SHORT COMMUNICATION

THE USE OF TWINN (NITROGEN FIXING BACTERIA FOR NON LEGUMES) AS AN ALTENATIVE SOURCE OF NITROGEN FOR SUGARCANE PRODUCTION

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Abstract

Inorganic fertilizers are the most widely used sources of nitrogen (N) in Sugarcane production. However these sources are not very efficient as they are prone to such losses as volatisation and leaching, besides causing soil acidity. This short communication reports on the preliminary results obtained from field trials setup at Nakambala Sugar Estate in Zambia to establish whether TwinN, a freeze dried N fixing microbial inoculants (Endophytes bacteria), could be used as an alternative and efficient source of N that could lead to a cut back on inorganic N usage. The trial design was a 3 x 3 Randomised Complete Block Design (RCBD) and was repeated at three sites, each with a different soil type. Combinations of double applications of TwinN plus 50% and 35% cut backs on standard N (standard N = 140kgN/ha) were compared with a no TwinN and no N cut back (standard fertilizer regime) treatment. The preliminary results obtained so far show that at 95% confidence level there is no statistical difference in the stalk elongation and thickness of three treatments. The field trials at the time of reporting had not been harvested to analyse yield parameters. However, by random sampling, preliminary yield trend obtained indicate higher yield for treatments with a combination of TwinN and inorganic fertilizer, in comparison with 100% Inorganic fertilizer with no TwinN.

Keywords: Endophytes, Nakambala, Nitrogen, Sugarcane, TwinN.

Introduction

With pressure to maintain profitability in the face of increasing costs of inputs, sugarcane producers are looking at alternative, cost effective sources of nitrogen (N). A recent introduction to the Sugar industry in Zambia is TwinN, a mixture of aerobic and endophytic N-fixing microbes. The microbes establish within the leaves, stems and root tissues as endophytes and also colonise the soil immediately adjacent to the root surfaces (rhizosphere). The microbes act to reduce the need for inorganic N fertilizers by two mechanisms. Firstly, the microbes fix atmospheric N for the crops using the same reaction as legumes use, although at lower efficiency. This supplies N to the crop steadily throughout the season. Secondly, the microbes produce Plant Growth Factors (PGFs) that drive the development of larger root systems, resulting in more efficient capture of inorganic N fertilizer which usually suffers large losses from leaching and volatilisation.

In addition, the beneficial effects of TwinN would improve soil life through recycling of organic material, release of tied up nutrients, fixing atmospheric N and improving the soil structure. Furthermore, due to their interactions in the soil, there is increased root growth and photosynthetic sugar production, enhanced solubilisation of phosphorus bound in the soil and improved water use efficiency." (www.mapletoninternational.com).

Research work on the evaluation of TwinN effects on crop yields and soil N has been carried out in a number of countries. (Munthali et al 2009, Neumann 2009). However, in Zambia trials have not been done in the sugarcane crop. This short communication therefore reports on a TwinN trial conducted at Nakambala sugar estate in Zambia.

The objective of the trial was to determine the ability of TwinN to supply nitrogen to a sugarcane crop through biological nitrogen fixation and to establish the proportion of chemical N fertilizer that could be replaced by two TwinN applications while maintaining yield parameters at acceptable levels.

Materials and Methods

The trials were set up to test two combinations of TwinN with the standard inorganic fertilizer type in use at Nakambala estate. The trial was designed in a 3 x 3 randomised complete block and was replicated in 3 different soil types (light, medium and heavy). Each plot comprised 6 rows by 10m long and covered a total area of 0.009 ha. There were 9 plots per trial site and each site covered a 0.081 ha. Plots were separated by one row that was left unplanted.

The TwinN microbial product was applied when the cane was about 15 cm high by first mixing the product with the culture solution containing the microbial nutrition and then rehydrated with 50mls of clean non chlorinated water. The microbial mixture was then diluted in 100 litres of non chlorinated water. Knapsack sprayers fitted with cone shaped nozzles were used to apply the microbial mixture during the evening hours.

The trial was top-dressed first and a second dose of TwinN was then applied. Leaf samples were also taken for analysis. Table 1 outlines the treatments and gives preliminary mean results of the trials at 36 weeks of sugarcane age.

Table 1: Preliminary results at 36 weeks after the application of TwinN microbial product in three trials at Nakambala sugar estate in Zambia.

	Treatment	Plant Basal dressing (kg/ha)	Top dress Urea (46%) (kg N/ha)	Total Chemical N kg/ha	TwinN Application	Height (cm) at 36 weeks	Thickness (mm) at 36 weeks	Yield (TCH) at 36 weeks
1	Standard chemical N	N-60 P-70 K-100	N-80 P-0 K-0	140	Zero TwinN	223	29	126
2	50% Chemical N + 2 TwinN	N-60 P-70 K-100	N-10 P-0 K-0	70	1st at 15cm crop height, 2nd after 3 months	219	27	132
3	65% chemical N+ 2 TwinN	N-60 P-70 K-100	N-31 P-0 K-0	91	1st at 15cm crop height, 2nd after 3 months	207	28	149

Results and Discussion

At the time of writing, the trial fields were at an average age of 9 months, therefore not yet at a harvestable age of 12 to 13 months. However, based on the mean plant population, 36 plant stalks were randomly sampled from each treatment in order to extrapolate the yield in tons cane per hectare (TCH). The results showed that the combination of 65% chemical N and two applications of TwinN resulted in the highest yield (149 TCH) at 9 months of age in all treatments. The yield resulting from two TwinN applications combined with 50% chemical N were also higher (132 TCH) than those achieved with 100% chemical N fertilizer (126 TCH). At a 95% level of confidence using analysis of variance (ANOVA), for stalk elongation at 36 weeks, the mean treatment's F-observed value (3.49) was less than the required F value (6.94). This implied that there were no significant differences in treatment results.

Randomly selected plants from each of the TwinN treatments were extracted from the soil and observed for root mass. Root growth was substantially greater in TwinN treated sugarcane plants at 6 months of age. (Figure 1).

Figure 1. Root mass in cane sampled at 6 months as A, B and C, representing TwinN treatments 1, 2 and 3.

In conclusion, the general results showed no significant differences between treatments, which indicate that:

- TwinN microbes were identified as beneficial bacteria that fix N.
- Combined use of TwinN and 65% chemical fertilizer produced the highest yield.
- A complete analysis of final yield parameters, including leaf samples results is recommended for more conclusive results.

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