EVALUATION OF LAND PREPARATION OPERATION FOR LOCAL GRAIN CORN PRODUCTION

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ABSTRACT

Mechanization operation contributes almost 45% of the total of grain corn production cost. Land preparation is the most expensive activity compared to the others. Conventional practice of land preparation needs at least one round of disc ploughing, one round of harrowing and followed by one round of rotor. These three activities are costing around RM 1000.00 per season. The optional practices the strips tillage or zero tillage planting and reduced tillage need to further study to obtain the most effective land preparation activity for grain production in Malaysia. Reducing tillering operation by three operations become two round operation and minimal tillage (only one round rotor) can reduce operation cost. While Strips tillage is a cultivation of a narrow strip in the row planting area, has the potential advantages of providing a suitable seedbed for corn production with minimum energy consumption. This cultivation system mostly come together with planting machine means no delaying on planting date after land preparation. By reducing tillering operation and applying zero tillage operation, planter can overcome issue of unexpected weather and high operation cost. The objective of this study is to evaluates a tillage planting technique that can be implemented in Malaysia to minimize the cost of grain corn production. The field trials were conducted at MARDI Seberang Perai, Pulau Pinang. The experiment has been arranged in six treatments with three replications which was laid out in the RCBD. Strip tillage and zero tillage cultivation methods have the capacity to be applied since they can lower the production cost of local grain maize by RM 975.00/ha, despite the fact that there is no substantial change in yield.

Keywords: Grain corn, unstable weather, minimum tillage, zero tillage, soil erosion, randomized complete block design (RCBD).

INTRODUCTION

Malaysia's grain corn production is growing after a period of instability due to high production costs and poor profits. Unlike its neighbouring, Indonesia has been persistent in its grain corn development efforts to date and is on the verge of achieving self-sufficiency level (SSL) and exporting its grain corn products internationally (AB.R Rohazrin). Priority is given to large-scale production systems in the growth of the grain corn industry in Malaysia, which includes the use of mechanization while also conducting research to find new varieties capable of providing high yields.

In Malaysia, mechanization accounts for 46% of the entire cost of grain corn production (AB. G. Mohamad Bahagia. C.C.Sheng, 2019). Land preparation, planting, crop care, irrigation, and harvesting are the five key operations involved in grain corn production. Mechanization is necessary to assure the long-term viability and improving the productivity of grain corn production, particularly large-scale operations. Plantation operations are becoming more efficient as a result of mechanization, with shorter working hours and fewer workers. The kind of machinery used in the mechanization of grain corn production should be determined based on adaptability as well as the planting circumstances. The tillage operation accounts for the vast majority of the total. Ploughing, harrowing, and rotor are examples of conventional tillage operations. These techniques allow seed planting and vegetative development to take place on the soil surface. Depending on characteristics including cropping history, soil type, climatic conditions, and earlier tillage method, different tillage techniques can alter soil physical attributes (Mahboubi et al., 1993).

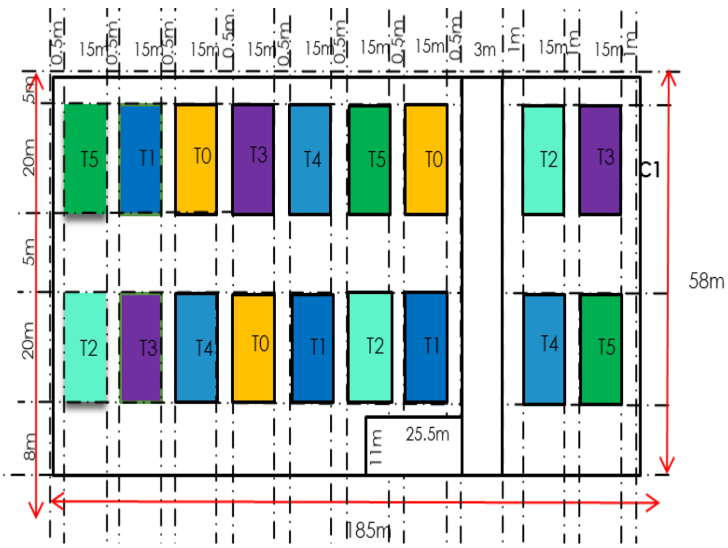
Tillage is important for seedling establishment, growth, and yield. (Atkinson et al., 2007). Ploughing and harrowing stimulate root penetration, seed sowing, and organic matter absorption into the soil and enhance soil structure, despite the fact that no tillage treatments build soil surface organic matter and enhance soil biochemical characteristics (Rashidi et al., 2010). Several methods and approaches are often used to reduce costs, including enhancing corn production and lowering or eliminating tillage operations being the most effective.

The conventional tillage method based on a high amount of soil engagement and soil inversion (Weise and Baurarach, 1999). Conservation tillage refers to a wide range of agricultural techniques that are focused on planting crops in the residues of previous crops that have been purposefully left on the soil surface (Uri et al., 1999). Strip tillage and zero tillage are part of conservation tillage. The effects of tillage on the performance of grain maize crops have been studied extensively. According to Uri et al. (1999), Conservation tillage will significantly prevent soil erosion and improve soil quality, and it may be an attractive idea to conventional tillage for farmers due to its ability to reduce labor and fuel use, as well as decrease total production costs (Uri, 2000). This technique is considered to provide the best results in terms of lowering manufacturing costs. This study evaluates a tillage planting technique that can be implemented in Malaysia to minimize the cost of grain corn production.

MATERIALS AND METHODS

Field tests have been conducted at MARDI Seberang Perai, Pulau Pinang. The experimental design was a factorial, arranged in a randomized complete block design (RCBD) with three replicate blocks for six treatments, T0) Conventional, T1) Harrow and rotor, T2) Rotor, T3) Strip tillage, T4) Zero tillage, and T5) Spading and rotor. Eighteen total fields plots designed for the study. Each plot measured 20 m by 15 m with the individual plots separated by 0.5 m buffer zones. Fields were selected with relatively uniform soil type and vegetative cover for the field, with sandy loam soil types and grain corn with three cropping histories. Plot areas were selected in portions of the field and the tillage treatments randomly assigned as showed in Figure 1.

Figure 1. Experimental plot layout



Grain corn Tillage Evaluation:
6 Test (T0,T1,T2,T3,T4,T5,)
T0=Control (Disc plough+Harrow+Rotor) (A+B+C)
T1=Harrow+Rotor (B+C)
T2=Rotor (C)
T3=Strip Tillage (D)
T4=Zero Tillage (E)
T5=Spading Tillage + Rotor (F+D)
3 Rep for each Experiment
Total experiment plot = 18

For conventional test T0, disc plough, harrow and rotor implement (figure 2 (A,B,C)) attached to the tractor and each operation done 15 day before planting (DBP), 5 DBP and 1 DBP in sequence. T1 treatment using harrow and rotor method were done 5 DBP and 1 DBP (figure 2 (A,B)). T2 treatment, minimal rotor tillage (figure 2 (C)) done 1 DBP . T3 Test using Strip tillage machine (figure 2 (E)) develop by MARDI. This machine applies with planter attached behind the machine on the same day planting. T4 treatment use Zero tillage machine manufactured by Gaspardo company (Figure 2 (D)). This machine tillering implement consist tillering, planting, and fertilizing applicator mechanism in this machine. T5 done by using spading tillage machine (figure 2 (F)) applied on 10 DBP and rotor machine 1 DBP (figure 2 (C)). Each implement attached to a standard 70.8kW (95 Hp) 4 rubber wheel tractor with 4-wheel drive (4WD). This tractor was chosen for its suitability and technical aspects to work in domestic grain corn farm. Grain moisture content, cob weight with husk, cob weight without husk, grain weight, and yield data was recorded for this study. The data collected using crop cutting test technique (CCT). Another data collected were the overall work rate of the cultivation operation according to the method of land preparation.

Figure 2. Land preparation evaluation


(A)Ploughing


(B)Harrow


(C)Rotor


(D)Zero Tillage


(E)Strip Tillage


(F)Spading

RESULTS AND DISCUSSION

Statistical analysis Data were analyzed using SAS (version 9.3; SAS Institute, Cary, NC). Replication was treated as a random factor. Mean separation was performed statements using the LSD method.

Table 1: Results of a comparative study of land preparation methods

Treatment	Grain MC	Cob Weight with husk (kg)	Cob weight without husk (kg)	Grain weight (kg)	Gross Yield (ton/ha)	Yield @ 14 (ton/ha)
Conventional Plough+harrow + rotor (T0)	26.99 ±1.43	16.40±1.85	14.63±1.56	11.71±1.25	7.80±0.83	6.62 ± 0.6
Harrow + rotor (T1)	24.25 ±1.58	11.57 ±1.72	10.60 ±2.55	8.48 ± 2.04	5.65 ± 1.36	4.96 ±1.08
Rotor (T2)	25.05 ±1.59	11.93 ±2.25	11.87 ±2.50	9.49 ±2.00	6.33 ±1.33	5.53 ±1.25
Zero tillage (T3)	25.90 ±1.63	15.23 ±2.41	13.76 ±2.05	11.01 ±1.64	7.34 ±1.09	6.32 ± 0.92
Strip tillage (T4)	25.78 ±0.62	14.31 ±0.67	13.31 ±0.99	10.65 ±0.79	7.10 ±0.53	6.12 ± 0.41
Spading + rotor (T5)	28.48 ±1.75	15.37 ±0.47	13.47 ±0.23	10.77 ±0.18	7.18 ± 0.12	5.97 ± 0.23

Table 2: The overall work rate of the cultivation operation according to the method of soil preparation

Land Preparation Method	**Operation Work Rate**
Conventional + planting	8 hour/ha
Strip tillage + planting	2 hour/ha
Spading Machine + planting	4 hour/ha
Zero tillage planting	2 hour/ha

There is no significant difference in harvest yield between T0, T3 and T4 (Table 1) but the cultivation method with T3 and T4 method gives higher productivity with low cost than the others, which is at 2 hours/ha and saves in terms of production costs (Table 2). T1 and T2 showed a slight lack of yield compared to the other methods. This may be due to several factors such as competition with weeds and the situation when the soil left after harvest has become dry and hard to penetrate. This will cause the depth during soil plowing to be shallow and difficult for the implement harrow and rotor to press into the soil.

T5 or implement spading application method is a new method in breaking down hard layers during soil plowing for the study of grain maize in Malaysia. from the study conducted, the method of using spading showed better yield results than using conventional implement such as harrow in T1. From the study conducted as well, it was found that spading implement (T3) can penetrate into and lift the hard soil layer compared to harrow implement (T1)

In this study, T3 and T4 are the better planting method because it can minimize operational costs. These methods also have a positive effect on the cultivation and development of grain corn. T3 and T4 had less competition with weeds because the left-over residue during harvesting was pushed aside when this method was used. This residue will cover the weed and stunt its growth. Compared to T0 and T2 methods, T3 and T4 will cut down on operational or land preparation costs such as ploughing, harrowing, and rotor. The cost is approximately RM900-RM1000 for each activity. Moreover, this approach will raise farmers' and gain operators' incomes by minimizing production costs.

CONCLUSIONS

One of the challenges that should be overcome in order to guarantee the industry's economic viability is the cost of production. Based on the current findings, strip tillage and zero-tillage cultivation methods have the potential to be implemented since there is no significant difference in yield, but they can reduce production costs of local grain corn by RM 975.00/ha, and farmers can gain their income. For Malaysian grain corn production, a planting method and yield output have yet to be defined. It is necessary to demonstrate that the agricultural approach is suitable for Malaysia's conditions. Cooperation between government and commercial institutions is critical to ensuring that any new methods proposed will be implement.

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