EARLY AND MID-SEASON ADVANTAGES OF FOLOCRON, A SLOW RELEASE NITROGEN FERTILIZER

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Abstract

Foliar fertilization with nitrogen (N) is a widely used practice but there have been reports of poor response to the applied fertilizer later than three weeks after first flowering. The introduction of slow release nitrogen (SRN) fertilizers, such as FOLOCRON may solve these problems. Results of research conducted in Arkansas, California and Texas have shown yield increases averaging 10% from mid-season foliar applications of FOLOCRON. These increases were associated with increased boll numbers and boll weight. Other innovative research with FOLOCRON on drought-stressed cotton seedlings have shown enhanced growth after relief of the stress. The profit analyses from these applications is presented showing a net return of $35.72/A compared to the control and $12.73 compared to urea foliar applications.

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 supply (balance) 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 the plant needs, less product needed and independence on soil conditions.

While foliar feeding in cotton has gained wide acceptance across the Cotton Belt, recent research has identified some short comings. Purdue University in the 1980's demonstrated that up to 70% of urea nitrogen can be lost to the atmosphere depending on field conditions. Also, the response to foliar "N" fertilization has been shown to decease three weeks after first bloom (Keisling, et al 1995). Part of this lack of response is 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 slow (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 fertilizers without concern for leaf burn. Use of this product should alleviate problems of volatilization and lack of response to late season foliar "N" applications.

Cotton often experiences cool, wet early-season growing conditions which are detrimental to seedling development and yield. Producers and researchers have tried various techniques to alleviate this poor seedling growth, including various foliar fertilizers without success. For example, Holman and Oosterhuis (1992a) and Holman et al. (1992b) 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 innovative research has shown that applications of slow 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 the US Cotton Belt on the use of FOLOCRON slow release fertilizer on cotton. Results are presented for: (a) mid-season foliar applications, and (b) early-season applications to drought stressed cotton.

Materials and Methods

Field research was conducted in various States under different field conditions. Field plots were completely randomized block design. Management of fertilizer, irrigation, weed control and insect control inputs were according to state extension recommendations.

Results and Discussion

Early-season Application

In a growth chamber study, 2-week old cotton seedlings were subjected to a period of drought stress during which foliar applications of FOLOCRON and Soluspray® were applied. Measurement of height, nodes, leaf area and dry matter were made 3 days after relief of the drought stress. With Folocron containing polymethylene urea which exhibits some of the characteristics of spreader/sticker/surfactant compounds, the nitrogen

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1348-1351 (1996)
National Cotton Council, Memphis TN

remains on the leaf area for a longer period of time and is not washed from the leaf surface by average precipitation. The following results would not change appreciably once the drought situation is corrected. Note that Holman and Oosterhuis (1993) found no significant effect of Soluspray or Bayfolan on cotton seedlings growing in waterlogged soil, or during cool temperatures. Presumably the slowed growth and metabolism had no need for the additional nutrients. However, these authors have since shown that foliar applications after relief of the stress enhanced subsequent plant growth.

Results of Folocron applications showed that all plant growth parameters measured were increased (Table 1), e.g. leaf area (+18.8%), number of leaves (+12.9%), and total dry matter (+21.7%) compared to the untreated control. Other plant parameters measured showed increases important to the overall health of the plant e.g. dry weight leaf (+22.3%), dry weight stem petioles (+20.6%), plant height (+5.4%) and main-stem nodes (+2.2%) compared to the untreated control (Table 2). The increases were also significantly greater than from the Soluspray. Presumably because the nutrients in Soluspray were fast (normal) released nutrients they were either lost or largely non-utilized by the plant during the slowed growth during the stress period. Growth parameters of the Soluspray treatment were mostly non-significantly different from the control.

Use of Folocron in this manner, therefore, provides a new and exciting means of alleviating the stress effects of early-season drought. Thereby allowing more rapid recovery from the detrimental stress, and improved yields. The possibility of alleviating other early-season stresses (e.g. cool temperature*) is currently being investigated. The above mentioned field study is currently being repeated in the field.

*Holman and Oosterhuis (1993) found no significant effect of Soluspray or Bayfolan on cotton seedlings growing in waterlogged soil, or during cool temperatures.

Mid-season Applications

Yield
Folocron has been field tested on cotton for six years in California, Texas and Arkansas(Table 3). Yields have varied greatly between regions (depending on seasonal conditions) but overall there has been a positive yield response averaging a 10% increase in lint yield. Increase in yield was associated with an increase in boll numbers. Leaf phytotoxicity was not a problem even at rates as high as 15 pounds of “N” per acre.

Yield Components
In Arkansas, over the three year period, 1993-1995, yields have been consistent with FOLOCRON generating the largest yield response in two out of the three years. The yield increase from Folocron in 1993 and 1994 was significant at P=0.05 level (Table 4). Yield response in 1995 was negated by late season heat that forced the cotton plant to shed its boll load prior to harvest. The boll weight in 1995 was slightly higher than the control and urea treatments indicating that additional nitrogen from FOLOCRON was translocated to the boll and would have generated a higher yield.

Total boll number was affected by FOLOCRON while the urea treatment was comparable to the untreated control(Figure 1). FOLOCRON resulted in the highest boll weight (5.61 grams) compared to urea (4.91 grams) and the control (4.83 grams). With FOLOCRON generating the highest number of harvestable bolls. Boll weight was significantly (P=0.05) higher as compared to urea or the control treatments (Figure 2). Yield differences were caused by this increase in boll weight along with a higher percentage of harvestable bolls. This does indicate that an early maturity factor could be considered along with a more even maturity.

Foliar Burn
There were no visual symptoms of foliar burn from the FOLOCRON applications while the Urea applications resulted in a very light burn but not severe enough to affect final yield. Any leaf burn can cause concern because of possible reductions in photosynthesis membrane integrity in the cotton plant.

Petiole, Leaf and Boll N Content
Nitrate accumulation in the plant was significantly (P=0.05) increased by FOLOCRON in 1993. Movement from the leaf to the boll was significantly enhanced from the use of the controlled release nitrogen foliar fertilizer (Figure 3). It appears that the characteristics of CRN’s help maintain higher percentages of nitrogen in the plant with the greatest benefits in the nitrogen content in the boll (Figure 4).

Advantages of Using Folocron

Early-season application of Folocron to drought-stressed cotton seedling results in improved recovery after relief of the stress. Whereas, mid-season applications improve yield and yield components through enhanced plant nutrition. The benefits of mid-season foliar applications of Folocron are reflected in the net profitability. In current research, net profits were increased by $23.00/A by the use of Folocron from $12.73/A with Urea to $35.72/A by Folocron (Table 5).

Conclusion

Folocron provides a unique method of foliar fertilizer application due to the slow nutrient release properties. Research has demonstrated that this property can be advantageously used as foliar applications at (a) mid-late season, and (b) early-season stressed cotton seedlings.

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Table 1. Effect of various spray treatments on cotton seedlings 12 days after relief of the drought stress*.

Treatment	Total dry matter g	Leaf area cm^2/plant	Total leaves #/plant
Control	5.08	992	18.6
Folocron	6.18	1178	21.0
Soluspray	4.84	1023	16.3
PGR-IV	6.07	1164	21.0
LSD	0.50	120	2.4

*The water stress was applied 14 days after planting for 3 days.

Table 2. Effect of various spray treatments on leaf and petiole weight of cotton seedlings 12 days after relief of the drought stress*.

			Dry weight	
Treatment	Plant ht. cm.	Main-stem nodes #/plant	Leaf g	Stem petioles g
Control	31.3	9.9	3.14	1.94
Folocron	33.0	10.1	3.84	2.34
Soluspray	31.3	9.1	3.03	1.81
PGR-IV	32.4	9.9	3.83	2.24
LSD	4.8	0.7	.052	0.41

*The water stress was applied 14 days after planting for 3 days.

Table 3. 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[1]	California[1]	Texas[2]
Control	902	1414	841
Folocron	979	1681	867
Urea	927	--	830

1. Two year average
2. Three year average

Table 4. Yield response to mid-season applications of Folocron and urea to field-grown cotton in Arkansas, 1993-1995.

	Yield (lb lint/A)			
Treatment	1993	1994	1995	Average
Control	850	954	1414	1072
Folocron	983	976	1380	1113
Urea	948	906	1398	1084

Table 5. Yield and profit increase from mid-season foliar applications of Folocron. Arkansas 1993-1994.

Treatment	Lint Yield lb/A	Yield Increase lb/A	Yield Increase $/A[1]	Material Cost $/A	Net Profit ($/A)
Control	902	--	--	--	--
Folocron	979	77	53.90	18.18	35.72
Urea	927	25	17.50	4.77	12.73

1. Cotton based on $.70/lb of lint.

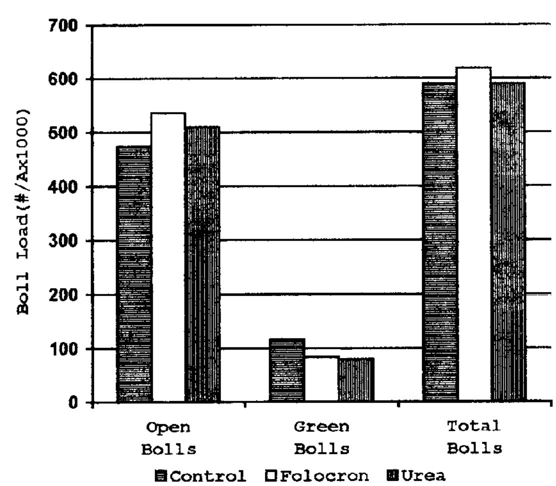

Figure 1. The effects of foliar applications of Folocron and urea on boll numbers per acre at time of harvest. LSD (P = 0.05)

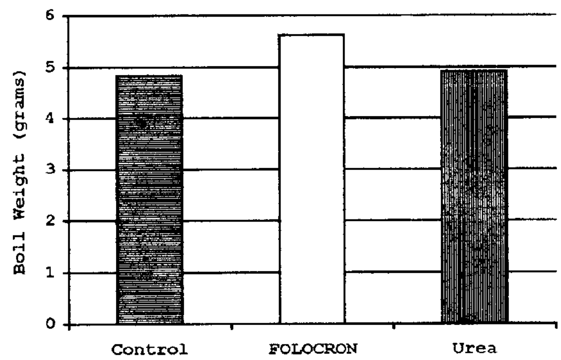

Figure 2. The effect of foliar applications of FOLOCRON and Urea on boll weight at time of final harvest. LSD (P = 0.05)

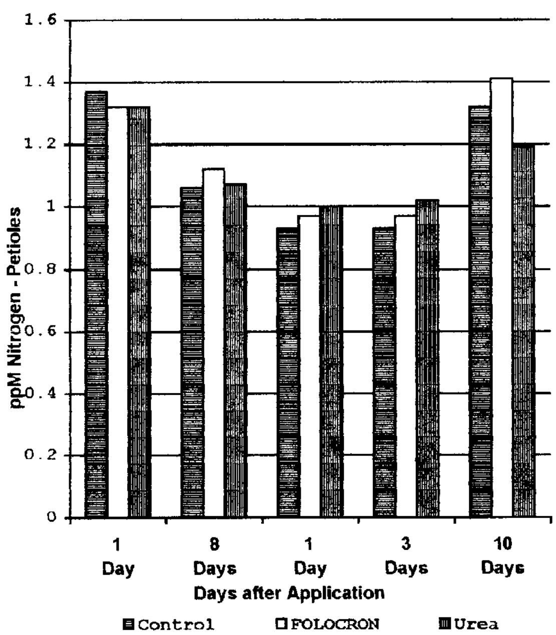

Figure 3. Nitrogen content in the petioles. LSD (P = 0.05)

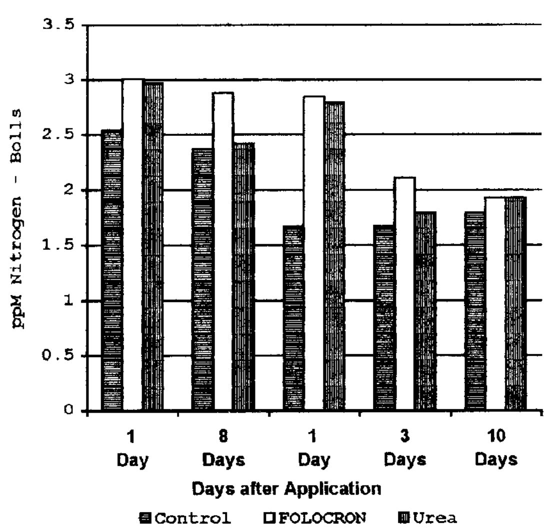

Figure 4. Nitrogen content in the bolls. LSD(P=0.05)