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SELECTED FOLIAR CORON® APPLICATIONS AS AN AID IN COTTON FERTILITY MANAGEMENT

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Introduction

Nitrogen is the nutrient most required by cotton, however less than 50% of soil applied N is recovered by cotton plants (Morrow and Krieg, 1990). Due to the rising cost of fossil fuels, N fertilizer cost is increasing rapidly. Optimizing N fertilizer rates are important, because a lower rate will limit yields, while excessively high rates promote vegetative growth (Hutchinson et al., 1995). Another reason for maximizing N fertilizer use is the environmental concerns from nitrates in runoff and ground water. Improving N fertilizer use efficiency could involve replacing a portion of soil applied N with a slow release foliar source. There are advantages to foliar feeding including rapid and efficient plant response to nutrient needs, and treatment implementation under adverse field conditions. However, there are some disadvantages. Those would include inconsistencies in plant responses, and difficulties in suppling adequate quantities of fertilizer (Oosterhuis et al., 2000). Past research with N foliar feeding to plants has largely involved KNO_3 or feed grade urea. The problem with feed grade urea is that it is difficult to dissolve in water, and once applied it is easily washed off the leaf by rainfall (Kenty et al., 2002). A slow release foliar N fertilizer, that is readily available for uptake as needed, could eliminate some of the inconsistencies and improve production cost. Earlier research conducted by Howard in 1988, showed that cotton responded to foliar N when 80 lb of N was applied at planting. However, later research by Howard et al., (2001) showed soil applied N at higher than recommended rates failed to boost yields. A response to foliar N may be more likely when applications are made close to flowering, because the N demand is greater at this time. The use of soluble and slow release N fertilizer source for foliar feeding for timely availability may have an impact on lint yields and fertilizer use efficiency. This research evaluated CoRoN as a potential product satisfying such a need. CoRoN is composed of 25% control release N(long chain of polyethylene urea) coupled with 75% foliar urea(fast release low biuret urea) (Helena Chemical Co.). It is a non-drying foliar fertilizer in nature, that retains moisture therefore reducing crystallization on the leaf. Also, the slow release CoRoN reduces the chance of NH3 volatilization and is believed to adhere tighter to the plant leaf. With this in mind, our objectives in this study were to determine if (1) reducing the N soil test recommended rate of 60-20-0 by 1/3 to 40-20-0 followed by foliar feeding can sustain cotton yields and (2) can lint yields be increased above those from soil test recommended N rate due to foliar nutrition. Also, an additional purpose of this study was to evaluate the addition of HM9754 to N fertilizer at both the recommended and the 2/3 recommended rates for their influence on lint yields and fiber properties.

Materials and Methods

The experimental site was located at the TAMU Research Center in Corpus Christi, TX. on an Orelia sandy clay loam soil (Hyperthermic Typic Ochraqualf). At the start of the experiment this soil has a pH of 8.21, soil nitrate of 16 ppm (low-med), extractable P at 43 (medium) and exchangeable K at 381 ppm (high). At the end of year 3 the soil nitrate values were 62 ppm (high) due to fertilizer carryover while extractable P, remained at medium. The experiment involved two levels of fertility, the first using the recommended soil test rate of N at 60 lbs with 20 lb of P_2O_5/ac and the second level was 2/3 of the recommended rate of N or 40 lb with 20lb P_2O_5/ac. Fertilizer, was banded pre-plant 6" to the side of the seed row and 3" below the seed zone. DPL 436RR cotton was used in the three year test. In all years a 2/3 rate of N was compared to the soil test recommended rate. Both of these rates were also compared with and without foliar CoRoN (25-0-0) in year 1-2; (10-0-10+0.5B) in year 3. In all years, APP (11-37-0) and Uran (32-0-0) fertilizers were used in a preplant blend producing a recommended rate of 60-20-0, and a 2/3 recommended rate of 40-20-0. Only in year 3 an addition of HM9754 at 1 gal/ac to Uran and APP was made to selected treatments. The potential benefit of HM9754 is an improved uptake of applied fertilizers. All treatments were arranged in a RCB design with 4 replications.

The plant nitrate and K levels were monitored at weekly intervals from pinhead square through cutout using a Cardy meter. Land preparation in year 1 included a bed and re-bed tillage system, followed by fertilization and planting on April 9. In year 2 following stalk shredding, sweep cultivation was performed. Treflan incorporation was completed in December and fertilizer treatments were banded in February. Due to shortage of planting moisture, replanting was completed on April 24.. In this second year to insure a good stand we manually irrigated from nurse tanks.

In year 3 the experiment was conducted with reduced tillage. Middles were run with buster sweeps then the stalks were undercut with a McElroy root plow to maintain our fertilizer band from the previous year. Following preplant fertilization ,planting of the nine treatments was finished on April 14. A blanket foliar application of CoRoN 12-0-0+5%B was applied at 1 qt/ac at pinhead square. Also, a blanket foliar application of Ele-Max® Phos-Cal was applied at 2 qt/ac during 50% bloom. When tissue nitrate levels reached preset weekly thresholds from first bloom through cutout, foliar applications of CoRoN 10-0-10+0.5%B were made at a rate of 1 gal/ac.

Results

Lint yields for the three year study are presented in Figures 1-5. Since treatment modifications and additions were made following the first two years, the data will be discussed in two phases. In a comparison of the first two years, year 1 (2001) yields were considerably lower due to drought and averaged 76% of those in year 2 (2002). Lint yield from year 1 showed a near significant decrease due to N rate reduction to 2/3 of the recommended rate (Fig. 1). Applying CoRoN (25-0-0) significantly increased lint yield over the 2/3 rate and the control. The addition of foliar B at 0.2 lb/ac failed to produce an additional yield response. In year 2 there were no statistically significant lint yield responses. Inadequate rainfall during critical stages of fruit set and boll development contributed to relatively low yields even though yields improved over year 1.

In year 3 due to favorable rainfall, lint yields increased by 146% over year 1, and by 86% over year 2. Good soil moisture in year 3 and nitrogen carryover in the soil from previous years were the principal reasons. In this third year, lint yields were reduced only slightly when the recommended rate was reduced by 1/3. A possible explanation for the insignificant effect of N rate reduction on lint yield, involves the relatively high soil nitrate levels at the start of the growing season due to residual fertilizer N resulting from drought in the first two years. Results of fiber quality are presented in Table 1. Results show no statistically significant differences in micronare, fiber length, fiber strength, or uniformity across all treatments.

Petiole values were taken weekly from pinhead square through cutout in year 3, with the exception of week 2 when heavy rainfall prevented accessability to our test site. Nitrate data show cotton plant petioles in the unfertilized treatments contained significantly less nitrate than petioles in all the fertilized cotton (Figs. 6-8).

At the soil test recommended rate of N fertilization, foliar applied CoRoN had no effect on petiole nitrates. However at 2/3 recommended rate, CoRoN significantly increased petiole nitrate at mid-season (weeks 3-4). On the other hand, the fertilizer amendment, HM9754, applied to the soil significantly increased petiole nitrate at weeks 1, 3, and 5. At the 2/3 recommended fertilizer rate, HM9754 significantly increased petiole nitrate at mid-season (weeks 3-4) but when combined with foliar applied CoRoN showed no additive or synergistic effects on tissue nitrates. These beneficial effects of HM9754 and CoRoN on petiole nitrate failed to be reflected in lint yield increases. Correlative analysis between lint yield and petiole nitrate were not statistically significant (Fig. 9).

Results of petiole K levels monitored at the same time as petiole nitrates are presented in Figures 10-11. The soil used in this study contained a high K content, therefore we did not anticipate a need for foliar K. As expected in the recommended rate treatment, the K content was extremely high early season. The petiole K values measured close to the critical values, therefore no extra applications of K were applied, except what was contained in the CoRoN (10-0-10+0.5%B). The 2/3 rate treatments followed a similar trend as that of the recommended rate, and again there were no statistical differences in petiole K due to treatment at the mid-season sampling (weeks 3-4). Potassium levels varied widely in the control only at the first and last sampling at both the recommended and 2/3 recommended N rates.

Summary

A response to N fertilizer either soil or foliar applied was generally not significant. The exception was in year 1 when the 2/3 rate plus CoRoN produced a significant yield response. In years 2 and 3 reducing the N fertilizer rate had no significant effect on lint yield. Overall, treatment effects on yield were not significant even though in year 3 yields doubled those of the previous two. The petiole nitrate and K levels generally remained adequate during the monitoring period and did not correlate with yields. With the addition of both the HM9754 and the CoRoN to the 2/3 recommended rate, petiole nitrates increased significantly at mid-season, but did not correlate with yield increases. Fiber quality did not change significantly among treatments.

Disclaimer

Information presented here is not to be construed either as a recommendation for the use or an endorsement of a specific product by Texas A&M University.

Acknowledgments

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Table 1. Fiber properties as affected by treatments in year 3 of the study (APF-03).

Treatment	Micronaire	Length	Strength	Uniformity
Rec. Rate N-P-K	4.7	1.16	28.2	84.9
2/3 Rec. Rate	4.7	1.16	28.2	84.8
RR + HM975	4.8	1.16	28.9	84.4
2/3 RR + 9754	4.9	1.15	27.9	84.1
RR + CoRoN	4.7	1.16	28.7	84.5
2/3 RR + CoRoN	4.8	1.16	28.5	84.2
RR + HM9754 + CoRoN	4.8	1.16	28.4	84.8
2/3 RR + HM9754 + CoRoN	4.7	1.17	28.7	84.3
Control	4.8	1.16	27.9	84.9
LSD 0.05	n.s.	n.s.	n.s.	n.s.

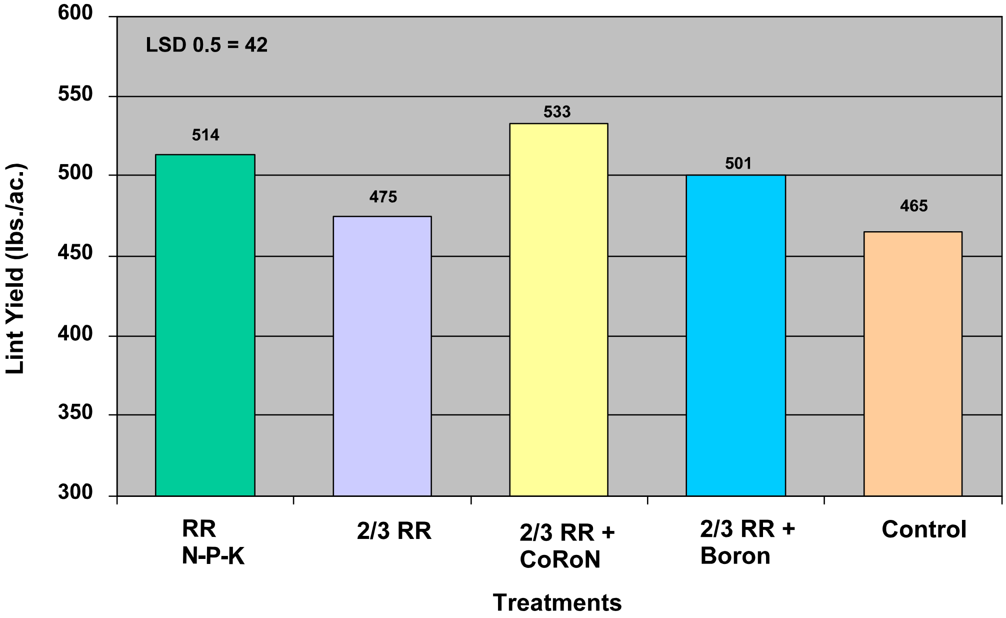

Figure 1. Lint yields as affected by soil applied N and foliar treatments. RR = soil test recommended rate (60-20-0); 2/3 RR = 2/3 rate (TAES, year 1).

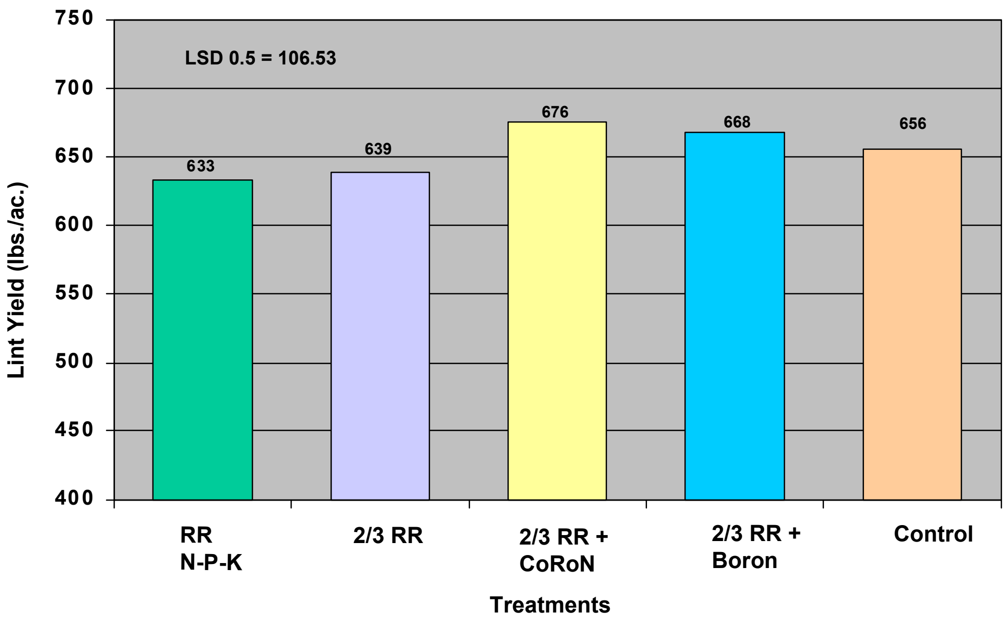

Figure 2. Lint yields as affected by soil applied N and foliar treatments. RR = soil test recommended rate; 2/3 RR = 2/3 rate (TAES, year 2).

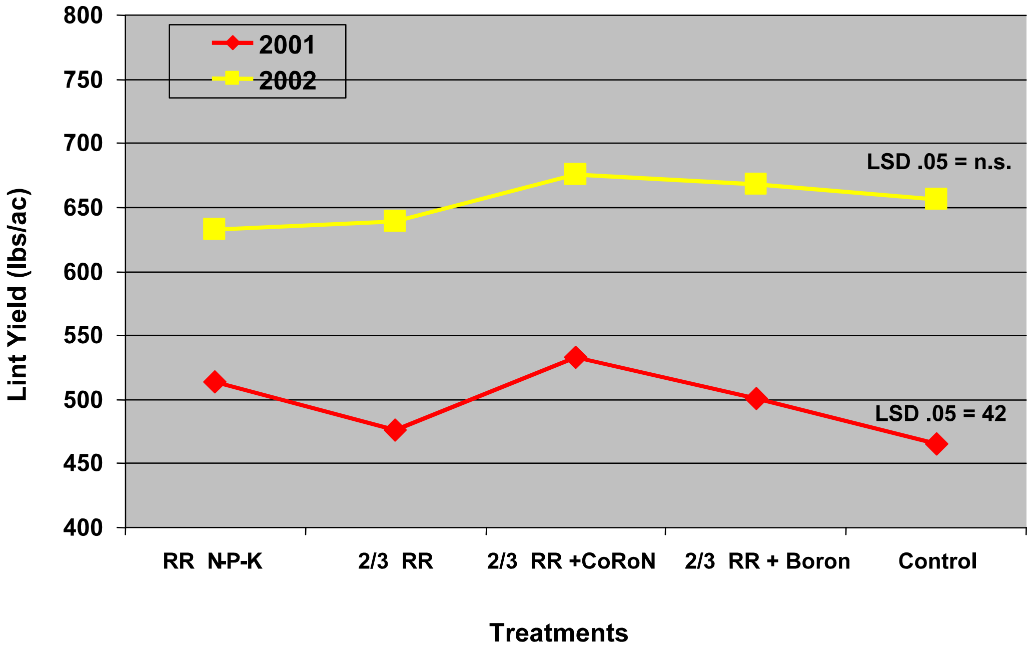

Figure 3. Lint yield comparisons for year 1 and 2 of the study evaluating soil applied and foliar treatments. RR = soil test recommended rate; 2/3 RR = 2/3 rate (TAES, year 1-2).

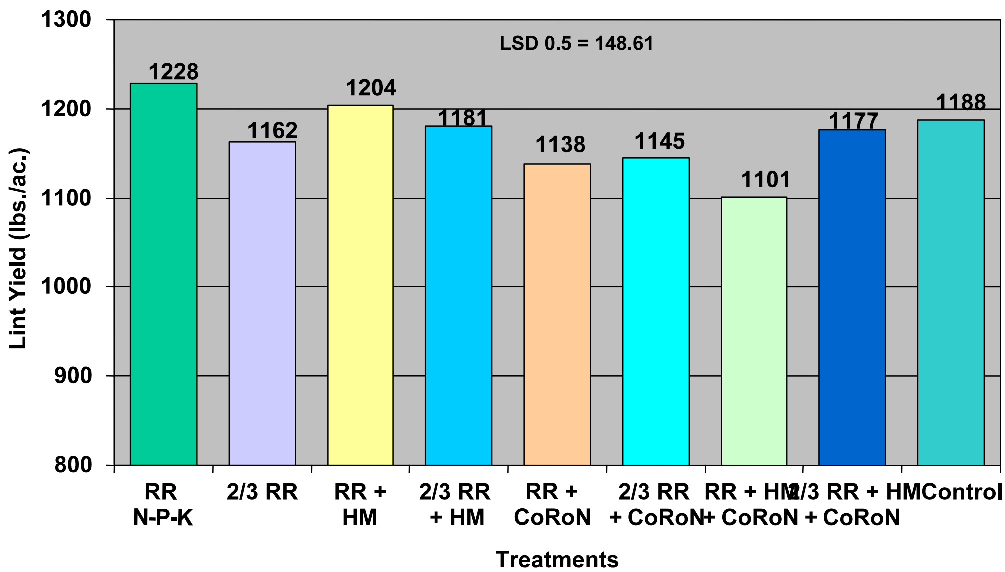

Figure 4. Influence of reduced rates of soil applied N with and without slow release foliar N and other fertilizer amendments on yields. RR = soil test recommended rate; 2/3 RR = 2/3 rate; HM = HM9754 (TAES, year 3).

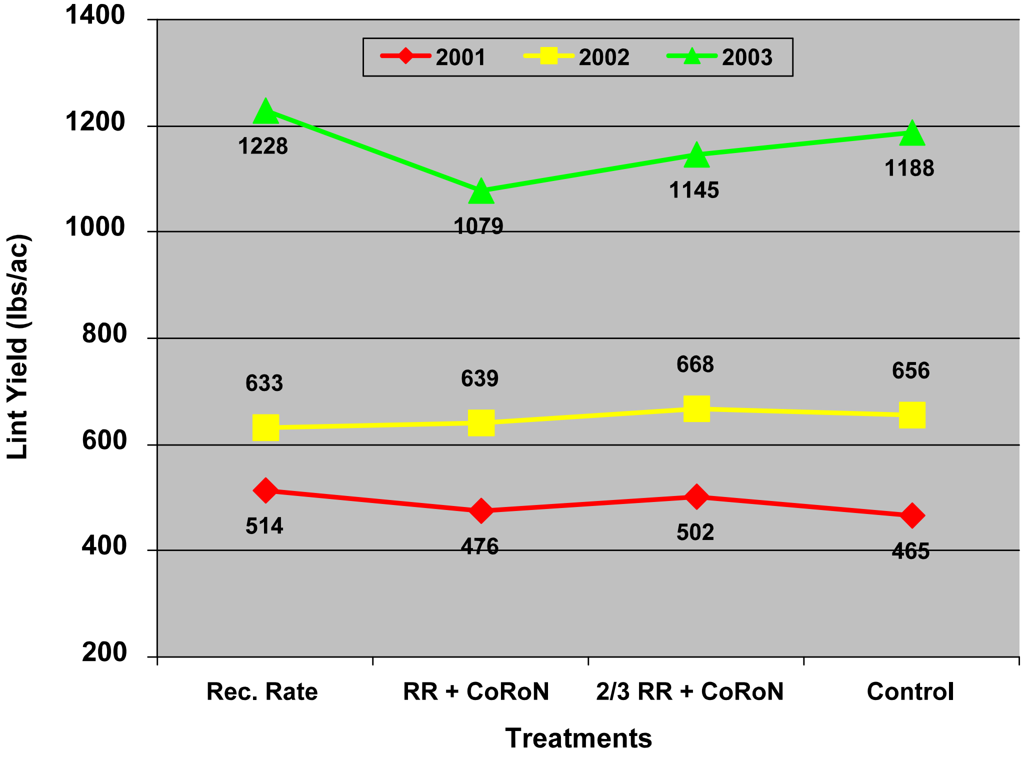

Figure 5. Comparison of identical treatments for this 3 - year study. RR = soil test recommended rate; 2/3 RR = 2/3 rate (TAES, year 1-3).

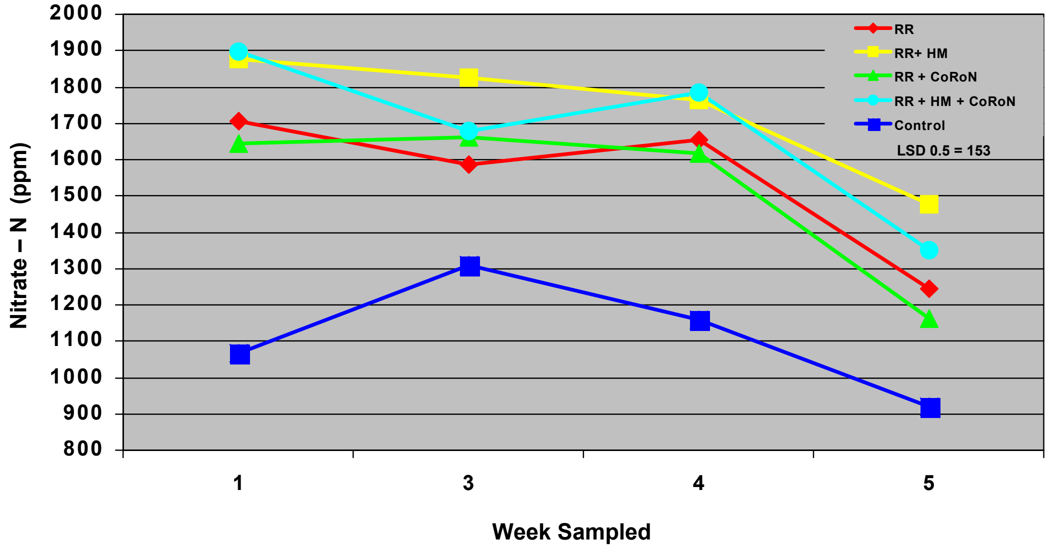

Figure 6. Petiole nitrate values for the soil test recommended fertilizer rate and additional soil applied and foliar treatments. RR = soil test recommended rate; 2/3 RR = 2/3 rate; HM = HM9754 (TAES, year 3).

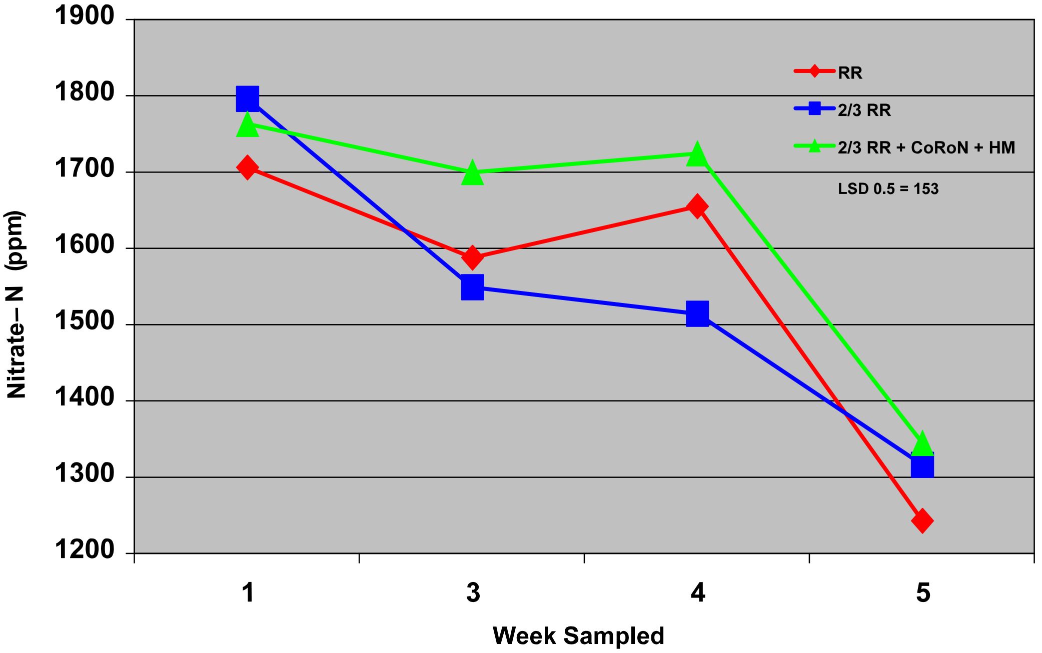

Figure 7. Petiole nitrate values for the soil test 2/3 recommended fertilizer rate and additional soil applied and foliar treatments. RR = soil test recommended rate; 2/3 RR = 2/3 rate; HM = HM9754 (TAES, year3).

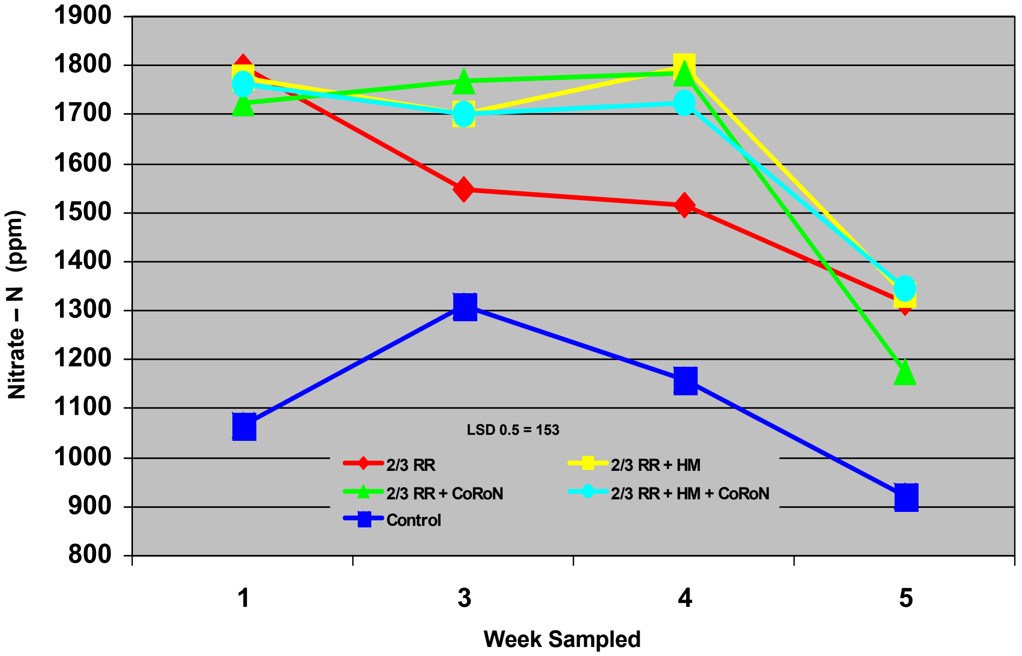

Figure 8. Petiole nitrate values comparing the recommended rate and 2/3 recommended rate treatments plus foliar sprays with 2/3 rate. RR = soil test recommended rate; 2/3 RR = 2/3 rate; HM = HM9754 (TAES, year3).

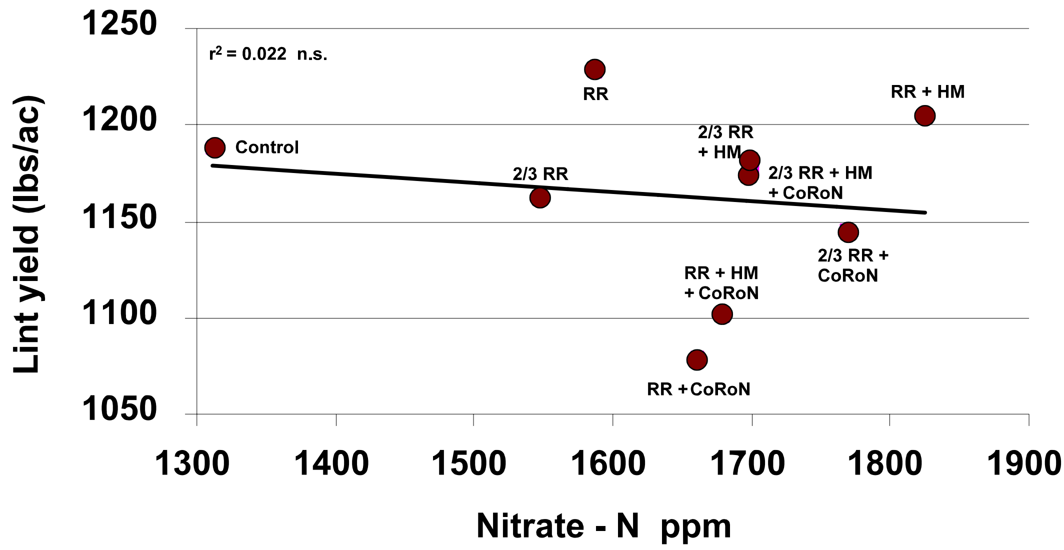

Figure 9. Results of correlative analysis between mid-season petiole nitrates and lint yields. (TAES, year 3).

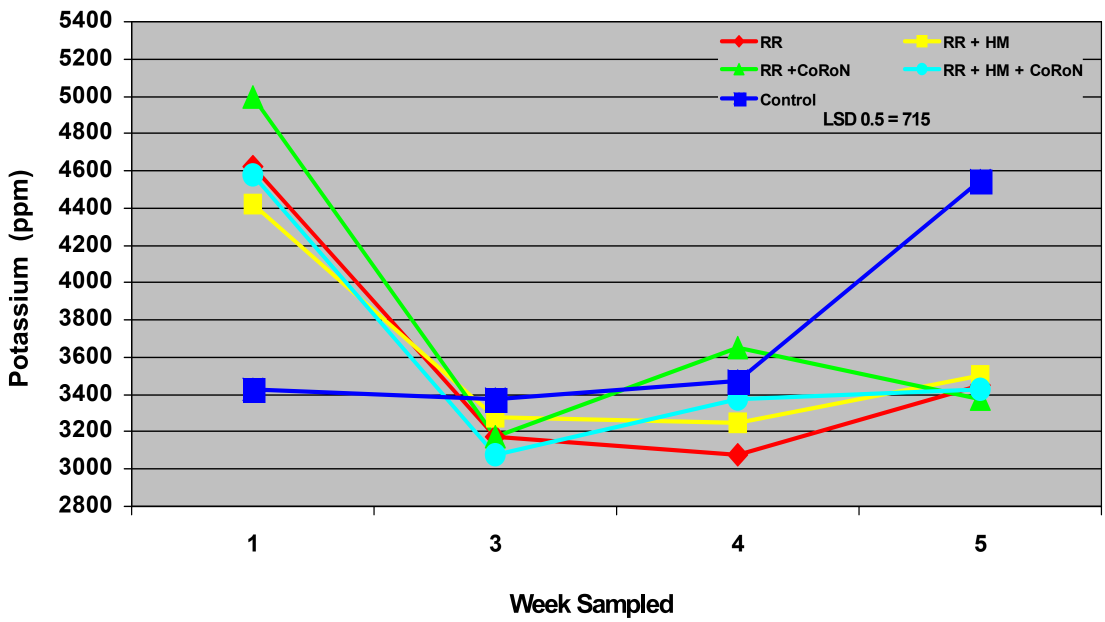

Figure 10. Petiole K values for soil test recommended fertilizer rate treatments. RR = soil test recommended rate; HM = HM9754 (TAES, year 3).

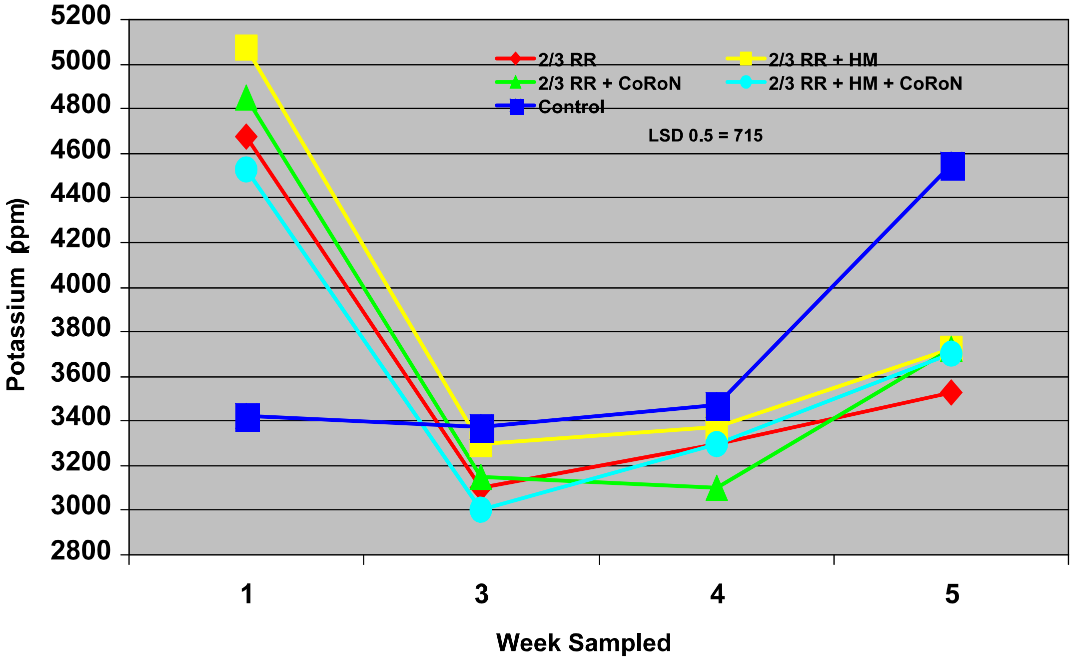

Figure 11. Petiole K values for soil test 2/3 recommended fertilizer rate treatments. 2/3 RR = 2/3 soil test recommended rate; HM = HM9754 (TAES, year 3).