MODIFICATION OF THE TWO-WHEELED TRACTOR IN RELATION TO THE
DEVELOPMENT OF EQUIPMENT FOR SUGARCANE CULTIVATION IN THAILAND

By

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Abstract

In Thailand, manual labour is predominant for cultivation, weeding and fertiliser application. High cost and shortage of labour have created a demand for cheaper ways of mechanising farm operations. This poster describes the development of equipment which can operate with two-wheeled tractors for cane cultivation. Modifications were made to the tractor to enable it to travel in the narrow (110–130 cm) inter-row, and to balance the weight of the implement to reduce operator inconvenience. The drawbar hitch was altered for better control of the implement. An inter-row weeder, a trash cutter and a fertiliser applicator were developed and tested in the field. While the performance of the weeder was good, the trash cutter was not effective, especially in a heavy trash blanket. The fertiliser applicator was effective. However, due to the weight of the fertiliser, the engine was moved to the front and counter-weights were used to balance the implement.

Introduction

Mechanisation of small farms is very challenging due to various factors such as smallholdings, undulating and dispersed farmlands and economy of scale. Even if the engineering is ‘right’ there is no guarantee that a machine or system will be regarded as socially acceptable or be economically viable (Crossley and Kilgour, 1983). In Thailand, operations such as weeding, fertiliser application and chemical spraying are mostly carried out manually by farmers with small or medium-sized holdings. This poster presents the use of a two-wheeled tractor for various cultivation practices in Thailand.

Modification of the two-wheeled tractor

The two-wheeled tractor is also known as a power tiller or the walk-behind tractor. When modified and used with suitable implements, this can become a viable option for operations such as cultivation, weeding and fertiliser application in sugarcane fields.

These tractors are widely available to cane farmers and are extensively used for rice cultivation, irrigation and farm transport. The tractors are powered by diesel engines ranging in capacity from 8 to 12 hp (Vincent, 1999). To enable the tractor to travel in the cane inter-row space (110–130 cm) the rubber wheels were replaced with modified steel cage wheels of narrower width and diameter. The wheel-to-wheel outer dimension became 90 cm and resulted in reduced speed (Figure 1).

The front chassis where the engine is mounted was extended so that the engine could be moved further forward. This was necessary to balance the weight of

KEYWORDS: Power Tiller, Small Farm, Weeder, Trash Cutter, Fertiliser Applicator.
the implement and to reduce strain on the operator when steering or turning. Counter-weights were also placed at the front end to improve the overall balance and manoeuvrability of the implement.

The drawbar hitch on the tractor was modified into a dual axis (i.e. the lock pin can be mounted horizontally or vertically) for better control of the implement.

**Implements**

Three implements were manufactured and tested using the two-wheeled tractor under field conditions.

**Inter-row weeder**

The inter-row weeder is hitched to and drawn by the tractor. The weeder has adjustable tynes and tills the soil in the inter-row. Weeds are uprooted and allowed to die in the sun. The ridge formed during furrow making is broken and is spread across. A turn-buckle is provided for adjustment of the implement. The performance of the implement was good. Working in the sandy soils required a floatation skid to be provided to prevent it from sinking into the soil (Figure 2).

- Overall dimensions: 800 x 700 x 550 mm —35 kg (Vincent, 1999)
- Rate of work: 2.19 Rai/h (1 Rai = 1600 m²)
- Cost of operation: Baht 40/Rai (US$6.25 per hectare)
- Weedicide to be applied along the rows after the operation.

![Fig. 2—Inter-row weed remover.](image)

**Trash-cutter**

The implement consists of four serrated steel discs mounted on a long shaft, which is bolted to a steel frame. It was designed with the objective of chopping trash in ratoons. Due to the unbalanced nature of the two-wheeled tractor the force applied by the discs over the trash was inadequate. Furthermore, the well-dried soil in the ratoon field did not allow penetration of the discs for effective chopping (Figure 3).

- Weight = 85 kg (Vincent, 1999).
- Chopping was more effective in slightly damp soil.
- A heavy trash blanket greatly reduced performance, as the cutter tended to float over the trash.

![Fig. 3—Trash cutter.](image)

**Fertiliser applicator**

Two sets of coulter discs followed by tynes open small furrows in the soil into which fertiliser is dropped through a plastic tube. A land wheel drives the screw feeder mechanism in the fertiliser bin and meters the fertiliser. The entire system is mounted on a steel frame and hitched to the tractor. At the end of the row, the operator has to lift the handles together with the implement and steer the tractor. To make it easier for the operator, the engine was moved to the front end of the tractor and counter-weights were placed at the front of the tractor (Figures 4 and 5).

- Rate of work: 3.25 Rai/h (Vincent, 1999)
- Cost of operation: Baht 41.40/Rai (fertiliser cost not included).

![Fig. 4—Fertiliser applicator.](image)

Several trials were conducted with varying results. The following factors determine the successful use of these implements:
• Implements must be as lightweight as possible. This reduces the strain on the operator.
• Cultural practices must be altered for effective operation of these implements (row spacing and irrigation).
• The implement must be compatible with the tractor.
• The implement cost and design must address the economic conditions of the farmers.

Conclusions
The rising cost and shortage of labour creates an opportunity for increasing mechanisation of small and medium farms, especially in developing countries. With the objective of satisfying this need, modifications were made to a two-wheeled tractor, and various implements were developed and tested. The implements were manufactured and distributed to the farmers and their adaptation will now be studied.

Fig. 5—Two-wheeled tractor with fertiliser applicator attached.

REFERENCES

MODIFICATION DU MOTOCULTEUR PAR RAPPORT AU DEVELOPPEMENT D’EQUIPEMENTS POUR LA PRODUCTION DE LA CANNE EN THAILANDE

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Résumé
En Thaïlande, la plupart des opérations culturales telles la plantation de la canne à sucre, le désébrage et l’application d’engrais sont faites manuellement. La pénurie et le coût élevé de la main-d’œuvre ont suscité une demande pour des méthodes moins onéreuses de mécanisation des opérations culturales. Cette affiche décrit le développement d’équipements pouvant être utilisés avec des motoculteurs pour la culture de la canne à sucre. Le motoculteur a été modifié afin de permettre son passage dans l’interligne étroit (110–130 cm) et pour contrebalancer le poids de l’outil dans le but d’améliorer le confort de l’opérateur. L’attelage du timon a été modifié pour un meilleur contrôle de l’outil. Un équipement pour le sarclage de l’interligne, un coutre pour couper la paille et un applicateur d’engrais furent développés et évalués. Si le sarclage était réussi, le coutre n’était pas efficace, surtout sur une épaisse couche de paille. L’applicateur d’engrais a bien fonctionné. Toutefois, en raison du poids de l’engrais, le moteur a été déplacé vers l’avant et des contrepoids furent utilisés pour équilibrer l’équipement.

Mots clés: herse animée, petite ferme, équipement de désébrage, coutre, applicateur d’engrais.
MODIFICACION DE UN TRACTOR DE DOS RUEDAS PARA ADAPTARLO A DESARROLLOS DE EQUIPOS PARA CULTIVOS DE CAÑA DE AZUCAR EN TAILANDIA

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Resumen

En Tailandia predominan las labores manuales para realizar actividades de laboreo de suelo, control de malezas y aplicación de fertilizantes. El costo y la carestía de la mano de obra a creado una demanda por formas más económicas de mecanización de las operaciones de campo. El presente poster describe el desarrollo de un equipo que puede operar como un tractor con dos ruedas para cultivar la caña. Se realizaron modificaciones en el tractor para adaptarlo a los efectos de que opere en una trocha estrecha (110-130 cm) y para balancear el peso del implemento para reducir inconvenientes durante la operación. El enganche de la barra de tiro fue alterado para un mejor control del implemento. Se desarrollaron equipos de escarda en la trocha, para cortar el residuo vegetal y para aplicar herbicidas, los que fueron evaluados en condiciones de campo. Mientras el desempeño del cultivador fue bueno, el equipo para cortar el trash no fue efectivo, especialmente cuando la cobertura de residuos fue espesa. El equipo para la aplicación de fertilizantes fue efectivo. Sin embargo, debido al peso del fertilizador, el motor fue movido hacia el frente y un contrapeso fue usado para balancear el implemento.

Palabras claves: cultivador autopropulsado, pequeños productores, escardador, cortador de residuos, fertilizadora.