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UTILIZATION OF CORON® TO COMPENSATE NITRATE DEFICIENCIES IDENTIFIED BY PETIOLE ANALYSIS

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Introduction

Traditionally, fertility programs in cotton (*Gossypium hirsutum* L.) have consisted of preplant and /or early season applications of fertilizers based on recommendations following soil analysis. As the EPA implements comprehensive Nutrient Management Plans for all aspects of agriculture it may become necessary to manage nutrient applications to meet plant requirements differently than in the past. Foliar applying nitrogen (N) and/or potassium (K) has been widely used to supplement soil applied fertilization (Oosterhuis, 1999).

Oosterhuis (1999) summarized the advantages and disadvantages of foliar fertilization in cotton. Some of the advantages listed were low cost, quick plant response, correct nutrient deficiencies, and increased yield and quality. The major disadvantages were related to the physical properties of the fertilizers used, rather than the ineffectiveness of the product. He concluded that foliar fertilization is a viable means of supplementing soil applied fertilizers.

Petiole analysis is available to the producer as a tool to identify NO_3-N and K deficiencies in a crop during the growing season. In addition to the standard lab analysis, Cardy portable electrode-based NO_3-N and K ion meters (Horiba, Ltd., Kyoto, Japan) are available to perform petiole analyses. The Cardy ion meters offer crop advisors the ability to quickly evaluate crop N and K levels relative to growing conditions. Cardy meters have been widely used in vegetable production with NO_3-N and K thresholds established for several crops (Maynard and Hochmuth, 1997). Smith, et al. (1997) concluded that a Cardy NO_3-N meter could be a valuable diagnostic tool for use in cotton.

Subsequent to identifying NO_3-N and K deficiencies, foliar applications of appropriate fertilizers can be made to supplement the soil applied fertilizers. There are many forms of N and K available to producers for foliar fertilization including CoRoN®. CoRoN, a liquid nitrogen that comes in several formulations, can be foliar applied to a multitude of crops.

In a previous study, Coburn, et al. (2001) determined petiole nitrate levels were impacted by foliar applications of CoRoN. They showed a positive trend towards higher yields with the CoRoN applications. The objectives of this study were to evaluate: 1) the utility of CoRoN formulations to compensate for NO_3-N and K deficiencies as identified by petiole analysis; and 2) the impact of CoRoN N and K treatments on cotton yield and lint quality.

Materials and Methods

Seven locations within five Mid-South cotton producing states were selected for the evaluations. The locations were selected in an attempt to encompass the annual fluctuations in environmental conditions where production cotton is grown. Cooperators were given the option of conducting a large strip trial or a small replicated trial within production fields. Locally adapted agronomic practices were followed at each location. Research locations and agronomic data is reported in Table 1 by location.

Four foliar treatments consisting of two formulations of CoRoN (25-0-0 0.5% B and 10-0-10 0.5% B) were evaluated against an untreated check. The treatments are to supplement standard soil N and K applications. The treatments and timing of application are listed in Table 2.

Petioles were randomly sampled weekly from the two center plot rows of each treatment. Petiole evaluations were started approximately two weeks prior to first bloom and continued through cutout. From each plot, approximately 20-30 petioles were collected from the most mature leaf, generally the fourth below the terminal, throughout the season.

Prior to each sampling both the NO_3-N and K Cardy meters were calibrated in accordance with the procedures and standards provided with each meter. The fresh petioles were cut approximately ½" in length and placed in a garlic press for sap extraction. As the crop matured, it was necessary to place the petioles in a freezer for approximately 20 minutes to rupture the cell walls facilitating sap extraction. The sap extract was placed directly on the sensor pad of each Cardy meter and the readings were recorded. Generally, 3 – 5 readings were obtained and averaged for each plot.

The weekly readings for each plot were compared against the threshold concentrations outlined in Table 3 to determine the need of an additional foliar application.

Following the initial applications of CoRoN 25-0-0 0.5%B or 10-0-10 0.5%B, in treatments 1 and 4 respectively, additional application(s) were made based on NO_3-N and K thresholds (Table 3).

The individual locations were treated as replications and an ANOVA and Duncan's LSD (Gylling Data Management, 2001) were performed on the yield data. Additionally, treatments 1 and 5 are the same as treatments 2 and 5 in the 2000 study (Coburn et al., 2001) and the mean yields for these treatments from each year (2000 and 2001) are compared.

Results and Discussions

At all locations the study was as conducted as a strip trial except for the Tillar, AR location at which the study was conducted as a small plot replicated trial. The other six locations had a single strip plot for each treatment. The lint yields from each location are reported in Table 4.

The yields from Cheneyville, LA and Tillar, AR were not included in the statistical analysis of the yield. The LA location was not included due to the extremely high incidence of boll rot (>50%). Since the AR location was a small plot replicated trial and not a strip plot trial, the mean yields from AR were not included in the analysis. An ANOVA was performed on the yield data from the remaining five locations. The ANOVA indicated that the lint yields from the five locations were significantly affected ($P = 0.035$) by the CoRoN treatments. Although the yields for all four CoRoN treatments were numerically higher, only the yield from treatment 4 was significantly higher than the check ($P = 0.1$) with an average increase of 67.4 lbs. lint /A over the untreated. The mean yields are shown in Figure 1.

Treatments 1 and 4 had 2 – 4 gals./A of their respective CoRoN formulations applied based on petiole analysis determination at each location. It is apparent from the yield data that the addition of one or more gals./A CoRoN 10-0-10 0.5% B increased lint yield. The data indicates a positive, and even significant ($P = 0.1$, treatment 4), yield response to multiple foliar applications of both N and K over the check. Apparently the K was essential for the higher yields since the basic difference between treatments 1 and 4 is the K application. Also, as Coburn et al. (2001) demonstrated, applications of two or more gals./A of CoRoN 25-0-0 0.5% B increased lint yield when compared with the check yield. Although not statistically significant the two-year average increase for CoRoN 25-0-0 0.5% B over the untreated was 22.7 lint lbs./A (Figure 2).

At most locations the additional treatments applied in treatment 1 and 4 were trigged by NO_3-N, rather than K, deficiencies. Although applications of CoRoN 10-0-10 0.5% B in treatment 4 were triggered by a NO_3-N deficit, the K application improved yields (+ 35 lint lbs./A) when compared with treatment 1 (Figure 1). In this research, the addition of K as a foliar component with N (CoRoN 10-0-10 0.5% B) increased yields when compared with foliar applying N (CoRoN 25-0-0 0.5% B) when 2 – 4 gals./A of both materials were applied.

The lint quality at most locations classed out at 31 or 41, with a few 42. Since there were very few differences observed in lint quality among treatments in this study quality will not be discussed.

Conclusions

Foliar applying two or more gals./A of CoRoN 10-0-10 0.5% B increased average lint yields from six locations throughout the Mid-South cotton producing states. The actual application rate varied after the initial gallon and was applied only when petiole analysis indicated petiole N was below the threshold level. Applying K in combination with N as a foliar treatment was essential for higher yields relative to foliar applying only N.

Literature Cited

Coburn, G., M.M. Kenty, J. Townsend, T. Crook, C. Turney, and R. Renfroe. 2001. Utilization of CoRoN® to compensate nitrate deficiencies identified by petiole analysis. Vol. 1:514. Proc. Beltwide Cotton Conf. National Cotton Council, Memphis, TN.

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Table 1. Locations and agronomic information.

Location	Variety	PD	HD	Plot Size	Irrigated
Tanner, AL (gray loam)	DPL 451BR	5/02/01	10/30/01	0.35 A	No
Tanner, AL (red loam)	SG 521 RR	4/25/01	10/19/01	0.54 A	No
Merdianville, AL	DPL 215	4/26/01	11/02/01	10 A	No
Tillar, AR	PM1218 BR	5/11/01	10/19/01	0.015 A	Yes
Cheneyville, LA	STV 4892 BR	4/30/01	10/25/01	10 A	No
Friars Point, MS	PM1218 BR	4/25/01	10/02/01	10 A	Yes
Somerville, TN	SG 125 BR	5/2/01	11/02/01	~ 6.5 A	No

Table 2. Foliar treatment list.

Plot	Treatment	Rate	Growth Stage
1	CoRoN 25-0-0 0.5% B	1 gal/A	1st Bloom
	Followed by (Fb)		
	CoRoN 25-0-0 0.5% B	1 gal/A	Each time NO_3^--N dropped below threshold until cutout
2	CoRoN 10-0-10 0.5% B	1 gal/A	1st Bloom
3	CoRoN 10-0-10 0.5% B	1 gal/A	1st Bloom
	Fb		
	CoRoN 10-0-10 0.5% B	1 gal/A	1st Bloom + 10-14 days
4	CoRoN 10-0-10 0.5% B	1 gal/A	1st Bloom
	Fb		
	CoRoN 10-0-10 0.5% B	1 gal/A	Each time NO_3^- -N or K^+ dropped below threshold until cutout
5	Standard or check	-	-

Table 3. Nutrient thresholds for cotton.

Growth Stage	NO_3^- - N (ppm)	K^+ Level (ppm)
Through the 2nd week of Bloom	1132	3000
3rd week of bloom through cutout	905	2000

Table 4. Cotton lint (lbs./A) for all locations.

Plot	AL (1)	AL(2)	AL(3)	AR[2]	LA	MS	TN
1	1012	943	907	884	569	1046	917
2	972	916	872	867	657	1116	823
3	994	935	880	863	681	1159	847
4	1057	980	874	926	690	1185	902
5	973	905	868	799	697	.	824

1. AL(1) = Tanner (gray loam), AL(2) = Tanner (red loam), AL(3)= Meridianville.
2. Yields are the average of four replications.

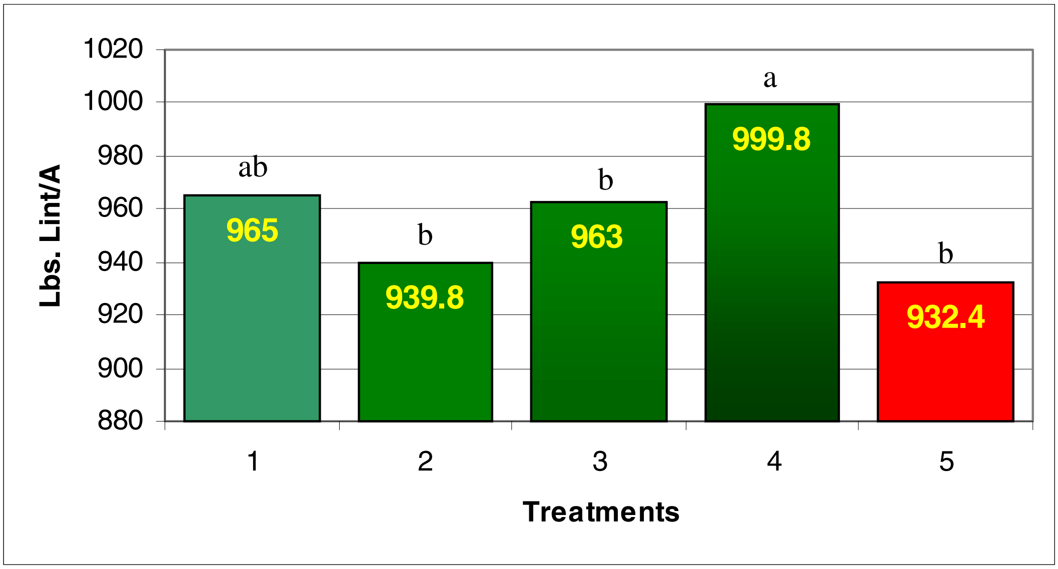

Figure 1. Average lint cotton yields of four CoRoN treatments vs. an untreated check.

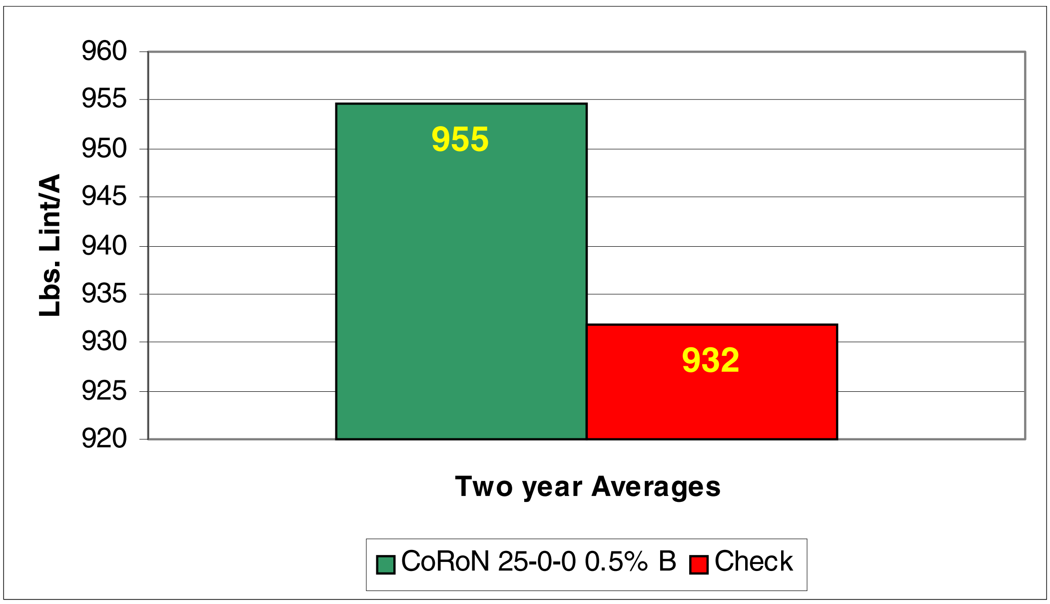

Figure 2. Effect of foliarly applying CoRoN 25-0-0 0.5% B fb CoRoN 25-0-0 0.5% vs. untreated check on two year average lint yields.