UAN, AN Effective For Sugarcane in Brazil

Field studies show them more effective than urea.

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Summary: *Nitrogen application is a key practice for high sugarcane yields, but the right source must be selected in order to avoid losses under certain soil and climate conditions.*

Sugarcane sits as the third most important crop in land use in Brazil, after soybeans and maize, occupying over 9.0 million ha that produced 630 million tons last season, which represented 35.5 million tons of sugar and 28.7 billion liters of ethanol. Nitrogen (N) is the second most applied nutrient for sugarcane production, about 750,000 tons every year, just after potassium (P). Nitrogen use efficiency (NUE) may be interfered by chemical reactions generating losses by leaching or volatilization, therefore the use of distinct sources is strategic to overcome such problems. As most of the sugarcane fields are harvested without burning, a thick layer of straw remains on the top soil, which enhances the chances of N losses through volatilization. That is why, in many sugarcane areas of Brazil, farmers are testing different sources to increase N use efficiency (NUE).

Table 1. Analysis of variance regarding source, rate, and locality of application of N for gross yield (GY) and industrial characteristics[1]. Control treatments were disregarded in this analysis.

Cause of variation	GY	TRS	TPH	TSH
	ton/ha	kg/ha	ton/ha	
Source				
UAN	81.72a	126.74a	10.34a	10.36a
AN	81.14a	125.71ab	10.14a	10.17a
Urea	74.38b	119.30b	8.81b	8.91b
Rate				
60	78.35	123.80	9.68	9.74
120	80.50	123.72	9.92	9.97
180	78.39	124.23	9.68	9.73
Locality				
In furrow	79.24	123.03	9.71	9.76
Surface	78.92	124.81	9.82	9.87
CV(%)	11.79	7.56	15.35	14.76
Mean	79.08	123.92	9.76	9.81

[1] Industrial characteristic: total recoverable sugar (TRS), total POL per hectare (TPH), and total sugar per hectare (TSH). Means followed by the same letters do not differ (Duncan P>0.05).

Sources

The main sources of N for sugarcane in Brazil are ammonium nitrate (AN), ammonium phosphate (AP), and urea, with an estimated use of 50%, 10%, and 35%, respectively, while urea-ammonium nitrate solution (UAN) is used by very few farmers. Many studies have evaluated N volatilization from urea application in sugarcane fields as estimated to be between 30 to 50%, depending on weather and soil conditions, according to Nascimento et al. (2013). Choosing the right source of N will also depend on the operational ability of the farmer in order to apply it at the right rate, at the right time, and at the right place such as to avoid losses, maximizing its efficiency.

Objective

A study was set to evaluate agronomic effectiveness of three N fertilizers for sugarcane in a tropical soil in the state of São Paulo. Also, two other important factors, which affect N fertilizer effectiveness, were studied: rate of N and place of application.

Methodology

Trial was installed using a complete randomized block design with 4 replicates in a factorial 3x3x2 and 4 controls such as: 3 N sources (UAN, Urea and Ammonium Nitrate), 3 N rates (60, 120, and 180 kg/ha), and 2 localities of application (in furrow and surface).

Controls were: no N application (in furrow and surface) and 120 kg N/ha via Ammonium Sulfate (in furrow and surface).

Soil. Original soil conditions (0-20 cm) were pH_{CaCl2} 5.4, P-Resin 6 mg/dm^3, CEC

and available K, Ca, Mg 76, 1.8, 34, and 15 mmolc/dm3,respectively, and BS 67%.

Field. A three-year-old sugarcane field was used to set up the study after harvest in May 2014.

Results

Response. Table 1 presents the results for gross yield and industrial characteristics of sugarcane in response to treatments applied. Nitrogen source affected all parameters evaluated, while rate and locality of application did not affect anyone. For every parameter, UAN and AN presented a similar performance and were superior to Urea. Exception was made to the amount of total recoverable sugar (TRS) while AN performed similarly to UAN and Urea, although UAN Was superior to Urea.

Effectiveness. Table 2 presents the relative agronomic effectiveness (RAE) of N sources for gross yield. Under in-furrow application of sources, UAN and AN presented a similar RAE of 108%, when compared to Urea. Considering the surface application, UAN and AN were 112% and 110%, respectively, more efficient when compared to Urea.

Gross yield. Figure 1 presents the gross yield response to rates and sources of N, regarding the locality of application. Quadratic models were adjusted to UAN and AN, while a linear model was adjusted to Urea for both localities of application. Gross yield with UAN and AN application were, respectively, 12% and 14% higher as compared to Urea at the rate of 60 kg N/ha. At the recommended rate (120kg N/ha), UAN and AN produced, respectively, 10% and 12% more gross yield as compared to Urea.

Discussion

Vitti et al. (2007) studied N fertilizers (urea, AP, AN and UAN) at a single rate (70 kg N/ha), submitted to two places of application (broadcast vs. strip), and observed no effect on yield caused by the locality of the fertilizer application. Authors observed that N losses due to volatilization with urea and UAN decreased gross yield significantly as well. In another study, Costa et al. (2003) also found yield decrease to be related to N losses due to volatilization. The absence of yield response to N rates and places of application may be attributed to dry weather conditions during the period of the trial, as well as due to partial supply of N coming from residue decomposing from previous seasons.

Summing up

Nitrogen application is a key practice for high sugarcane yields, but the right source must be selected in order to avoid losses under certain soil and climate conditions. Under the agronomic conditions of this study, UAN and AN showed to be more effective than Urea, disregarding if it is applied in furrow or to the soil surface. Soil surface application of fertilizer tends to be cheaper and easier for farmers, being a great advantage for sources like UAN and AN.

Table 2. Relative agronomic effectiveness (RAE) of N sources† for gross yield of sugarcane, regarding the locality of application, in the state of São Paulo, Brazil.

Source	RAE (%)	
	In furrow	Surface
Urea	100	100
UAN	108	112
AN	108	110

† Considering all N rates applied for each source.
‡ No nitrogen applied.

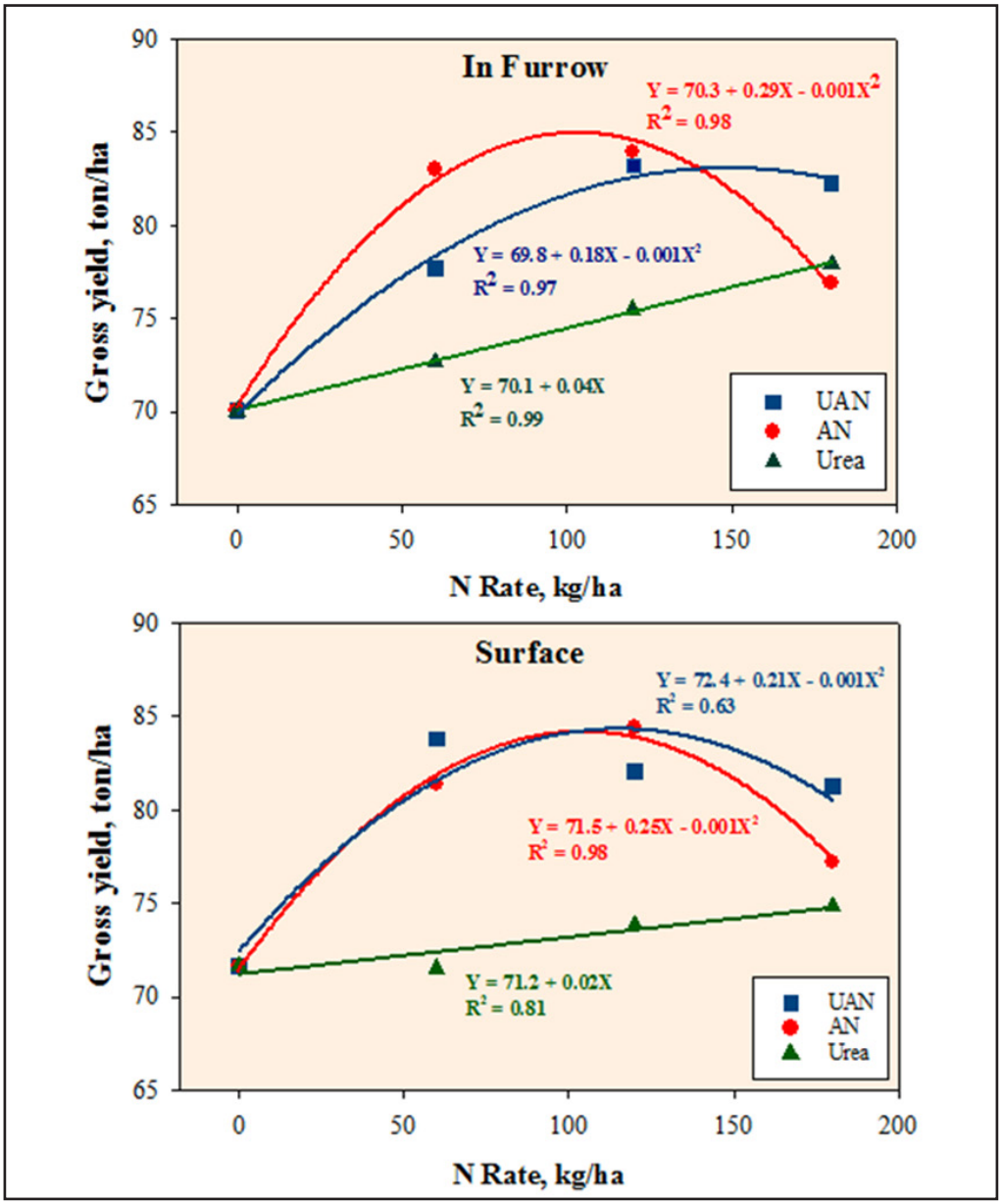

Figure 1. *Gross yield of sugarcane in response to sources, rates and locality of application N in the state of São Paulo, Brazil.*

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