EVALUATION OF LATE SEASON NITROGEN AND POTASSIUM FERTILIZER APPLICATIONS IN LOUISIANA COTTON

Owen Clark
Melanie Netterville
Ana P. Campos
Peters Egbedi
Josh T. Copes
LSU School of Plant Environmental and Soil Sciences
Baton Rouge, LA

Abstract

Potassium (K) and nitrogen (N) management can be challenging, in Louisiana cotton production systems. In Louisiana, mid- to late-season K and N deficiencies are commonly observed in the Mississippi alluvial soils. This raises concern for producers that yield is being reduced as a result. In an attempt to better manage K and N fertility, some producers will apply a urea/muriate of potash blend to cotton at 1 to 3 weeks after bloom. Since root growth has essentially stopped by first bloom, coinciding a fertilizer application at a growth stage that will provide available nutrients to the active root zone at peak K and N uptake time may increase cotton lint yield and quality. Therefore, research was conducted at the LSU AgCenter's Northeast Research Station on a Sharkey clay soil evaluating applications of urea and potash fertilizer applied at the first week of bloom and two weeks later effect on cotton growth and yield. In 2018, the field trial was conducted in a strip-trial design replicated three times. Treatments included 23-0-30 (urea + muriate of potash) applied during the first week of bloom (July 6, 2018), 23-0-30 applied three weeks after the first week of bloom (July 30, 2018), and a non-treated. In 2018, there were no significant differences found between treatments for the cotton lint yield. In 2019, treatments included urea (46-0-0), muriate of potash (0-0-60), and urea plus muriate of potash applied during the first week of bloom (July 19, 2019) and the third week of bloom (August 2, 2019), and a non-treated. This study showed that an additional application of nitrogen applied at either first or third week of bloom can have a significant effect on yield.

Introduction

Potassium and nitrogen management can be challenging, in Louisiana cotton production systems. In Louisiana, mid- to late-season K and N deficiencies are commonly observed in the Mississippi alluvial soils. Producers are concerned that cotton yield is reduced as a result of these deficiencies. Cotton uses about 60 lb of K and N per acre per 480 lb per bale (Stewart et al. 2000). In Louisiana, producers' typically side-dress with urea ammonium nitrate (UAN 28 or 32%) shortly after cotton emergence with nitrogen rates ranging from 85 to 120 lb of N per acre. The majority of N uptake occurs after first bloom, peaking during fruiting, and approximately 70% of K uptake occurs after first bloom (2 to 3 lb of K per acre per day) (Stewart et al. 2000). Nitrogen management concerns are related to actual and perceived losses that can occur as a result of rainy weather. In Northeast LA, cotton is predominately grown on clay soil types. Denitrification losses on these clay soils are a concern for producers, and denitrification can lead to nitrogen deficiencies later in the growing season. Some producers compensate for the potential denitrification losses by applying more nitrogen when they side-dress. Problems arise with too much nitrogen, which can lead to excess vegetative growth and reduced fruit set and yield. With low cotton yields the last several growing seasons, producers are questioning the need for increased application of N fertilizer. There have been reports of up to 150 units of N being applied at side-dress. It seems that producers are applying more nitrogen in order to make up yield and perceived nitrogen losses. This amount of N applied near cotton emergence will likely lead to excessive vegetative growth and reduced yield. Late-season potassium deficiencies can be observed in most fields each year. As with nitrogen, producers are concerned that these deficiency symptoms are resulting in yield loss. In an attempt to better manage K and N fertility, some producers will apply a urea/muriate of potash blend to cotton at one to three weeks after bloom. They feel that the cotton plant has enough of a fruit load at this point to prevent excess fruit shed and vegetative growth. Rainfall, however, will be required in dryland fields to incorporate the urea/potash blend into the active root zone. Since root growth has essentially stopped by first bloom, coinciding a fertilizer application at a growth stage that will provide available nutrients to the active root zone at peak K and N uptake time may increase cotton lint yield and quality. This strategy may minimize fruit shed and excessive vegetative growth caused by too much N applied during vegetative growth. However, applications such as this could be better suited for irrigated fields and clay soils. Therefore, a trial was conducted evaluating if applications of urea and potash fertilizer applied at first week of bloom and two weeks later would affect cotton growth and yield.

Materials and Methods

In 2018, a field study was conducted at the LSU AgCenter Northeast Research Station near Saint Joseph, La on a Sharkey clay soil. Study was conducted in a strip-trial design replicated three times. The plots were 26.67 feet wide and measured 310 feet in length. Deltapine1646 cotton variety was planted May 18, 2018. Cotton was side-dressed with 80 units of nitrogen on June 6, 2018. Treatments included 23-0-30 (urea + muriate of potash) applied during the first week of bloom (July 6, 2018), 23-0-30 applied three weeks after the first week of bloom (July 30, 2018), and a non-treated. The fertilizer blend was broadcast using a JD Hiboy 6000 equipped with a spreader. Folex (phosphorotrithioate) at 80 oz/a plus 2 oz/a Freefall (thidiazuron) cotton defoliant was applied on September 14 and 80 oz/a Folexplus 32 oz/a Super Boll (ethephon) was applied on September 20, 2018. Five random plants from each plot (strip) was selected and plant mapping data recorded for each plant. The center four rows were harvested from each 8 row strip on October 22, 2018 using a JD 9870 inline picker. A weigh buggy was used to record weights of individual plots. In 2019 the field trial was conducted in a randomized complete block design replicated four times. The plots were 20 feet wide and 45 feet in length. Deltapine1646 cotton variety was planted May 3, 2019. Cotton was side dressed with 80 units of nitrogen on June 4, 2019. Treatments included urea (46-0-0), muriate of potash (0-0-60), and urea plus muriate of potash applied during the first week of bloom (July 19, 2019) and the third week of bloom (August 2, 2019), and a non-treated. Fertilizer was applied using hand-spreaders that covered the center four rows. 4 oz/a Def plus 2 oz Drop cotton defoliant was applied October 1, 2019 and a second shot of 12 oz/A of Def was applied on October 8, 2019. The center two rows from each plot were harvested on October 30, 2019 using a JD 9965 two-row plot picker equipped with a weigh basket.

Results and Discussion

In 2018, supplemental in-season nitrogen and potassium applications applied either at first bloom or three weeks after first bloom did not affect final plant height, cotton plant mapping variables, or fiber quality (Table 1). Yield was not affected by any treatment (Table 2). Due to the abundance of rainfall during fruit set and boll fill, irrigation was not required to incorporate the in-season supplemental fertilizer or preserve cotton yield. Adequate and timely rainfall may have masked the benefit of the in-season supplemental N and K applications in this year. Applying in-season supplemental K and N fertilizer could potentially be better suited for irrigated fields and clay soil types. Irrigation would ensure the incorporation of the fertilizer into the soil solution in a timely manner. Clay soil types have the greatest probability of nitrogen loss due to denitrification and may have reduced K availability compared to a silt loam soil when moisture is limiting.

In 2019, urea and potash + urea applied at third week of bloom and urea and potash plus urea applied at first week of bloom produced similar yields ranging from 1366 to 1339 lb per acre (Table 3). All treatments containing urea, however, yielded significantly higher than the non-treated and the third week of bloom potash treatment. Potash applied alone at the first and third week of bloom was not significantly greater than the non-treated (Table 3.). Under these conditions, the results indicate that applying potash at 30 lb K_2O/acre during bloom would have no effect on yield Rainfall of 0.31” was received after the first week of bloom application three days after application. Within three days of this rainfall event, several more occurred and totaled approximately one inch, all within a week of application. For the third week of bloom application, rainfall did not occur until seven days after application, with 0.7” of rainfall being recorded. Even with rainfall occurring seven days after application cotton yield responses were observed for the urea treatments. Pre-plant potash was applied across the entire test at a rate of 26 units of K_2O/acre. This may have masked the benefit of applying potash during early bloom. This study showed that an additional application of nitrogen applied at either first or third week of bloom can have a significant effect on yield. Urea applied at the first and third week of bloom yielded 163 and 178 lb per acre greater, respectively, compared to the non-treated.

Table 1a. 2018 In-Season Fertilizer Effects on Plant Height, Total Node Number, Upper Most Cracked Boll, Upper Most Harvestable Boll, Number of Fruiting Branches, % Lint Turnout.

Fertilizer Treatment	Plant Height	Total Node	Cracked Boll	Harvestable Boll	Fruiting Branches	% Lint
1st week	52	28	19	19	21	45.5
3rd week	51	27	19	19	20	45.3
Non-treated	51	26	20	19	19	45.5

[1] Plant Height, height of plant taken from ground level

[2] Total Node, total number of nodes.

[3] Cracked Boll, number of upper most cracked boll.

[4] Harvestable Boll, number of upper most harvestable boll.

[5] Fruiting Branches, number of first fruiting branch.

[6] Percent Lint Turnout, percent lint from seed cotton sample (lint weight ÷ seed cotton weight).

Table 1b. 2018 In-Season Fertilizer Effects on Fiber Length, Uniformity, Short Fiber Index, Strength, Elongation, Micronaire, and Maturity.

Fertilizer Treatment	Length	Uniformity	SFI	Strength	ELG	MIC	Maturity
1st week	1.3	84.6	7.7	28.7	5.2	4.4	81.7
3rd week	1.3	84.1	7.9	28.1	5.2	4.4	81.5
Non-treated	1.3	85.0	7.6	28.0	5.3	4.4	81.8

[7] Length, fiber length

[8] Uniformity

[9] SFI, short fiber index

[10] Strength

[11] ELG, elongation

[12] MIC, micronaire

[13] Maturity

[a] Cotton harvested on October 22.

Table 2. 2018 Fertilizer Treatment (Potash + Urea) Effect on % Lint Turnout, and Lint Yield.

Fertilizer Treatment	% Lint Turnout	Lint Yield (lb/a)
First Week of Bloom	45.5	1,687
Third Week of Bloom	45.3	1,736
Non-Treated	45.5	1,741

[1] Percent Lint Turnout – percent lint from seed cotton sample (lint weight ÷ seed cotton weight).
[2] Lint Yield (lb/a) – lint yield.
[a] Cotton harvested on October 22.

Table 3. 2019 Fertilizer Treatment (Potash + Urea, Potash Only, and Urea Only) Effect on % Lint Turnout, and Lint Yield.

Fertilizer Treatment	% Lint Turnout	Lint Yield (lb/a)
1st Week of Bloom (Potash + Urea)	43.8	1,340
3rd Week of Bloom (Potash + Urea)	46.2	1,329
1st Week of Bloom (Urea Only)	44.5	1,351
3rd Week of Bloom (Urea Only)	44.8	1,366
1st Week of Bloom (Potash Only)	46.1	1,219
3rd Week of Bloom (Potash Only)	44.7	1,173
Non-Treated	44.0	1,188

[1] Percent Lint Turnout –percent lint from seed cotton sample (lint weight ÷ seed cotton weight).
[2] Lint Yield (lb/a) – lint yield.
[a] Cotton harvested on October 30.

Summary

Cotton fertility needs will vary based on the yield potential of a field in a given year. Favorable growing conditions during the season may dictate the need for supplemental N and K applications in order to maximize yields. The results of the 2018 study did not find any benefit to applying urea and potash to cotton during bloom. Phosphorus and potassium levels were high based on soil analysis within the test area. Other levels such as: pH, sulfur, and zinc were all within the recommended ranges for optimal cotton yields. Growing conditions were optimal during the 2018 growing season, which was reflected in the high yields across the cotton growing areas in Louisiana. Adequate and timely rainfall allowed for good nutrient availability. Also, the timing of fertilizer treatments may have occurred too late in the growing season for a yield response. In 2019, results showed that in season applications of urea fertilizer (46-0-0) at both the first and third week of bloom was significantly greater than the non-treated and the urea/potash (23-0-30) third week treatment. An additional application of nitrogen applied at either first or third week of bloom can have a significant effect on yield. Urea applied at the first and third week of bloom yielded 163 and 178 lb per acre greater, respectively, compared to the non-treated. The preplant K application likely negated the utility of K applied at 1 and 3 weeks after bloom. Soil tests should be taken routinely and necessary fertilizer applied when soil tests are in the medium to low range.

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References

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