Effect of different fertiliser application management strategies on leaching of nutrients and sugarcane yields on Negros Island, the Philippines

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Abstract

Groundwater is essential to residents as a water resource, especially on islands. Approximately 60% of sugarcane in the Philippines is produced on Negros Island. The concentration of nitrate-nitrogen in groundwater on Negros Island is relatively high, with fertilisers applied to sugarcane being the primary source of this nitrogen (N). Many famers apply a substantial amount of N during the initial growth stage of sugarcane, when the N-uptake ability of sugarcane is low.

To optimize fertiliser management, we conducted a field trial that included different fertiliser application strategies during the initial growth stage of newly planted sugarcane, and observed leaching of fertiliser using dielectric moisture and salinity sensors.

A randomized block design trial that included six N application treatments and four replicates was planted on 7 July 2016. As with the usual practice on Negros Island, the fertiliser treatments were applied as split applications according to the following schedule: T1 – recommended rate (87 kg N ha^{-1}) applied immediately after planting; T2 – recommended rate one month after planting; T3 – recommended rate two months after planting; T4 – half of the recommended rate applied one month after planting; T5 - zero N. In T1 to T5, 87 kg N ha^{-1} was applied as a second application three months after planting. T6 was zero N in both applications. Recommended rates of phosphorous (92 kg P_2O_5 ha^{-1}) and potassium (240 kg K_2O ha^{-1}) were applied to all plots. Dielectric moisture sensors (GS3, Meter Group, Inc.) were installed at 5 depths (5, 15, 25, 40, 60 cm from surface) in T1, T2, T4, and T6.

Soil solution concentration in T1 increased rapidly and substantially after fertiliser application. The fertiliser leached into deeper soil layers, and the soil solution concentration decreased to levels as low as before the first application one month before the second application. In contrast, soil solution concentration in T2 increased moderately compared to that in T1; however, concentration was maintained until the second application. In T4 and T6, concentration did not fluctuate substantially between applications. There was no significant difference in sugarcane yield or sugar content among treatments in the new planting.

Results indicate that immediate application of fertiliser after planting (T1) may lead to leaching of nutrients into the soil, and a shortage of nutrients before the second application. When nitrogen was applied at half the recommended rate or not at all (T4 and T5), sugarcane still maintained the same yield levels as plants that received the full recommended rate. Therefore, the recommended rate of nitrogen application (T1, T2, and T3) might be excessive during initial growth stage of sugarcane and could be reduce in new planting.

Keywords: Sustainable fertiliser management, nitrogen fertiliser, dielectric moisture and salinity sensor