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Comparisons of sugar blend 1 plus fertilizer over straight fertilizer as basal application on growth and yield of sugarcane (*Saccharum officinarum* L).

Misheck Chandiposha[2*], Ngonidzashe Kunedzimwe[1], [2]Gwazane Munyaradzi, Daniel Chiriman'ombe[1]

[1]*Hippo Valley Estates P O Box 1 Chiredzi, Zimbabwe*

[2]*Agronomy department, Midlands State University P Bag 9055, Gweru, Zimbabwe*

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Abstract

An investigation to compare sugar blend 1 plus with straight fertilizers (single super phosphate and muriate of potash) as basal fertilizer was carried out at Hippo Valley Estates in the 2012/13 growing season.A 2x3 factorial experiment in a Randomised Complete Block Design with 3 replications was used. The first factor was fertilizer type which consisted of two levels, sugar blend 1 plus and straight fertilizer and the second factor was variety with the following levels N14, Zn10 and Nco376.The results showed that there was no interaction ($p<0.05$) between fertilizer type and variety on number of sugarcane tillers, stalks, sugarcane height and yield. However, there was significant difference ($p< 0.05$) between the fertilizer types on number of sugarcane tillers, stalks, sugarcane height and yield. Also varieties had significant difference on yield. Sugar blend 1 plus fertilizer increased the number of tillers, primary stalks, cane height and yield when compared to straight fertilizer. The cane yield in treatments applied sugar blend 1 plus increased by 24% when compared to use of straight fertilizer, from 87.2 to 108.4 tonnes / hectare.

* **Corresponding Author:** Misheck Chandiposha ✉ mchandiposha@gmail.com

Introduction

Zimbabwe is one of the producers of sugarcane and is grown commercially in the South Eastern Lowveld which comprises of Triangle, Chisumbanje, Hippo Valley and Mkwasine Estates. Sugarcane production is the major primary source of livelihoods; it entails creation of employment (Esterhuzein, 2012). It also generates foreign currency since sugarcane products such as sugar is sold regionally and internationally to European Union (Chandiposha, 2013).The by-products of sugarcane are bagasse, molasses and filter cake. Bagasse is used for the generation of electricity for industrial and domestic use. Molasses is used for fermentation and distillation to produce either alcohol or fuel grade ethanol. The filter cake after curing is use as compost for many crops including sugarcane and horticultural crops.

Despite the economic importance of sugarcane, its production is mainly constrained by a number of factors that include diseases, pests and weeds infestation, poor price, water shortages and nutritional deficiencies, among others. Nutritional deficiency in sugarcane can have dramatic impact on yield and profitability (Singh *et al*., 2008). A balanced supply of nutrient elements results in good growth and high sucrose in sugarcane production (Morgan *et al*., 2009).

Currently, single super phosphate and muriate of potash are used as a basal fertilizer at planting of seed cane at Hippo Valley Estates. However, sugarcane yields has decreased over years, as for the past three years an average cane yield of 87.2 tonnes per hectare has been achieved against 101,4 tonnes cane per hectare attained for further three years backwards (Mutorogodo,2011).Among other factors that had contributed to this cane yield reduction is nutrition. Sugarcane at Hippo Valley Estates has exhibited chlorotic symptoms at early stages of growth until the first split of nitrogen application applied as ammonium nitrate (34.5%).

Alternatively, Sugar Blend 1 plus can be applied as basal fertilizer to supply nitrogen that may be lacking at the early stages of sugarcane. Sugar Blend 1 Plus contains major nutrients, nitrogen, phosphorous, potassium, magnesium and minor nutrient zinc. The granules are coated with K-Humate derived from decayed plant and microbial matter. K-humate stimulates growth of beneficial soil fungi and bacteria, provides a source of carbon for soil microbes, had chelating properties which reduce loss of nutrients due to leaching, free-up soil bound nutrients such as calcium, phosphates and micro-nutrients. Sugar Blend 1 Plus also lock-up aluminium in acidic soils, stabilize the soil against strong pH changes from fertilizer application due to its buffering properties, augment formation of a good soil structure (Nyemba, 2009). The aim of the study was to determine the effect of basal fertilizer type and variety on number of tiller, number of stalks, plant height and sugar cane yield.

Materials and methods

Study area

The project was done at Hippo Valley Estates situated in the South Eastern Lowveld of Zimbabwe. The site is at an average altitude of 430 meters above sea level, latitude is 21° 01'S and longitude 28° 38'N.The area receives an average rainfall of 590mm per annum in November to March. The mean air temperature vary from 26°C (October-January) to 16°C (June and July). Relative humidity is lowest in August-September (55%) and highest in January-March (70%). The soils have a large reserve of weatherable minerals derived from gneisses ranging from mafic to siliceous.

Experimental Design and treatments

The experiment was set up as a 2x3 factorial experiment in a randomised complete block design (RCBD) with 3 replications. The first factor was basal fertilizer type with straight fertilizer (single super phosphate and muriate of potash) and sugar blend 1 plus fertiliser as levels. The second factor was variety with N14, Zn10 and NCo376 as levels.

Agronomic procedure

Conventional tillage was done and the operations included first disking, levelling, ripping, second

disking and ridging. First disking was done to destroy old cane stools while levelling was carried to provide uniform gradient. Cross ripping was done to loosen the soil at the depth of 0.5m while second disking was done to breaks the clods. Ridging (25cm depth) was done ensuring that furrows are 'v' shaped at 80-100 cm apart and the spacing of ridges was 1.5m apart. Basal application was applied as straight fertilizers comprising single super phosphate (SSP) and muriate of potash (MOP) at the rate of 500kg/ha and 350kg/ha, respectively. While, Sugar Blend 1 plus was applied at the rate of 500kg/ha. Basal fertilizer was applied before planting using Mayfield applicator. Top dressing was applied as Ammonium Nitrate (34.5) at the rate of 480kg/ha in 3 splits of 150,150,180kg/ha after 4, 8 and 12 weeks after planting.

All the seed cane setts were dipped in a solution of the fungicide Bayfidan for a minimum of 5 minutes before planting. Double stick method was used and the setts covered with (5mm) soil and flatbed method was used for sett covering for even distribution of water in furrows.

Pre-emergency herbicides, Sencor 480SC (Metribuzin) at 2litres/ha and Prowl (Pendimethalin) was used to control broadleaved weeds and shamva. Post-emergence herbicides included MSMA and MCPA at a rate of 3litres/ha and 2litres/ha, respectively, to control shamva and broadleaves weeds. Manual weeding was also done to control escaped weeds in sugarcane rows. Irrigation was conducted at 50% moisture depletion levels. Dursban 48EC (chlorpyrifos) was sprayed to control *Heteronychus licas* at the rate of 2litres/ha in 100 litres. Sugarcane was harvested after 14months from planting date manually using sugarcane knives and the tops removed at the natural breaking point.

Data collection

The number of secondary tillers and stalk counts were determined at 4 weeks after planting. Measurements of stalk height were taken at 4 weeks after planting using a tape measure from 10cm peg to the top visible dew lap (last visible collar) on monthly interval. Sugarcane yield was determined at weigh bridge.

Data analysis

Data was subjected to analysis of variance using Genstat statistical package 14th edition. Mean separation was done using Least Square Differences (LSD) at 5% significant level.

Results and discussion

The effect of fertilizer type and variety on number of sugarcane tillers

There was no interaction ($p<0.05$) between fertilizer type and variety on number of sugarcane stalks. However, there was significant difference between the fertilizer types. Sugar blend had the highest significance ($p<0.05$) number of stalks over the straight fertilizer as shown in Fig 1. This might be due to nitrogen requirement of sugarcane which is greatest during the tillering (formative) phase which is present in sugar blend 1 plus and not available in straight fertilizer. Nitrogen is required for adequate tiller production and canopy development. Tillering in sugarcane commences around 30 to 45 days after planting or cutting. Therefore, adequate N supply should be made available to the crop in the soil from the start of the tillering phase. Availing nitrogen at the early stages of sugarcane production facilitates cane formation, checks tiller mortality and promotes cane growth (Nyemba, 2009).

Table 1. Effects of fertilizer type on cane yield of sugarcane.

Treatment	Transformed yield
Straight fertilizer	10.430^{a} (108.56)
Blend fertilizer	8.607^{b} (73.79)
P value	<.001
CV%	2.8
$LSD_{0.05}$	0.1429

*Means with the same letter in the column are not significantly different at P<0.05.

*Figures in brackets are the original yield (tonnes/ha) data before transformation.

The effect of fertilizer type and variety on number of primary stalks in sugarcane

There was no significance difference ($p<0.05$) between varieties, however there was statistical difference between the fertilizer types. Sugar blend 1 plus had the highest significance ($p<0.05$) number of primary stalks over the straight fertilizer as shown in Fig 2. The same trend from the previous variable (Fig 1) was observed and perhaps the Sugar Blend 1 plus availed enough nitrogen to the primary stalks to reduce the mortality as compared to use of straight fertilizer which does not supply nitrogen. Patil *et al.* (1977) also reported significant increase in primary stalks of sugarcane with N application. White (1991), revealed that adequate and timely supply of N promotes tillering, canopy development, stalk formation and stalk growth.

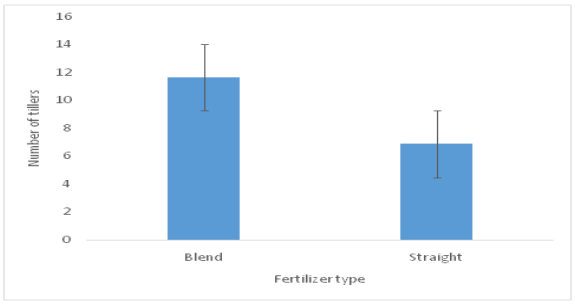

Fig. 1. Effect of fertilizer type on number of sugarcane tillers.

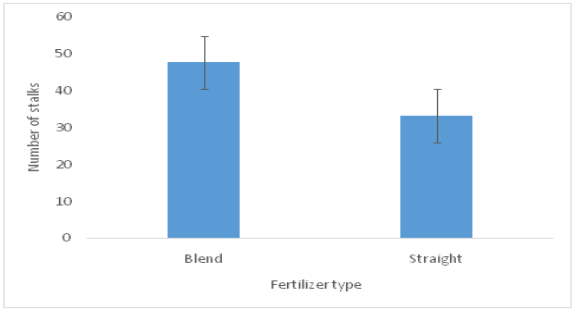

Fig. 2. Effect of fertilizer type on number of primary stalks in sugarcane at 10 months.

The effect of fertilizer type and variety on sugarcane height (cm)

Sugar blend 1 plus had the highest significant ($p<0.05$) sugarcane height over the straight fertilizer as shown in Fig 3. Perhaps this may be due to added availability of the nitrogen (N) besides from top dressing in blend fertilizer which is not available in straight fertilizer. Aktar and Silva (1999) reported an increase in plant height in sugarcane with high nitrogen availability. Nitrogen has been regarded as the most influential plant nutrient element, controlling sugarcane growth (Savant *et al.*, 1999) and is associated with vigorous growth of plants (White, 1991). Marschner (1986) also indicated that shoot elongation is enhanced by applied nitrogen. Similarly, Afghan *et al.* (2004) reported that blended fertilizer has a better effect on growth and yield of sugarcane in comparison to straight fertilizers although the results were not significant.

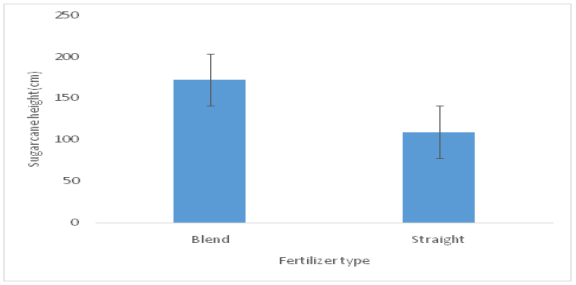

Fig. 3. Effect of fertilizer type on sugarcane height.

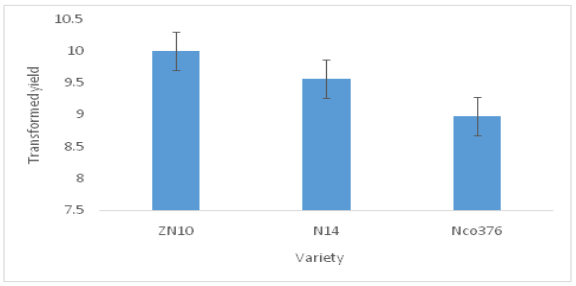

Fig. 4. Effects of variety type on sugarcane yield.

The effect of fertilizer type and variety on sugarcane yield

Sugar blend 1 plus fertilizer had the highest significant cane yield as shown in Table 1. This may be explained by observed increase number of tillers, primary stalks and plant height for treatments which were applied Sugar blend 1 plus. Increase in cane yield with increasing N levels has been reported by Akhtar and Silva (1999). Besides the additional nitrogen supply in Sugar blend plus 1, the basal fertilizer has K humate which is known to stabilize pH, free-up soil bound nutrients such as calcium, phosphate and micronutrients and this may have contributed to the additional sugarcane yield for this treatment. Also there was significant difference on variety, where Zn10 had the highest significant cane yield and was statistically similar to N14 as shown in

Fig 4. The differences may be due to genetic differences that exist between sugarcane varieties. Black (1993) indicated that for production of higher cane and sugar depends on the selection of high yielding cultivars and proper management of the crop including fertilizer application rate and time.

Conclusion

Sugar blend 1 plus fertilizer resulted in increased number of tillers, primary stalks, cane height and cane yield.Cane yield increased by 24% from 87.2 to 108.4tonnes/hectare. Zn10 and N14 had higher yields in respect of fertilizer type.

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