DIRECT AND RESIDUAL EFFECT OF N AND S FERTILIZATION ON SUGARCANE GROWN IN SUCCESSIVE CYCLES UNDER CONSERVATION SYSTEM

Paulo César Ocheuze TRIVELIN

Center of Nuclear Energy in Agriculture / University of São Paulo (CENA/USP)

Figure 1. Green cane as a conservation system: sugarcane fields with soil covered with straw

Nitrogen (N) is the most expensive nutrient applied to sugarcane as mineral fertilizer. Its effect, on plant, in general, is related with the effects of sulfur. Besides, N use efficiency by plants is also regulated by crop management and by the extent of the N losses that may take place in the soil-plant system. Current knowledge on yield response of sugarcane to N and S fertilization is mostly based on one cycle experiment either of plant cane or ratoon crop. However, sugarcane is a semi-perennial grass and as such, crop new growth is dependent on energy and nutrient reserves of roots and rhizomes. Therefore, the main objective of this project was to evaluate, across several cycles of cuttings, the yield response of sugarcane grown under conservation system – with no burning of cane straw before harvesting and maintaining little soil disturbance – in relation to a combination of N fertilization applied to the plant cane and to the ratoon cycle. The transformations of fertilizer-N and -S in the soil-plant system were evaluated by ^{15}N and ^{34}S stable isotope techniques in order to establish the relationship between N and S nutrition and cane yield. Three field experiments are carried out in soils of different textural classes. Sugarcane was planted between January and April 2005 and evaluations will be done during four years. Rates of N (0, 40, 80, and 120 kg ha^{-1}) as urea applied to plant cane were combined with rates of N (0, 50, 100, and 150 kg ha^{-1}) as ammonium sulfate (AS) applied to the first ratoon cycle. Micro plots with ^{15}N-labelled urea for the plant cane cycle and with ^{15}N- and ^{34}S-labelled AS for the first ratoon cycle were set up in order to determine the N and S fertilizer use efficiency by sugarcane and the residual effects of the fertilizers on yield of subsequent cycles.

SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

Usually high responses to N fertilization are observed in the first years after implementation of green cane system under the climatic conditions of the São Paulo State. Yield increases of both stalks and sucrose are likely to be obtained with N application. Considering the results of three experiments, the N rates that resulted in the higher economic return were between 40 and 80 kg ha^{-1} of N, which are lower than those obtained in the ratoon cycles. In eutrophic soil, N fertilization of plant cycle enhanced sugarcane growth and nutrient uptake as well as increased biomass and industrialized stalk yields. However, most of the N accumulated in the cane plant came from other sources, especially the soil stock, because only 12% of the N content of the whole plant derived from fertilizer. Nitrate leaching below 90-cm depth of N derived from both soil N mineralization and N fertilizer was negligible in the plant cane cycle: 1.1 and 0.02 kg ha^{-1} N, respectively, indicating that risks of ground water contamination were very low. Intense soil plowing before planting sugarcane promotes mineralization of soil organic N and of sugarcane crop residues incorporated into the soil, which is a possible explanation for the lower response to N fertilization in the plant cane cycle. The N accumulated in the sugarcane plant was around 200 kg ha^{-1}, of which 45% (85 kg ha^{-1} N) were in the stalks, 15% (30 kg ha^{-1} N) were in the dry leaves, 20% (40 kg ha^{-1} N) were in the plant tops and 6% and 13% respectively were found in roots and rhizomes. The N content of the above-ground part of the plant cane decreased with time: 11 to 13 g/kg dry mass in 5 to 6-month-old plants but only 3.2 to 3.3 g/kg after 14 to 16 months when plants were harvested. In the first ratoon cycle, under green cane management, which resulted in a thick mulch of crop residues of about 15 t ha^{-1}, yield response to N was high and optimum economic return was obtained with around 100 kg ha^{-1} N. Nitrogen fertilizer applied to the plant cane cycle resulted in a residual effect that caused an increase in stalk yield of the first ratoon crop. However, N fertilizer application to the plant cane cycle did not affect the response to the N added to the first ratoon crop. In the plant cane cycle, sugarcane absorbed around 30% of the N fertilizer applied (^{15}N urea), whereas in the ratoon cycle, the fertilizer N utilization (^{15}N AS) was 40%. These figures indicate that most of the N, added as fertilizer, does not end up in the sugarcane plant at the harvest stage.

Figure 2. Sampling of sugar cane plant ("green cane") at harvest to define the fate of 15N and 34S labeled fertilizers

MAIN PUBLICATIONS

Cantarella H, Trivelin PCO, Contin TLM, Dias FLF, Rossetto R, Coimbra RB, Quagio JA, 2008. Ammonia volatilization from urease inhibitor-treated urea applied to sugarcane trash blankets. *Scientia Agricola*. **65**: 397-401.

Paulo Cesar Ocheuze Trivelin

Centro de Energia Nuclear na Agricultura (CENA)
Universidade de São Paulo (USP)
Seção Isótopos
Caixa Postal 96
13400-970 – Piracicaba, SP – Brasil

+55-11-3429-4670
pcotrive@cena.usp.br