
Stoneville ST 373	1.36 e	1.32 ab	1.14 de

Values in columns not followed by the same letter are significantly different at the 0.05 level of probability according to Duncan's New Multiple Range Test.