MINIMUM TILLAGE OF SUGARCANE IN THAILAND: ITS EFFECT ON YIELDS, SOIL PROPERTIES AND COST EFFECTIVENESS

By

P. PRAMMANEET, I. GRANGEET, P. PRASERTSARKET, C. LAIRUNGREUNGET and C. SRUTTAPORNET

1Suphanburi Field Crops Research Center, U-thong, Suphanburi 72160 Thailand
2Faculty of Environmental and Resource Studies, Mahidol University, Nakon Pathom 73170

Abstract

Many sugarcane soils in Thailand are undergoing structural degradation after being planted to sugarcane for long periods of time. Five different soil tillage systems were tested. These were assessed by measuring changes in soil physical properties and cane yields over time. Cost benefit analyses were also performed. There was a relationship between the more compacted soil of the no-tillage system having lower yields (81.6 t/ha) and the less compacted soil of the conventional system having higher yields (91.8 t/ha). The minimum-tillage systems had the lowest amount of soil compaction that gave the best yield returns and the best profit margins.

Introduction

Three components of cane cultivation have been specifically identified as being detrimental to soil physical structure in Thailand: badly timed and excessive land preparation; heavy traffic at the time of harvest such as from mechanical harvesters and fully loaded trucks; and the reduction of soil organic matter through the burning of cane (Prammanee et al., 2000). These operations increase soil bulk density due to compaction, reducing porosity and lowering infiltration rates. The impact of traffic on soil physical properties is clear and has been documented (Soane, 1975, 1983). However, Johnston and Wood (1971), De Boer (1993) and Ng Cheong et al. (1999) reported no effect on cane yield, while Swinford and Boevey (1984) reported a reduction in yield.

Research in recent years using minimum or no-tillage techniques, combined with trash management, has shown beneficial results both for improving cane yields as well as reducing detrimental environmental impacts (Wood, 1991; De Beer et al., 1993). The present paper reports a long-term sugarcane trial being conducted in the Central Region. The main objective of the trial is to determine the effects of different soil tillage methods and trash return on sugarcane production and soil fertility.

Materials and methods

The trial was conducted at Suphanburi Field Crops Research Center in central Thailand (10° 18’N 99° 51’E, 7 m above sea level). The soils at the site were classified in the Kampaengsaen soil series (silty haplustalf) and were predominantly silty in texture. The climate is tropical wet and dry with a mean annual temperature of 28°C and mean annual rainfall of 1116 mm.

The trial was initiated in January 1994 and is presently in its 6th year which represents the 2nd ratoon of the second planting. Only the conventional tillage treatment (T1) has since been ploughed. The experimental design was a split plot, with the tillage system as the main plot. The five tillage systems being tested are as follows:

- **T1** conventional tillage + periodic burning of trash + manual planting;
- **T2** minimum-tillage + periodic burning of trash + stool removal + machine planting;
- **T3** minimum-tillage + periodic burning of trash + subsoiler + manual planting;
- **T4** minimum-tillage + periodic burning of trash + subsoiler + machine planting;
- **T5** no-tillage + no burn (trash blanket remains after all harvest cycles) + manual planting.

Soil physical measurements (bulk density, infiltration rate, penetration resistance, water release characteristic, aggregate stability) were made over the plant row and inter-row. The sugarcane variety used was U-Thong 2.

Results and discussion

Soil physical properties

Inter-row soil bulk density (BD) values were higher at depths between 0 to 25 cm than for those in the plant row for all treatments. The conventional tillage system (T1) had lower BD values in the upper 35 cm, which might be related to the incorporation of surface organic matter (OM). The conventional system (T1) produced the highest yields in the first crops. However, with time, the minimum-tillage systems generally produced the highest yields, in particular the treatment with mechanical stool removal (T2) (Table 1). Treatment T2 also had the lowest BD values, suggesting there is a relationship between lower BD in the upper 25–30 cm and higher cane yields.

Optimal soil moisture contents in the upper horizons is reflected in the higher yields obtained in recent years (1998 and 1999 crops, Table 1), when rainfall early in the season was high and evenly distributed.

KEYWORDS: Bulk Density, Conventional Tillage, Minimal Tillage, No-Tillage.
Cost benefit analysis of cane production

Pramannee et al. (2000) compared the costs associated with cane production using conventional tillage (labour and machine planting) with no-tillage systems. Production costs were found to be 36% and 20% higher for the conventional systems with hand planting and machine planting, respectively, than the no-tillage system. The major cost of the conventional tillage (using machine planting) was mechanisation accounting for up to 75% of production costs. This is reflected in the net profit of the three systems with the no-tillage system being 37% and 65% more profitable than the conventional systems with hand and machine planting, respectively.

Conclusion

Despite the higher yields associated with the conventional system compared with the minimum-tillage system, cost benefit analyses clearly indicate that the extra cost of land preparation in the conventional system reduced the net profit significantly.

REFERENCES


LE LABOUR CHIMIQUE DE LA CANNE EN THAILANDE: SES EFFETS SUR LE RENDEMENT, LES PROPRIETES DU SOL ET LA RENTABILITE

P. PRAMANEE1, I. GRANGE2, P. PRASERTAK1, G. LAIRUNGREUNG1 et C. SRUTTAPORN1

1Suphanburi Field Crops Research Center, U-thong, Suphanburi 72160 Thailand
2Faculty of Environmental and Resource Studies, Mahidol University, Nakorn Pathom 73170

Résumé

Beaucoup de sols plantés en canne à sucre en Thaïlande ont une structure dégradée suite à de longues années de culture. Cet état de fait est causé par la préparation du sol de façon continue et intensive. Cinq différentes méthodes de travail du sol furent mises à l’essai. Elles ont été évaluées par des mesures de l’évolution temporelle des propriétés physiques du sol et des rendements. Des analyses coûts-bénéfices furent aussi entreprises. Il y avait une relation entre les sols compactés des méthodes de semis direct à plus faible rendement et les sols moins compactés de la méthode conventionnelle à plus fort rendement. Les différences de compactage se trouvaient seulement sur les premiers 35 cm, aucune différence n’étant notée à plus grande profondeur. En dépit de cette
relation, le facteur ayant une influence primordiale sur le rendement était le climat. Les rendements étaient plus élevés quand la pluviométrie était au-dessus de la moyenne et mieux distribuée, surtout en début de saison. Les systèmes de labour chimique donnant les meilleurs rendements étaient ceux qui avaient le moins de compactage dans la couche supérieure du sol. Dans les études de rentabilité, les méthodes de labour chimique et celles de semis direct donnaient les meilleures marges de profit et permettaient une plus grande flexibilité pour la gestion des exploitations.

*Mots clés:* densité apparente, travail conventionnel, labour chimique, semis direct.

LABRANZA MÍNIMA DE LA CAÑA EN TAILANDIA: EFECTO EN LA PRODUCCIÓN, PROPIEDADES DEL SUELO Y COSTOS

P. PRAMANEE1, I. GRANGE2, P. PRASERTAK1, G. LAIRUNGREUNG1 y C. SRUTTAPORN1

1Suphanburi Field Crops Research Center, U-thong, Suphanburi 72160 Thailand
2Faculty of Environmental and Resource Studies, Mahidol University, Nakon Pathom 73170

Resumen

Muchos de los suelos de Tailandia están sometidos a degradación estructural después de la siembra continua con caña de azúcar por periodos largos de tiempo. Se probaron cinco tratamientos para la preparación del suelo. Los tratamientos fueron evaluados midiendo los cambios en el suelo y en la producción de caña después de varios años; también se calculó la relación costo/beneficio. El tratamiento sin laboreo y donde el suelo estaba más compacto mostró la producción más baja (81.6 t/ha) y en el suelo menos compacto con laboreo tradicional presentó la mayor producción (91.8 t/ha). El sistema de labranza mínima presentó el menor valor de compactación y se obtuvieron los mejores retornos económicos y las mayores ganancias.