USE OF ORGANOMINERAL FERTILISERS ON SUGARCANE PRODUCTIVITY IN A TYPIC HAPLUSTOX SOIL

By

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KEYWORDS: Alternative Fertiliser, Organomineral, Organic Matter, Sugarcane.

Abstract

THE ASSOCIATION of organic manure with mineral fertiliser, called organomineral fertiliser, combines the benefits of organic manure through the improvement of the physical, chemical and biological soil qualities with the efficiency of the mineral fertiliser provided by its high solubility and ready availability of nutrients in the soil solution. The objective of this study was to evaluate the efficiency of organomineral fertiliser in sugarcane productivity in a dystrophic soil. The statistical design was a randomised block with seven treatments and four replicates. The treatments consisted of a control (without fertilisation), three rates of a ternary chemical fertiliser providing 50, 100, 150 kg/ha each of K_2O and P_2O_5 and 10, 20, 30 kg N/ha, three rates of an organomineral fertiliser providing 50, 100, 150 kg/ha of K_2O and P_2O_5 and 7.5, 15, 22.5 kg N/ha. Lime was broadcast over the total area, 30 days before planting at the rate of 2.0 tonnes per hectare and the fertilisers were applied in the furrows at planting. The variety of cane used was SP81 3250. The results obtained from this study showed that fertilisation with organomineral fertiliser or conventional chemical fertiliser, in dosages that provided 100 and 150 kg/ha of K_2O and P_2O_5 produced the same yields of sugarcane. In relation to the technological traits, the two sources of fertiliser applied in the same dosages promoted the same values for Pol % cane and ATR (Total Recoverable Sugar). For fibre % cane, a difference was observed. The treatments with the doses of 50 and 100 kg/ha of K_2O and P_2O_5 in chemical form and 150 kg/ha of K_2O and P_2O_5 as organomineral form promoted the lowest levels of fibre % cane.

Introduction

The use of new technologies in sugarcane fertilisation has become necessary in the face of the expansion of the sugarcane growing areas on sandy soils with natural low soil fertility. In these soils, nutrient leaching and volatilisation, especially potassium and nitrogen, can be a problem due to the low CEC, and may decrease sugarcane yield. Under these conditions, the integrated use of organic and mineral forms of fertilisers, named organomineral fertilisers, may be more beneficial, as the organic fertilisation will lead to an improvement of the physical, chemical and biological qualities together with the proven efficiency of mineral fertilisation.

The addition of organic matter to soils is known to improve soil physical characteristics resulting in reduced soil bulk density, improved water holding capacity as a result of the aggregation of particles of sand, silt and clay by organic matter (Alves, 1997).

The organic material applied or existing in soil can also provoke modifications in its chemical properties such as nutrient furnishing, toxicity amendment, pH, CEC, and humus content (Kiehl, 1985).

The objective of this work was to evaluate the efficiency of organomineral fertilisation on sugar yield compared with mineral fertilisation on Typic Haplustox.

Materials and methods

The assay was conducted in the town of Altinópolis, SP- Brazil, on Typic Haplustox, the chemical analysis of which is in Table 1.

The cane variety used was SP813250, with the following characteristics: high agricultural yield, high sucrose content, good tillering, medium maturation and tolerant to the main diseases.

Table 1—Soil characteristics at study site

Properties	Depth 0–20 cm	Depth 20–40 cm
pH ($CaCl_2$)	4.6	4.5
M.O (mg/dm^3)	12	10
P (mg/dm^3)	5	4
K ($mmol_c/dm^3$)	0.8	0.4
Ca ($mmol_c/dm^3$)	5	5
Mg ($mmol_c/dm^3$)	2	1
H + Al ($mmol_c/dm^3$)	20	19
S.B ($mmol_c/dm^3$)	7.8	6.4
CEC ($mmol_c/dm^3$)	27	25
V (%)	26.6	26.4

The experimental design was randomised blocks with 7 treatments and 4 replicates. The treatments are described in Table 2.

Table 2—Description of the treatments.

Treatments	kg N/ha	kg K_2O/ha	kg P_2O_5/ha
T1 – Control	0	0	0
T2 – Chemical fertiliser	10	50	50
T3 – Chemical fertiliser	20	100	100
T4 – Chemical fertiliser	30	150	150
T5 – Organomineral fertiliser	7.5	50	50
T6 – Organomineral fertiliser	15	100	100
T7 – Organomineral fertiliser	22.5	150	150

The organomineral fertiliser used has the formulation of 3% of N, 12% of P_2O_5 and 12% of K_2O with minimal warrant of 25% of dry matter, due to the Brazilian Legislation. The mineral fertiliser had 4% N, 20% P_2O_5 and 20% K_2O.

The experimental plots were made up of five rows of sugarcane, spaced 1.4 m apart, 10 m in length. The assay planting was performed in March of 2007 and the crop was harvested in August of 2008.

Cane yield was evaluated through weighing in the useful area of each plot, and the technological characteristics by removing ten stalks from each plot for determination of fibre % cane, Pol % cane and ATR kg/t.

The F test was used to evaluate the effect of the treatments on the investigated variables and Scott-Knott test at the level of 10% of probability for comparison between means.

Results and discussion

Cane yield

The average results for cane yield are presented in Table 3. The treatment which was not given any chemical or organomineral fertilisation had lower cane yield (TCH), indicating nutrient

shortage and the need for nutrient mineral complementation, characteristic of dystrophic soils in nutrient furnishing for crops. This agrees with Raij *et al*. (1996) who recommended a dose of 120 kg/ha of P_2O_5 and K_2O to soils with low content of K_20 and P_2O_5,.

In the treatments which were given doses of 100 and 150 kg/ha of P_2O_5 and K_2O, either in the chemical or organomineral form, the yield means obtained were equal to one another and higher than the other treatments.

It can be observed that the nitrogen rates were low. However, they did not affect significantly the yield of cane. This can be explained by the edaphoclimatic conditions found in Brazil where the plant cane has shown low response to nitrogen fertilisation, mainly due to a better efficiency of biological fixation and other biotic factors that improve the use of nitrogen from the soil by plant.

When applying two sources of fertilisation, one strictly mineral and the other which possesses organic matter, promoting similar yield, it is advisable to choose the source which adds organic matter, since it promotes improvements in the physical, chemical and biological properties of soil. It will also contribute to future increases in agricultural yield.

Table 3—Average values for tonnes of cane per hectare (TCH), contents of fibre, Pol % cane and ATR (kg/ha)

Sources	Kg/ha			Cane yield t/ha	Fibre (%)	Pol (%) cane	ATR (%) Cane
	N	P_2O_5	K_20				
Control	0	0	0	54.78 c	13.33 a	15.84 a	154.74 a
Chemical	10	50	50	74.07 b	12.15 c	16.36 a	159.46 a
Chemical	20	100	100	85.63 a	12.13 c	16.51 a	161.15 a
Chemical	30	150	150	85.42 a	12.55 b	16.58 a	161.71 a
Organomineral	7.5	50	50	75.37 b	12.64 b	16.45 a	159.95 a
Organomineral	15	100	100	92.54 a	12.50 b	16.28 a	158.96 a
Organomineral	22.5	150	150	93.82 a	11.86 c	16.41 a	160.10 a

Technological characteristics

The average values obtained for the technological characteristics are presented in Table 3. As far as the chief technological characteristics are concerned, one can observe that use of fertilisation in the organomineral and chemical form, both at the same dosages of nutrients, promoted values statistically equal for contents of Pol % cane and total recoverable sucrose % cane.

Nevertheless, for the contents of fibre % cane, a difference can be noticed among the treatments. To a treatment which was given no source of fertilisation, the fibre content was higher than the other treatments, brought about by the decreased yield, causing less accumulation of sugars and hence an increased proportion of fibre in the stalks.

For the treatments which received doses of 150 kg/ha of K_2O and P_2O_5 in the organomineral form and 100 and 50 kg/ha of K_2O and P_2O_5 in the mineral form, there was decreased fibre content, when compared with the other treatments.

As yield is increased, promoted by the efficiency of fertilisation, a greater accumulation of photoassimilates (sucrose) occurs, to the detriment of fibre content.

Conclusions

The organomineral fertiliser provided the same agricultural and technological yield in sugarcane as the mineral fertiliser in plant cane.

So, it is suggested that the study of organomineral fertiliser and its effects on long-term productivity be the subject of future studies.

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EFFET DES ENGRAIS ORGANOMINERAUX SUR LA PRODUCTIVITÉ DE LA CANNE À SUCRE DANS UN SOL HAPLUSTOX TYPIQUE

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MOTS-CLÉS: Engrais Alternatif, Engrais Organomineral, Matière Organique, Canne à Sucre.

Résumé

L'association d'engrais organique avec de l'engrais minéral, appelée engrais organominéral, combine les avantages de l'engrais organique par l'amélioration des qualités physiques, chimiques et biologiques du sol avec l'efficacité de l'engrais minéral due à sa solubilité élevée et à la disponibilité rapide des éléments minéraux dans la solution de sol. L'objectif de cette étude était d'évaluer l'efficacité de l'engrais organominéral sur la productivité de la canne à sucre dans un sol dystrophique. Un dispositif statistique en blocs randomisés avec sept traitements et quatre répétitions a été utilisé. Les sept traitements étaient composés d'une témoin (sans fertilisation), trois doses d'engrais chimique ternaire fournissant respectivement 50, 100 et 150 kg/ha de K2O et P2O5, et 10, 20, 30 kilogrammes de N/ha, et enfin de trois doses d'engrais organominéral fournissant respectivement 50, 100 et 150 kg/ha de K2O et P2O5, et 7.5, 15 et 22.5 kilogrammes de N/ha. Ces engrais ont été appliqués dans le sillon à la plantation. De la chaux a été épandue en surface, 30 jours avant la plantation, à la dose de 2.0 tonnes par hectare. La variété de canne utilisée était la SP 81/3250. Les résultats ont montré, qu'aux doses de 100 et 150 kg/ha de K2O et de P2O5, l'engrais organomineral et l'engrais chimique conventionnel produisaient les mêmes rendements de canne à sucre. En ce qui concerne la qualité technologique, les deux types d'engrais appliqués aux mêmes doses ont donné les mêmes valeurs de Pol % de canne et d'ATR (sucre récupérable total). Par contre, des différences ont été observées pour la fibre % canne. Les traitements avec des doses de 50 et 100 kg/ha de K2O et P2O5 sous forme chimique et celui avec une dose de 150 kg/ha de K2O et de P2O5 sous forme organominerale ont produit les teneurs en fibre % canne les plus basses.

USO DE FERTILIZANTES ORGANOMINERALES EN LA PRODUCTIVIDAD DE LA CANA DE AZUCAR EN UN SUELO TIPICO HAPLUSTOX

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PALABRAS CLAVE: Fertilizante Alternativo, Organomineral, Materia Orgánica, Cana de Azúcar.

Resumen

LA ASOCIACIÓN de abono orgánico con fertilizante mineral, comúnmente denominada fertilizante organomineral, combina los beneficios del abono orgánico en el mejoramiento de las propiedades físicas, químicas y biológicas del suelo, con la eficiencia del fertilizante mineral, la cual es producto de su alta solubilidad y disponibilidad inmediata de nutrientes en la solución del suelo. El objetivo del presente estudio era evaluar la eficiencia del fertilizante organomineral en la productividad de la caña de azúcar en un suelo distrofico. La evaluación se realizo con un diseño experimental bloques al azar con siete tratamientos y cuatro repeticiones. Los tratamientos consistieron de un testigo (sin fertilización), tres dosis de un fertilizante químico triple, para proveer 50, 100 y 150 kg/ha de ambos K_2O y P_2O_5 y 10, 20, 30 kg N/ha, tres dosis de un fertilizante organomineral para proveer 50, 100 y 150 kg/ha de ambos K_2O y P_2O_5 y 7.5, 15 y 22.5 kg N/ha. Se aplico cal en todo el área 30 días antes de la siembra, en una dosis de 2 toneladas por hectárea y los fertilizantes se aplicaron en el surco al momento de la siembra. Se planto la variedad SP81-3250. Los resultados del estudio demuestran que la aplicación de fertilizante organomineral o el convencional químico, en dosis que provean 100 y 150 kg/ha K_2O y P_2O_5, produjo los mismos rendimientos para caña de azúcar. Respecto a los caracteres tecnológicos, las dos fuentes de fertilizante, aplicadas en la misma dosis, produjeron los mismos valores de Pol% cana y ATR (Total de azúcar recuperable). Se observo una diferencia en cuanto a porcentaje de fibra en cana. Los tratamientos con dosis de 50 y 100 kg/ha de K_2O y P_2O_5 en forma química y 150 kg/ha de K_2O y P_2O_5 en forma organomineral produjeron menor porcentaje de fibra en cana.