Evaluating the Effect of Nitrogen Sources Applied at Different Rates in Louisiana Sugarcane Production System

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INTRODUCTION

- Sugarcane is grown in the tropics and subtropics climate around the world.
- In Louisiana, sugarcane is one of the major agricultural industry and has the largest production area in the United States with more than 420,000 acres in production. Cane tonnage ranges from 33 to 36 tons per acre, with a nitrogen (N) removal rate of about 2 lbs per ton of millable stalks.
- Soil inorganic N testing, plant tissue testing and remote sensing are among the tools that can be used to monitor N health status in crop production.

OBJECTIVES

- Determine the effect of different nitrogen source on sugarcane yield and quality parameters.
- Monitor N-related variables in response to N sources applied at different rates.

MATERIALS AND METHODS

- The field study was established in 2013 at the LSU AgCenter Sugar Research Station in St. Gabriel, LA.
- Treatment consisted of fifteen combinations of different sources (urea - 46%N, ammonium nitrate AN - 34%N, polymer- coated urea, and UAN solution- 32% N dribbled and knifed-in) and rates (0, 40, 80, and 120 lbs N ac^{-1}) arranged in a randomized complete block design with four replications. The cane variety used is HoCP 96-540.
- Granular N fertilizers were applied in-furrow by hand (Photo 1) while UAN solution was either knifed-in (Photo 2) or dribbled (Photo 3) into the shoulder of the bed. Furrows were tilled after application.
- Soil samples and NDVI (Normalized Difference Vegetation Index) readings were collected seven, fourteen, twenty one days and two months after N fertilization (Photo 4 and 5).


Photo 1


Photo 2


Photo 3


Photo 4


Photo 5


Photo 6


Photo 7

- Ten stalks were randomly sampled from the middle row of each plot prior to plot harvesting using a combine chopper and a wagon with a load cell (Photo 6).
- Cleaned stalks were shredded and analyzed using SpectraCane Near Infrared System for quality parameters: theoretical recoverable sugar (TRS), total soluble solids (Brix), purity, sucrose, and fiber content (Photo 7). Shredded stalks were processed and analyzed for total N content.
- Data were analyzed using SAS 9.4. Analysis of variance were conduced for all measured variables to determine difference in treatment. Mean separation procedure followed for any significant effect detected (P<0.05).

RESULTS AND HIGHLIGHTS

Table 1. Effect of different N sources and rates on soil nitrate and ammonium content at 0-6 inch depth and NDVI values at seven, fourteen, twenty one, sixty days after N application, 2015 first ratoon crop.

Source	Rate lb/ac	0-6 Ammonium mg kg^{-1}				0-6 Nitrate mg kg^{-1}				NDVI			
		7 D	14 D	21 D	60 D	7 D	14 D	21 D	60 D	7 D	14 D	21 D	60 D
	0	6 b	8 b	8 b	3 a	2 b	3 a	2 b	1 a	0.325 a	0.414 a	0.419 b	0.433 b
AN	40	13 b	16 ab	16 b	4 a	21 ab	23 a	14 ab	1 a	0.341 a	0.447 a	0.491 ab	0.535 a
	80	21 ab	23 ab	17 b	4 a	34 ab	32 a	15 ab	1 a	0.311 a	0.420 a	0.477 b	0.552 a
	120	38 a	34 a	32 a	6 a	44 a	46 a	32 a	10 a	0.348 a	0.454 a	0.500 a	0.573 a
UAN-K	40	7 ab	15 a	12 ab	4 a	8 a	8 a	8 a	6 a	0.360 a	0.471 a	0.498 a	0.547 a
	80	40 a	29 a	18 ab	4 a	8 a	6 a	10 a	6 a	0.320 a	0.420 ab	0.484 a	0.571 a
	120	7 ab	35 a	56 a	5 a	6 a	10 a	9 a	4 a	0.299 a	0.399 b	0.496 a	0.570 a
UAN-D	40	10 a	15 b	11 ab	3 a	8 a	7 a	8 a	6 a	0.363 a	0.471 a	0.508 a	0.538 b
	80	14 a	20 b	18 a	5 a	9 a	6 a	10 a	5 a	0.307 a	0.422 a	0.474 a	0.548 b
	120	19 a	59 a	29 a	6 a	7 a	6 a	8 a	5 a	0.342 a	0.450 a	0.479 a	0.611 a
UREA	40	21 a	17 b	11 a	5 a	8 a	7 a	9 a	6 a	0.352 a	0.438 a	0.482 ab	0.527 b
	80	27 a	30 ab	13 a	5 a	8 a	7 a	9 a	5 a	0.329 a	0.428 a	0.455 ab	0.536 ab
	120	34 a	44 a	31 a	6 a	30 a	9 a	12 a	5 a	0.343 a	0.450 a	0.519 a	0.582 a
SR	80	16 a	26 ab	40 a	6 a	4 a	7 b	16 a	2 a	0.321 a	0.421 a	0.492 a	0.537 a
	120	22 a	29 a	45 a	7 a	4 a	12 a	20 a	3 a	0.348 a	0.446 a	0.495 a	0.621 a

D – number of days from N fertilization; NDVI- normalized difference vegetation index; AN – ammonium nitrate; UAN-K – urea ammonium nitrate, knife-in; UAN-D – urea ammonium nitrate, dribble; SR – slow release

- Generally for all N sources, soil nitrate and ammonium content increased with N rate. Similar trend was also observed with NDVI wherein sugarcane applied with the highest N rate (120 lb N acre^{-1}) showed significantly higher readings (P<0.05) compared to those applied with lower N rates (Table 1).
- Plots treated with urea and AN recorded the highest amount of total inorganic N as early as 7D and steadily declined with time. On the other hand, UAN-D and SR treated plots showed the highest total inorganic N at 14 and 21D, respectively. At 60D, inorganic N levels across all treatments were below 40 lbs acre^{-1} (Figure 1).

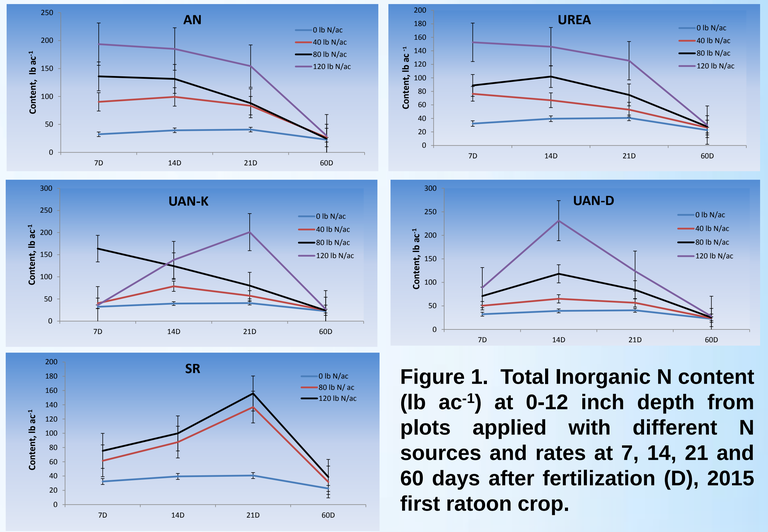

Figure 1. Total Inorganic N content (lb ac^{-1}) at 0-12 inch depth from plots applied with different N sources and rates at 7, 14, 21 and 60 days after fertilization (D), 2015 first ratoon crop.

Table 2. Yield, quality parameters, stalk N content , and N uptake of sugarcane with different rates and sources of N, 2014 plant cane.

	Cane tonnage	Sugar yield	TRS	Brix	Polarity	Stalk N Content	Stalk N Uptake
	t ac^{-1}	lb ac^{-1}	lb t^{-1}	%	%	%	lb ac^{-1}
N rate							
0	38 b	7972 a	212 a	18.35 a	65.14 ab	0.263 c	195 c
40	39 ab	8426 a	216 a	18.37 a	65.79 a	0.302 b	235 bc
80	40 ab	8306 a	207 ab	18.44 a	64.13 ab	0.317 ab	255 b
120	44 a	8674 a	208 b	18.33 a	63.39 b	0.350 a	301 a
Mean	40	8345	210	18.37	64.61	0.308	246
Source							
SR	42 a	8576 a	208 ab	18.18 b	64.00 bc	0.326 ab	273 a
UANK	40 a	8587 a	213 ab	18.43 ab	65.38 ab	0.292 bc	234 ab
UREA	40 a	8191 a	207 b	18.42 ab	64.08 bc	0.300 bc	240 ab
AN	40 a	8072 a	204 b	18.19 b	63.18 c	0.337 a	268 4a
UAND	38 a	8323 a	217 a	18.64 a	66.42 a	0.283 c	218 b
Mean	39.94	8350	210	18.37	64.61	0.310	247

Values within a column within N rate and source with the same letter are not significantly different at P<0.05

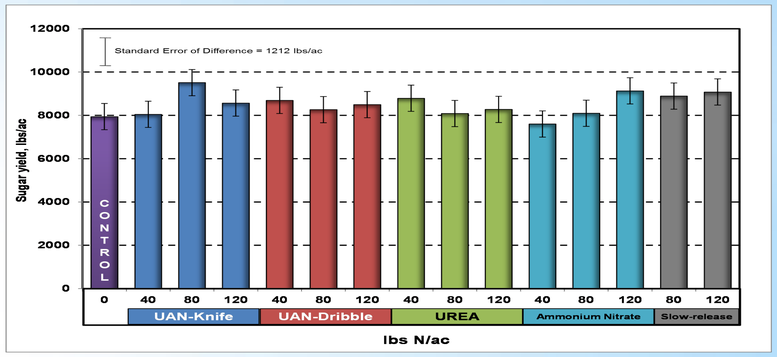

Figure 2. Sugar yield of cane applied with different N sources and rates, 2014 plant cane.

- There was no interaction effect of source and rate for all measured variables. Nitrogen rate had significant positive effect on cane tonnage, TRS, stalk N content, and uptake. Source effect was significant only on Brix, polarity, and stalk N content and uptake. (Table 2).
- Based on the results of the one-way ANOVA test, UAN-knifed in at 80 lbs ac^{-1} attained similar sugar yield level as those plots applied with 120 lbs ac^{-1} across sources and as dribbled-UAN (Figure 2).

Funding Support: American Sugar Cane League and CF Industries