

# NITROGEN PROFILE OF YOUNG ADEQUATELY FERTILISED SUGARCANE UNDER MOISTURE STRESS CONDITIONS

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The interaction between water supply and plant growth has received much attention in sugarcane production over the years. Although it is recognised that plant water relations may affect plant nutrition (Bishop, 1965; Marschner, 1993), and that some attempts have been made to correlate third leaf nutrient values with climatic measurements, or surrogates thereof (Bishop, 1964), quantitative information regarding the effect of moisture stress on the nutrient content of young sugarcane is limited. This interaction and the understanding thereof is fundamentally important in the interpretation of leaf analysis data (Halais, 1962; Evans, 1965), especially in countries such as South Africa where foliar testing is routinely used for assessing the adequacy of fertiliser applications (Schroeder *et al*, 1993). At present, it is recommended that sugarcane only be leaf sampled when there is active growth and no moisture stress effects are present (Gosnell and Long, 1971). This lack of understanding and absence of a suitable moisture stress indicator severely curtails leaf sampling of sugarcane in countries such as South Africa where periods of drought (Singels and Bezuidenhout, 1999) and uneven distribution of rainfall are not uncommon.

This paper reports on an investigation aimed at quantifying the interaction between moisture stress conditions and the nitrogen content of adequately fertilised sugarcane grown in large (80 litre) containers within a 4 x 4 (moisture stress x sampling date) factorial trial under semi-controlled conditions. The moisture stress treatments were as follows: unstressed - soil kept at field moisture capacity; stressed (early) - water withheld from

day 90 after planting; stressed (late) - water withheld from day 100 after planting; and stress/relief - water withheld from day 90 after planting, but soil rewatered to field capacity on day 110 after planting. The four harvest (complete destructive sampling) dates were separated by 10 days and began on day 100 after planting.

As expected, soil moisture content declined with time after water was withheld (Figure 1), and as a result plant extension rate (Figure 2), leaf area index (LAI) and dry matter production were all negatively affected by the imposition of moisture stress over the 30 day sampling period. However, significant increases in all of these measured quantities occurred with re-watering in the stress/relief treatment (Figure 1 and 2).

In relation to plant N, it was found that there was a significant interaction between moisture stress treatment and the sampling date. Compared with unstressed sugarcane, the total plant N declined markedly with imposition of moisture stress, but improved considerably with stress relief, resulting in no significant difference between the unstressed and stress/relief sugarcane on the last sampling date (Figure 3). These differences in plant N, due to moisture stress effects, were also generally apparent when the harvested plants were partitioned into their component parts (spindle, leaf and sheath number and trash). Only data relating to the spindle and leaves 1 to 6 were included here (Figure 4).

In particular, it was found that the moisture stress treatments and date of sampling had a significant effect on third leaf N content (Figure 5). However, the recovery in third leaf N content

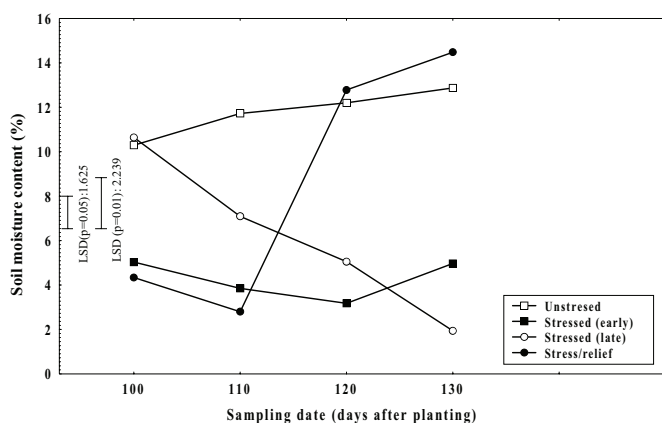


Figure 1. Mean soil moisture content values associated with the unstressed, stressed and stress/relief treatments over the thirty-day harvest period of the investigation.

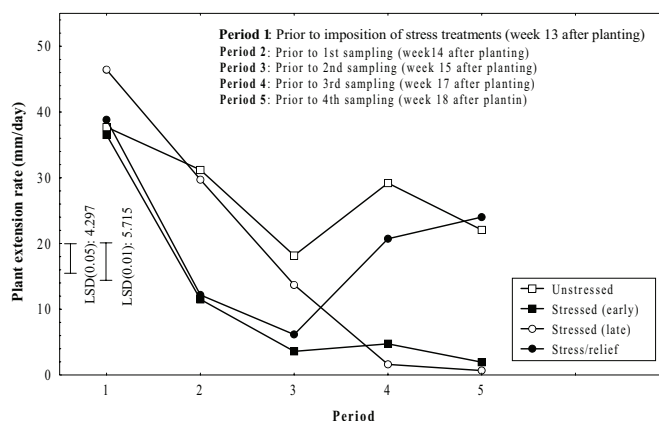


Figure 2. Mean plant extension rate values associated with the various moisture stress treatments with time.

associated with the stress/relief treatment was not as sensitive to the change in water availability as was plant extension rate, as evidenced by the longer period of recovery.

The decline and recovery in plant N values with time when water was withheld and then re-applied confirmed the interaction between water availability and the N content of sugarcane. It was concluded that the delay in recovery of third leaf N values compared with the more rapid recovery in plant growth has important implications for interpreting leaf analysis data. It is considered insufficient to base recommendations for suitable leaf sampling periods on parameters such as minimum plant growth rate, LAI, number of green leaves, etc. This work highlighted the need for a moisture stress indicator that could be

used in conjunction with leaf sampling. Such an indicator would not only need to be readily available and easily incorporated into leaf sampling routines, but also reflect the recovery in N content of third leaf samples following incidences of moisture stress.

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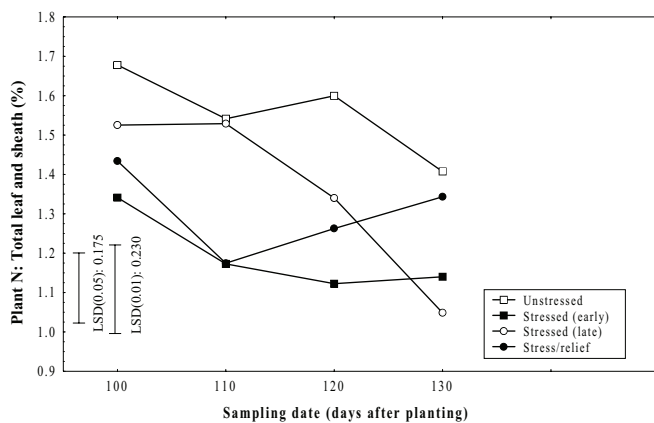


Figure 3. Interactive effect of moisture stress and sampling date on plant N content.

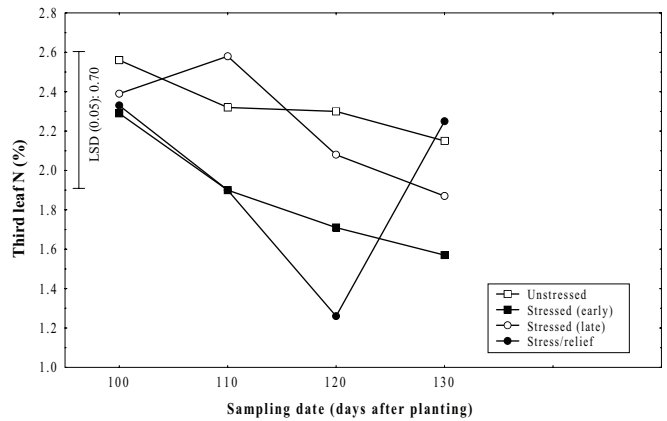
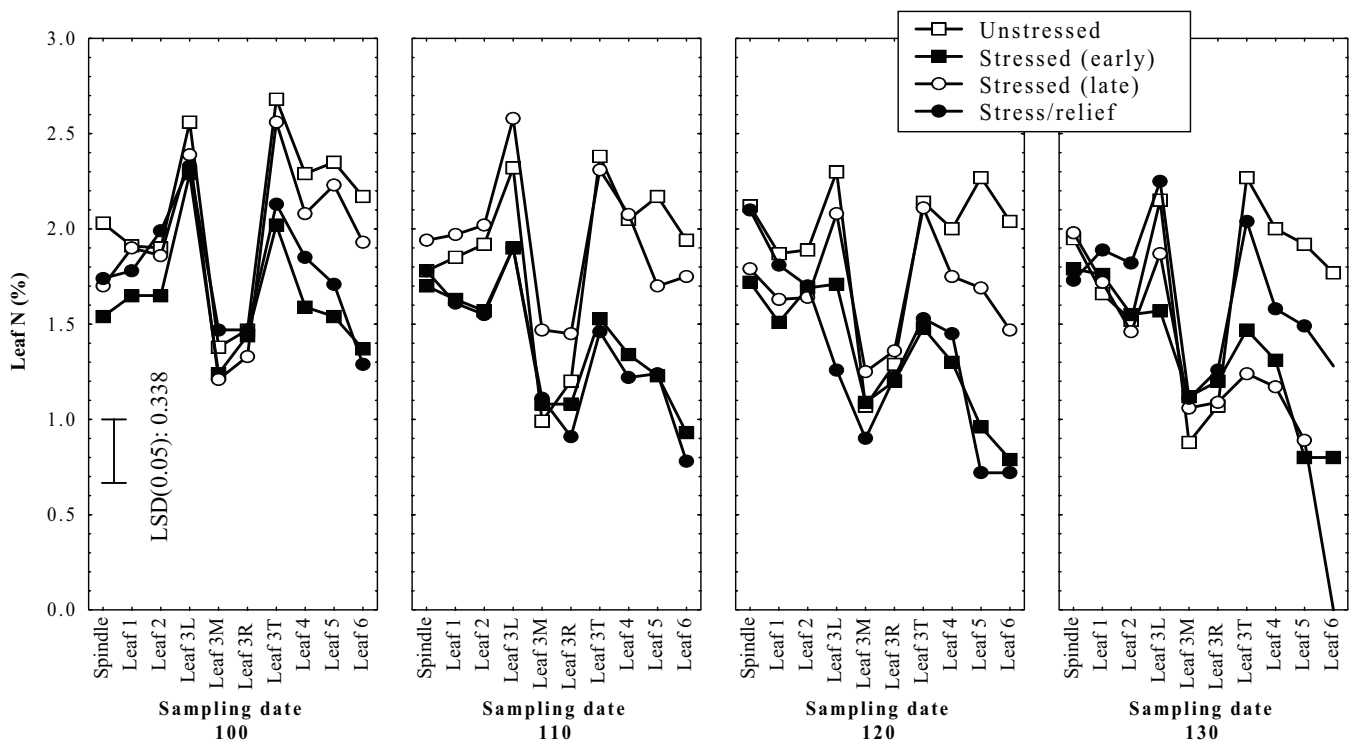


Figure 5. The effect of moisture stress and sampling date on third leaf N values.



L = lamina (mid 200mm section with midrib removed); M = midrib (from 200mm section); R = lower section of leaf (between the sheath and the 200mm section); T = top section of the leaf (between the 200mm section and the tip).

Figure 4. Effect of moisture stress and sampling date on N content of various leaf samples.

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