FOLOCRON CONTROLLED RELEASE FERTILIZER THE NEXT GENERATION IN FOLIAR-APPLIED NITROGEN

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Abstract

Folocron research across the Cotton Belt has given a consistent 10% lint yield increase from mid-season foliar applications. In Arkansas, California and Texas, yield responses have been associated with increases in boll numbers and boll weight. Other innovative research with Folocron on stressed cotton seedlings has shown enhanced growth after relief of the stress(Morse, et al 1996). Folocron has continued to demonstrate a higher return on investment over both foliar urea and the untreated control. Foliar fertilization with nitrogen (N) is continuing to advance as a standard management practice in the Cotton Belt even in the mist of recent reports of poor response to the applied fertilizer later than three weeks after first flowering. Controlled Release Nitrogen (CRN) fertilizers, such as Folocron may be the solution to these problems.

Introduction

Nitrogen (N) is used in large quantities throughout the life cycle of the cotton plant (Bassett, et al 1970), but difficulties arise in maintaining an adequate balanced supply during critical periods for optimum yield. Traditionally, nitrogen has been supplied as a preplant and sidedress application, and more recently foliar applications have been introduced.

While soil applications are the preferred method, conditions arise that call for the use of foliar fertilizers. Conditions favoring foliar feeding include; root growth problems, nematodes, poor soil conditions, etc. Advantages of foliar application methods include: rapid and efficient response to plant needs, less product needed and independence of soil conditions.

While foliar feeding in cotton has gained wide acceptance across the Cotton Belt, recent research has identified some short comings. The response to foliar N fertilization has been shown to decrease three weeks after first bloom (Keisling, et al 1995). This lack of response is partly due to increased canopy leaf age and wax content of the cotton leaf (Bondada, et al 1994). A possible solution to this dilemma is to use a controlled release nitrogen source that is released slowly to the plant for absorption into the leaf.

Folocron is a controlled release nitrogen (CRN) liquid fertilizer that contains 40% CRN and 60% foliar urea (White, et al, 1995); it is a unique combination of polymethylene urea coupled with fast release low biuret urea. This combination provides a foliar fertilizer that can be used as a superior nitrogen source for increased leaf absorption and improved yield. Folocron can be applied at higher rates than conventional foliar N fertilizers without concern for leaf burn. This product should alleviate problems of volatilization and lack of response to late season foliar N applications.

Early in the season, cotton often experiences adverse growing conditions which are detrimental to seedling development and yield. Producers and researchers have tried various techniques to alleviate these stress conditions during the growing season, including various foliar fertilizers without success. For example, Holman and Oosterhuis (1992a) and Holman et al. (1992b) in Arkansas applied foliar sprays of KNO_3 or urea to cotton seedling during a period of water stress with no significant effect on plant growth. Edmiston (1993) in Alabama had similar results on non-stressed cotton. Subsequent research in Arkansas has indicated that foliar fertilizers applied after relief of the water stress are beneficial for subsequent plant growth (Holman, unpublished). Recent research has shown that applications of controlled release nitrogen (CRN) during a drought stress is highly beneficial on subsequent plant growth upon relief of the stress (Oosterhuis, unpublished).

This paper provides a review of research conducted in Arkansas on the use of Folocron slow release fertilizer on cotton. Results are presented for: (a) mid-season foliar applications, and (b) growth parameters to determine N uptake in cotton.

Materials and methods

Field research was conducted in Arkansas under normal cotton production conditions. Field plots were completely randomized block design. Management of fertilizer, irrigation, weed control and insect control inputs were according to state extension recommendations. Standardized applications of Folocron and urea were applied at two and four weeks after first flower. Folocron and urea were applied at a rate of 10 lb. N/acre per application. Measurements were taken to record yield, petiole and boll nitrogen content, boll weight and quality.

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Results and discussion

Mid-season application

Yield

Folocron has been field tested on cotton for seven years in California, Texas and Arkansas (Table 1). Yields varied greatly between regions (depending on seasonal conditions) but overall there has been an average increase of 10% in lint yield. In Arkansas, lint yield increases have ranged from a high of 124 lbs./acre over the control to a low of 92 lbs./acre. In comparing Folocron to Foliar Urea the differences have ranged from 46 to 34 lbs./acre. Increase in yield was associated with an increases in boll number and boll weight. Leaf phytotoxicity was not a problem even at rates as high as 15 pounds of N per acre.

Yield components

In Arkansas, over a four year period, 1993-1996, yields have been consistent with Folocron generating a significant yield increase in 50% of the sites over the four year period (Table 2). Seasonal variance in growing conditions in the field will be the determining factor for increasing yields with any treatment applied during mid to late-season nitrogen applications. The boll weight was increased in 80% of all sites from Folocron applications (Table 3), along with an increase in boll numbers (Table 4). Total boll number was increased by Folocron while the boll number in the urea treatment was comparable to the untreated control. Folocron treatments have generally resulted in the highest boll weight compared to urea treatments and the control in the years that measurements of this type were taken. The number of harvestable bolls were also a factor in the overall success of Folocron as an enhancement to yield. There were no significant difference in harvestable bolls between Folocron treatments and Urea treatments while there was a significant difference between the Folocron and Urea treatments and the control. The primary difference between treatments across all years has been the boll weight (Figure 1).

Petiole, Leaf and Boll N Content

Beginning in 1994, petiole readings were analyzed from each treatment. The accumulated results indicate that Folocron will consistently increased the nitrogen concentration in the petiole, leaf and boll(Table 5). Movement from the leaf to the boll was significantly enhanced from the use of controlled release nitrogen as a foliar fertilizer. It appears that the characteristics of CRN's help to maintain higher percentages of nitrogen in the plant which in turn will maintain a greater content in the boll (Figure 2).

Research conducted in 1996 was more extensive in attempting to establish an uptake curve for Folocron within the plant at both the Fayetteville and Rohwer locations. In the Fayetteville study, petioles were taken 3,8,11,15,18 and 21 days after the second foliar application. There was a definite trend indicating higher uptake of nitrogen and maintaining the additional increased nitrogen through the bloom stage (Figure 3). The additional nitrogen absorbed into the leaf was translocated through the petiole to the boll. The same trend was evident in the total nitrogen content within the boll (Figure 4). In the Rohwer study, petioles were taken 4,7 and 11 days after the second application (Figure 5). By maintaining a higher nitrogen content in the plant, other nutrients and growth regulators were also maintained at a higher level as well (Table 6). Similar trends have been observed in previous years.

Conclusion

Folocron provides a unique method of foliar fertilizer application due to the slow nutrient release properties. Coupled with it's unique carrier characteristics for tank mixing with insecticides, Folocron provides a new opportunity to apply both crop protection chemicals and a foliar fertilizer in one pass (All, unpublished). Research has demonstrated that these properties can be advantageously used in foliar sprays during mid-season applications of nitrogen. Field research conducted over seven years provides a sufficient base to use Folocron as a replacement for foliar urea.

Literature cited

Bassett, D.M., Anderson, W.D., and Werkhoven, C.H.E. 1970. Dry matter production and nutrient uptake in irrigated cotton(Gossypium hisutum L.) Agron. J. 62:299-303.

Bondada, B.R., Oosterhuis, D.M., and Norman, R.J. 1994. Cotton leaf growth and foliar absorption. Arkansas Soil Fertility Studies 1994. Ark. Agric. Exp. Sta., Research Series 443, pp. 67-71.

Emiston, K.L., Wood, C.W., Burmester, C.H. and Mitchell, C.C., 1993. Foliar Fertilization of seedling cotton. Proceedings Beltwide Cotton Conference, Volume 3, p. 1304-1306.

Holman, E.M., Oosterhuis, D.M., and Hurren, R.G. 1992a. Effect of foliar-applied N and K on vegetative cotton. Arkansas Farm Research 41(1):4-5.

Holman, E.M. and Oosterhuis, D.M. 1993. Foliar fertilization of vegetative cotton in a waterlogged soil, and, or during cool temperatures. Arkansas Soil Fertility Studies 1992. Arkansas Agri. Exp. Stn., Research Series 425 p. 101-102.

Keisling, T.C., Mascagni, N.J., Maples, R.L., Thompson, K.C. 1995. Using cotton petiole nitrate-nitrogen concentration for prediction of cotton nitrogen nutrition status on a clay soil. J. Plant Nutrition 18:35-45.

Morse, S.G. and Oosterhuis, D.M., 1996. Early and Mid-Season advantages of Folocron, A slow release Nitrogen Fertilizer. Proceedings Beltwide Cotton Conference, Volume 2, p. 1348-1351.

Oosterhuis, D.M., Holman, E.M., and Hurren, R.G. 1992b. Foliar fertilization of drought-stressed cotton seedlings. Proceedings 1992 Cotton Research Meeting. Univ. Arkansas, Agric. Exp. Stn., Special Report 150 p. 26-29.

White, D.R., Morse, S.G., Oosterhuis, D.M. and Holman, E.M 1995. The effects of foliar applied controlled release nitrogen on uptake and yield on cotton in Arkansas. Proceedings Beltwide Cotton Conference, Volume 2, p. 1355-1356.

Table 1. Average yield response of mid-season applications of Folocron and Urea to field-grown cotton in Arkansas, California and Texas

	Yield (lb lint/A)		
Treatment	**Arkansas[2]**	**California[1]**	**Texas[2]**
Control	1123	1414	841
Folocron	1147	1681	867
Urea	1108	--	830

1. Two year average
2. Three year average

Table 2. Yield response of fielf-grown cotton to mid-season applications of Folocron and Urea in Arkansas, 1993-1996.

Yield (lb lint/A)

Treatment	**1993**	**1994**	**1995[1]**	**1996[2]**	**Average**
Control	862	895	1415	1272	1111
Folocron	986	987	1380	1204	1140
Urea	952	941	1398	--	1097

1. Yield response was negated by late season heat that forced the cotton plant to shed it's boll load prior to harvest.
2. Average of two sites.

Table 3. Boll weight from research plots in Arkansas, 1994 to 1996.

GRAMS (g)

Treatment	**1994[1]**	**1995[2]**	**1996[1]**	**1996[2]**
Control	4.83	4.21	5.00	5.01
Folocron	5.61	4.22	4.78	5.02
Urea	4.91	4.19	----	----

1. Research conducted at Fayetteville, Arkansas
2. Research conducted at Rhower, Arkansas

Table 4. Boll numbers for research plots in Arkansas, 1993 to 1996.

Treatment	**1993[1]**	**1994[3]**	**1996[1]**	**1996[2]**
Control	670,000	511,000	327,935	303,644
Folocron	693,000	554,000	315,789	319,838
Urea	630,000	550,000	----	----

1. Research conducted at Fayetteville, Arkansas
2. Research conducted at Rohwer, Arkansas
3. Research conducted at Marianna, Arkansas.

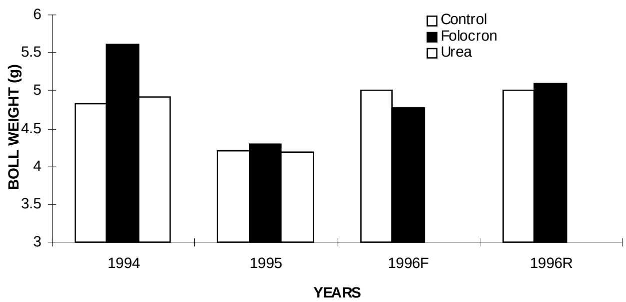
Table 5. Effect of Folocron petiole NO_3-N concentration in Arkansas, 1993 to 1996.

	WEEKS AFTER FIRST FLOWER					
TREATMENT	**W 1**	**W 2**	**W 3**	**W 4**	**W 5**	**W 6**
MARIANNA, ARKANSAS - 1993						
CONTROL	1049	336	50	47	47	
FOLOCRON	1360	487	53	85	51	
UREA	1497	356	118	51	37	
ROHWER, ARKANSAS - 1995						
CONTROL	12000	9700	12300			
FOLOCRON	11400	12300	13900			
UREA	11200	10700	13500			
ROHWER, ARKANSAS - 1996						
CONTROL	1476	315	220			
FOLOCRON	1328	732	451			
FAYETTEVILLE, ARKASAS - 1996						
CONTROL	170	430	360	340	230	200
FOLOCRON	240	590	440	430	290	190

Table 6. Petiole nutrient concentrations among treatments four, seven and eleven days after second the Folocron application, Rohwer, Arkansas, 1996.

Treatment	**NO_3-N (ppm)**	**P (ppm)**	**K (%)**	**S (ppm)**
Four days after application				
Control	1476 a[5]	1635 a	3.5 a	1072 a
Folocron[1]	1326 a	1856 a	4.1 a	1074 a
Folocron[1] + PGR-IV[2]	891 a	1908 a	3.7 a	1122 a
Folocron[1] + PGR-IV[3]	1958 a	1925 a	4.1 a	1098 a
Folocron[1] + Kcl[4]	1997 a	1830 a	4.2 a	1218 a
Seven days after application				
Control	315 a	1907 b	3.8 a	1099 a
Folocron[1]	732 a	2268 ab	4.4 a	1218 a
Folocron[1] + PGR-IV[2]	440 a	2145 ab	4.2 a	1122 a
Folocron[1] + PGR-IV[3]	189 a	2405 a	4.4 a	1141 a
Folocron[1] + KCl[4]	731 a	2076 ab	4.0 a	1061 a
Eleven days after application				
Control	220 b	2040 a	3.7 b	1114 a
Folocron[1]	451 ab	2314 ab	4.2 ab	1233 a
Folocron[1] + PGR-IV[2]	278 b	2183 ab	4.5 a	1154 a
Folocron[1] + PGR-IV[3]	312 ab	2511 a	4.5 a	1154 a
Folocron[1] + KCl[4]	692 a	2048 b	3.9 ab	1307 a

[123]foliar-applied
[2]Applied at PHS and FF
[3]applied at FF + three weeks
[4]tank mixed with Folocron
[5]Numbers followed by the same letter within a column are not significantly different (P=0.05).



1996F is research conducted at Fayetteville, Arkansas
1996R is research conducted at Rowher, Arkansas

Figure 1. The effect of Folocron and Urea on boll weight in Arkansas, 1994-1996.

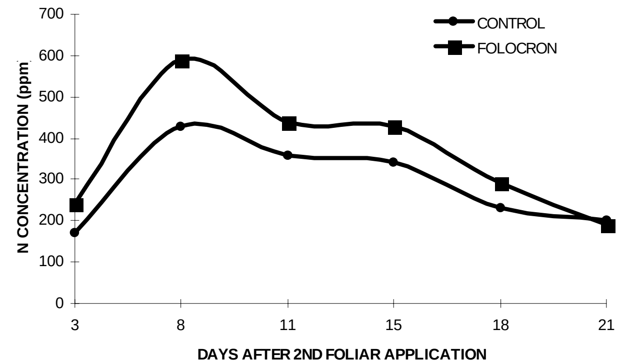


Figure 3. Nitrogen uptake curve of petiole samples from the Fayetteville, Arkansas, 1996.

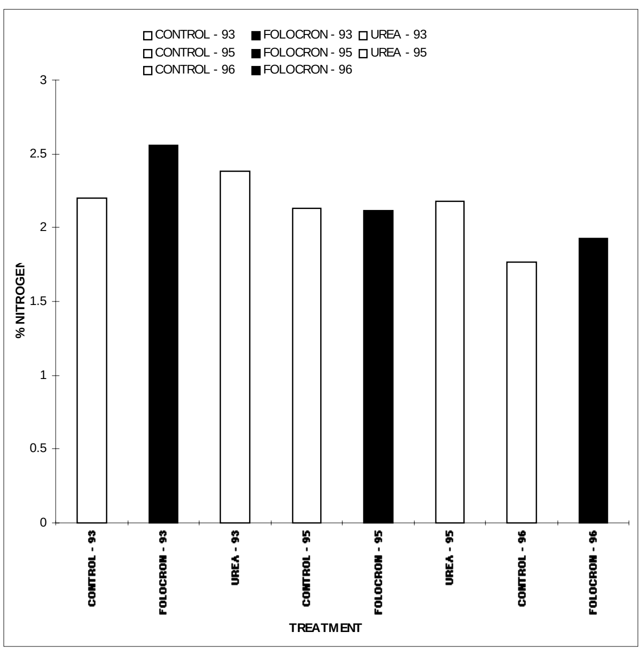


Figure 2. Accumulated effect of Folocron and Urea on nitrogen content in the boll, 1993-1996.

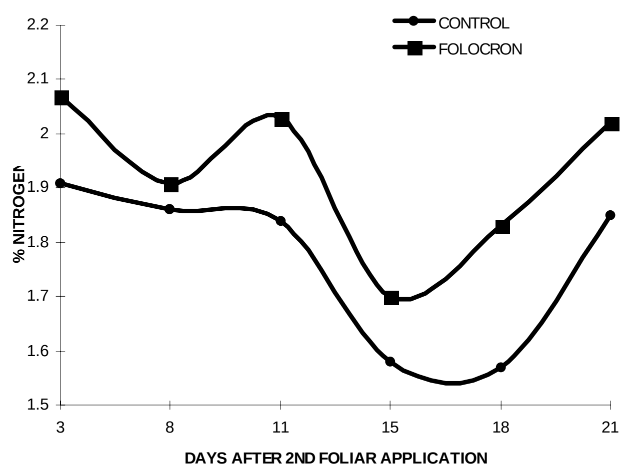


Figure 4. Nitrogen uptake curve in the boll samples from Fayetteville, Arkansas, 1996.

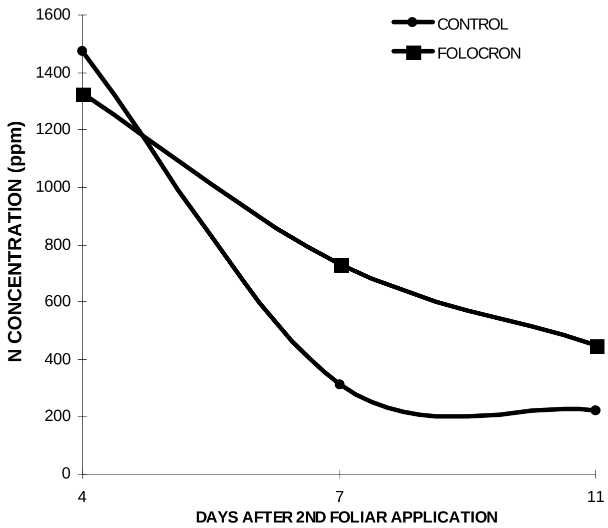


Figure 5. Nitrogen uptake curve for petiole samples from Rohwer, Arkansas, 1996.