WHEAT/LUPINE DOUBLE CROP WITH COTTON

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ABSTRACT

The research was conducted from 1995 to 1997 at the North Florida Research and Education Center (NFREC) in Quincy, FL, a unit of Univ. of Florida. Tests were conducted to define the influence of wheat (*Triticum aestivum ssp. vulgare* L.) and white lupine (*Lupinus albus* L.) (winter crops), and N rates (0, 60, 120, and 180 lb N/A) on cotton. The objectives of this experiment were to evaluate the yields, plant number, boll number, lint weight, and plant height of cotton grown after lupine as compared to cotton grown after wheat. According to regression functions, the maximum yields of cotton after wheat were obtained with almost 15% more N application than the maximum yields obtained after lupine; however, higher yields of lint were obtained after lupine than wheat. Differences in plant population due to nitrogen rates were smaller at 120 lb/A as compared to other N rates. Increasing N rates on cotton planted after wheat decreased the plant population, but after lupine higher cotton plant populations were obtained at 60 and 180 lb N/A. The number of bolls was significantly higher after lupine than wheat, and they were increasing with increasing nitrogen rates for cotton planted after lupine and wheat. The highest boll number per plant was obtained with almost 50% higher application of N after wheat than lupine, but generally boll number was higher for cotton planted after lupine than wheat with lower N application on cotton. Higher than 100 lb/A application of N significantly decreased the number of bolls on cotton planted after lupine. The lint weight per boll was higher from cotton grown after wheat than white lupine. Plants were generally taller after lupine than wheat. The regression functions for cotton grown after lupine show increasing plant height with increased N rate. The tallest cotton was grown after wheat at the maximum N application.

INTRODUCTION

The acreage of cotton grown (*Gossypium hirsutum* L.) in Florida increased from year to year, as it has in the southeast United States.

One of the most important agronomic benefits of growing legumes is their contribution to provide biological nitrogen, which may decrease the need of nitrogen fertilization of the next crop (Brown et al., 1985). Additionally growing legume crops tends to increase weed control, increase organic matter in the soil, reduce soil erosion, and decrease evaporation (Touchton et al., 1984, Brown et al., 1985, Varco 1993, Boquet et al., 1994). Field studies have shown that growing legumes as previous crops may reduce the need for nitrogen applications on cotton by 50% (Touchton and Reeves, 1988; Millhollon and Melville, 1991).

According to Boquet et al. (1994) growing cotton after vicia (*Vicia hirsuta*) increased the average cotton yield by 390 lb/acre as compared to cotton grown after no previous crop. Legume crops such as crimson clover (*Trifolium incarnatum* L.) and peas (*Pisum sativum* L.) may contribute up to 90 lb N/A for the next crop (Hoyt and Hargrove, 1986). Touchton et al. (1984) have shown that sufficient nitrogen is available after legume crops for cotton grown on sandy soils with low nitrogen content. Using legume crops as the only source of nitrogen for cotton resulted in the same or even higher cotton yields as compared to applying 120 lb N/A on monoculture. Measurements of fixed nitrogen in the soil suggest that 80 - 150 lb N/acre is produced by crimson clover and vicia during blooming in the spring (Mitchell, 1996). Nitrogen availability in the soil depends on previous crop, soil moisture, temperature, and plant maturity at desiccation (Ranells and Wagger, 1992; Wagger, 1989). According to Breintenbeck et al. (1994) cotton grown on clay soil after vicia didn't require high nitrogen fertilization to get a maximum yield. The balance of nitrogen fertilizer is generally negative (Brown et al., 1985; Wagger, 1989; Reeves and Touchton, 1991; Torbert and Reeves, 1994) due to a high C:N ratio in plant residues. After legume crops, nitrogen balance in the soil is from 13 to 180 lb N/A (Hoyt and Hargrove, 1986; Smith et al., 1987; Frye et al., 1988).

Touchton et al. (1995) have shown that is very important to provide the right rate, source, and application method of nitrogen for minimum tillage. This is partly due to the quality of plant residues after the previous crop. Using legume crops as previous crop contributes to significant increases of mineralized nitrogen and decreases the need for synthetic nitrogen to be applied to the next crop. Using rotation and growing winter crops may reduce leaching of nitrogen into the soil and degradation of the ground water. In reviewed literature, the optimum rate of nitrogen for cotton was from 31 to 120 lb N/A (Howard and Hoskinson, 1986; Lutrick et al., 1986; Maples and Frizzel, 1985; Phillips et al., 1987; Thom and Spurgeon, 1982; Touchton et al., 1981). To obtain maximum yield cotton should receive 81 - 200 lb N/A, but the optimum nitrogen rate is about 12 - 45 lb N/A lower than the rate giving a maximum yield (Constable and Rochester, 1988). According to research conducted by Wright et al. (1998), yield of lint was higher at 180 and 120 lb N/A, and it was, respectively 1250 and 1222 lb/A compared to rate of 60 lb N/A and without fertilization yield was, respectively, 1057 and 723 lb/A. The number of bolls per plant was higher at 180 and 120 lb N/A) and was, respectively, 15.1 and 13.7 bolls as compared to the application of 60 lb N/A and without nitrogen fertilization (respectively 11.2 and 7.4 bolls per plant).

The purpose of this work was to define the influence of a previous crop of lupine and wheat, and nitrogen rates on cotton grown in a multicropping system in Florida.

MATERIALS AND METHODS

The field research with cotton was conducted during 1995 - 1997 on a Dothan sandy loam (fine, loamy siliceous, thermic Plinthic Kandiudults) at the North Florida Research and Education Center / University of Florida in Quincy. In the experiment with cotton the following factors were: previous crop (white lupine - var. “Lunoble” and winter wheat - Pioneer 2684) and

N rate (0, 60, 120 and 180 lb N/A). Lupine was planted at the seeding rate of 155 lb/A in double rows during the last week of November. Winter wheat was planted at 90 lb/A in 7 inch wide rows at the end of November. Cotton was planted after harvest of white lupine and wheat in 36 inch row spacing at a seeding rate of 4 seeds per ft of row. The crop was grown from the last week of May to the second week of November. Nitrogen fertilizer in the form of ammonium nitrate was applied four weeks after planting of cotton, and 180 lb N/A rate, being divided into 120 lb N/A applied four weeks after planting and 60 lb N/A applied three weeks later.
The field experiments were static and conducted as split - plot with four replications. All results were analyzed statistically by analysis of variance for factor analysis, and means were separated using Fisher's Least Significant Difference Test at the 5% probability level. Analysis of linear and quadratic regression were added to the analysis of variance.

RESULTS

Significantly higher cotton lint yields were obtained after a previous crop of lupine than after wheat (Fig. 1). According to the regression functions, yields of cotton were highest with the application of 117 and 134 lbs N/A after lupine and wheat, respectively. The difference between previous crops was high at the rates of 0 and 60 lb N/A and 13.0 and 12.2% higher yields were obtained after lupine than wheat, respectively.

Plant number per square foot was influenced by nitrogen rates, and also by interaction of previous crop and nitrogen rates (Table 1). There was no difference in the plant number per square unit for previous crops. Differences in plant population due to nitrogen rates were smaller at 120 lb/A as compared to other N rates. Increasing nitrogen rates on cotton planted after wheat decreased plant population, but after lupine higher plant population was obtained at 60 and 180 lb N/A.

Boll number per square foot is shown in Fig. 2. The number of bolls was significantly higher after lupine than wheat, and was increased with increasing nitrogen rates for cotton planted after lupine and wheat. The maximum number of cotton bolls per square foot was obtained with the application of 180 lb N/A for both previous crops.

The regression functions for the boll number per plant are shown in Fig. 3. According to this regression, the highest theoretical boll number per plant was obtained with the application of 98 lb N/A after lupine and 145 lb N/A after wheat. Application of higher than 98 lb N/A after lupine significantly decreased the number of bolls per plant.

Table 2 shows the weight of lint per boll. The lint weight was influenced by previous crop. Lint weight of cotton after wheat averaged 2.12 gms and was 3.4% higher than the weight obtained from cotton grown after white lupine. There was no difference between N rates and no interaction of previous crop and N rates.

Plant heights were generally taller after lupine than wheat (Fig. 4). The regression functions show increased plant height with increasing N rate, and the highest value was obtained at 120 lb N/A after lupine. After wheat taller plants of cotton were obtained at the maximum application of nitrogen.

CONCLUSIONS

The lint yield of cotton was significantly higher after white lupine than wheat. The response of cotton to nitrogen fertilization was influenced by previous crop, but using higher than 60 lb N/A after lupine was not economically substantiated, and calculated theoretical rates to obtain maximum lint yields were 117 lb N/A after white lupine and 134 lb N/A after wheat.

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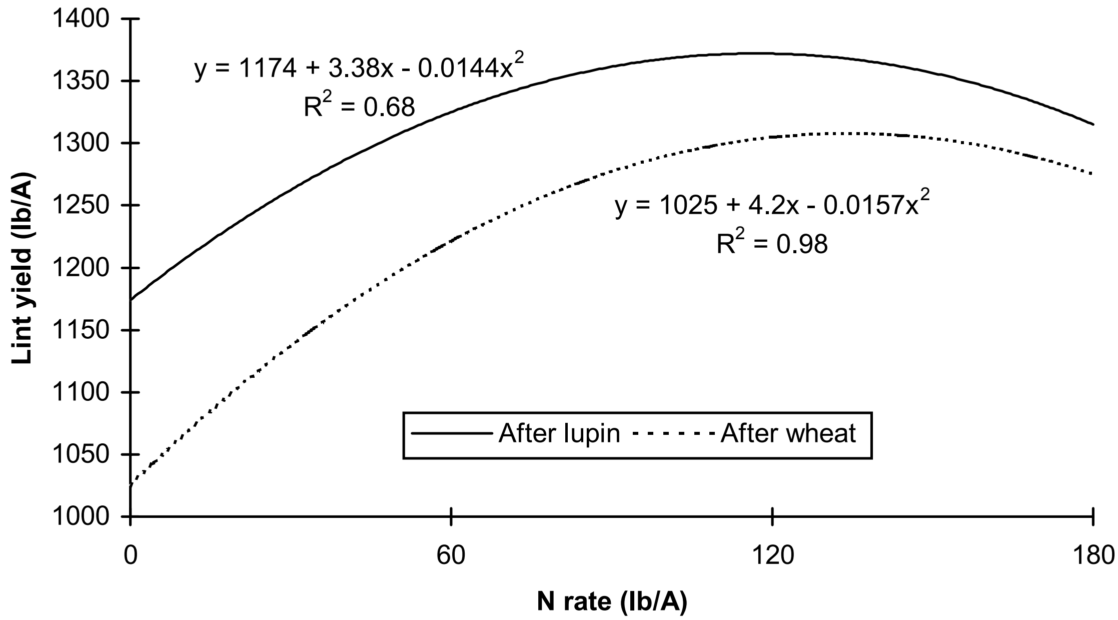

Fig. 1. Functions of nitrogen production for cotton yields after lupine and wheat.

Table 1. Influence of previous crop and nitrogen rates on plant number per sq. ft.

Previous crop	N rates (lb/A)				Mean
	0	60	120	180	
	------------------ plants / sq. ft. ------------------				
Lupine	53.8	58.0	51.2	57.7	55.2
Wheat	59.3	55.0	52.7	53.3	55.1
Mean	56.6	56.5	52.0	55.4	-

$LSD_{(0.05)}$ for previous crop - NS
$LSD_{(0.05)}$ for N rates - 1.39
$LSD_{(0.05)}$ for interaction - 1.96

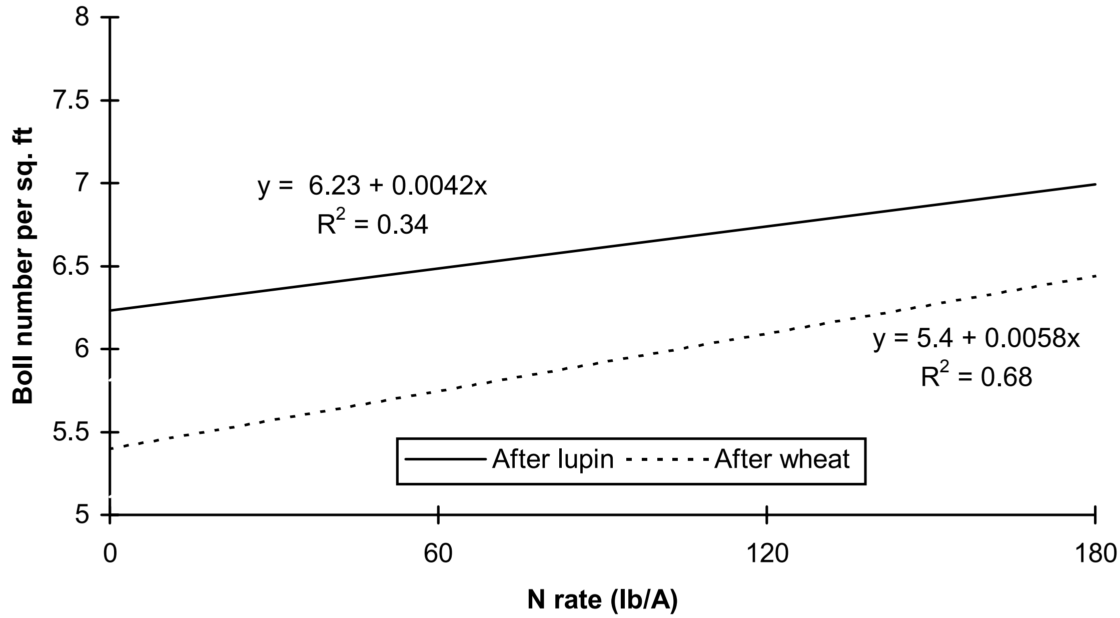

Fig. 2. Functions of nitrogen production for boll number per square foot.

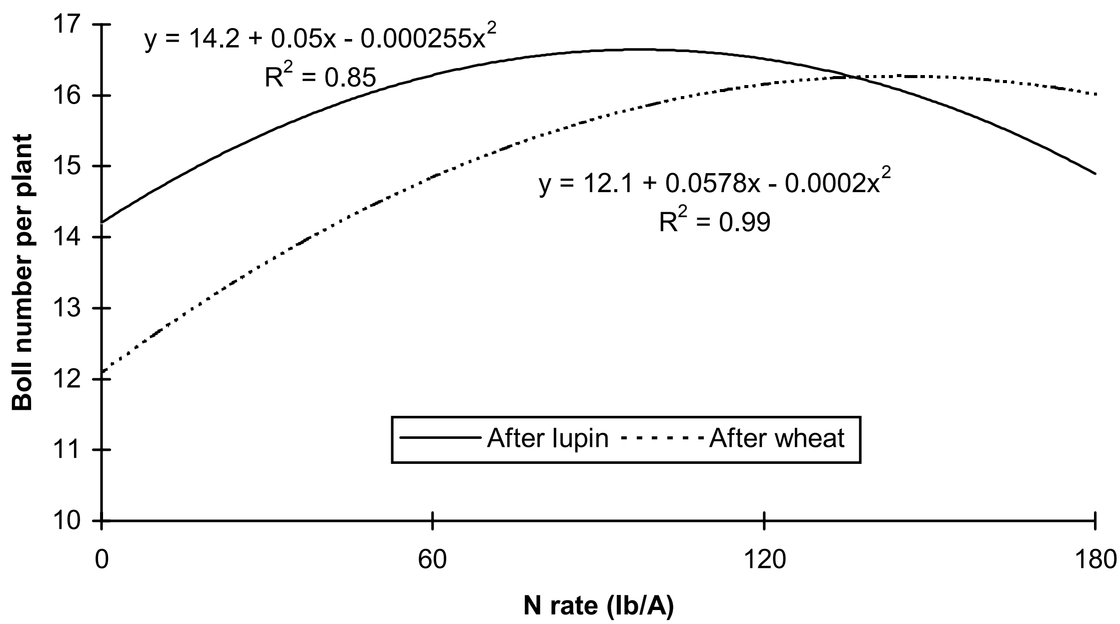

Fig. 3. Functions of nitrogen production for boll number per plant after lupine and wheat

Table 2. Influence of previous crop and nitrogen rates on lint weight per boll

Previous crop	N rates (lb/A)				Mean
	0	60	120	180	
	------------------ gram / boll ------------------				
Lupine	2.038	2.035	2.036	2.074	2.046
Wheat	2.071	2.106	2.197	2.110	2.121
Mean	2.054	2.071	2.117	2.092	-

$LSD_{(0.05)}$ for previous crop - 0.045
$LSD_{(0.05)}$ N rates - NS
$LSD_{(0.05)}$ for interaction - NS

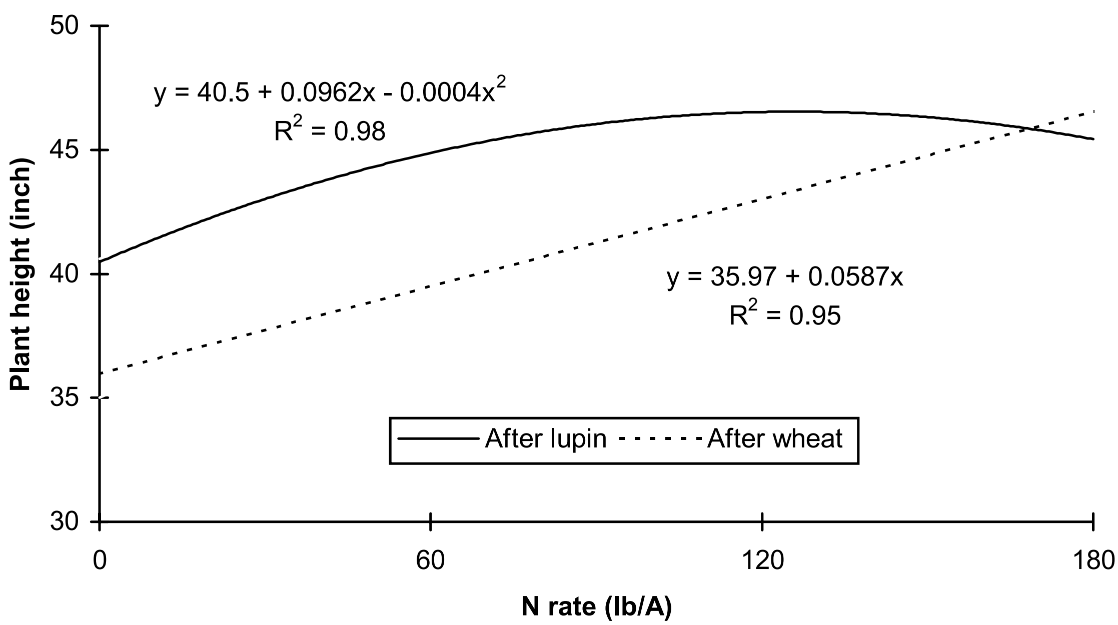

Fig. 4. Functions of nitrogen production for plant height