ENHANCING FIELD MECHANIZATION THROUGH INNOVATIVE TECHNIQUES IN RAISED BED PLANTING FOR GRAIN CORN PRODUCTION

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ABSTRACT

The demand for local grain corn has surged due to its versatile use in various industries, notably for livestock feed like broilers and eggs. However, meeting this demand faces challenges, especially in marginal areas with unpredictable weather and limited mechanization support. Innovative technology is crucial for sustainable local grain corn production. In areas with poor drainage, modified raised beds and conventional planting techniques address waterlogging issues. Raised beds enhance water drainage, particularly beneficial in wet climates, whereas traditional planting requires additional drainage measures for poor soil conditions. A 90hp tractor with a two-lane raised bed tool is used, creating a 3-meter planting area with a ditch in the center covered by a rotor for corn planting. Each 3-meter x 59 meter raised bed path takes 2 minutes and 16 seconds to build. The modified raised bed planting system accommodates grain corn machinery, featuring 3-meter-wide beds with a 40-centimeter-deep trench and 70-centimeter breadth. The choice between raised bed and conventional planting depends on soil type, climate, and resource availability, emphasizing the importance of tailored approaches for sustainable grain corn production.

Keywords: raised bed planting, ditch, grain corn, mechanized

INTRODUCTION

Malaysia, a tropical country with distinct dry and wet seasons, faces challenges in grain corn cultivation due to heavy rainfall, particularly in certain regions receiving up to 3000 mm annually. The nation's agroecological diversity presents opportunities and challenges, with some areas classified as marginal lands due to soil, climate, or topographical constraints. Marginal lands pose specific difficulties for traditional agricultural practices, necessitating careful planning and strategic approaches for successful grain corn production.

Mechanization plays a significant role in Malaysia's grain corn industry, constituting 46% of production costs. Large-scale production systems prioritize mechanization alongside research for high-yielding corn varieties. However, challenges persist, including unpredictable weather patterns due to climate change, necessitating simultaneous land preparation and planting operations within a day, requiring substantial power resources and multiple tractors.

Addressing soil challenges, especially in areas with imperfect drainage and water stagnation, is crucial for successful grain corn cultivation. The Malaysian Agricultural Research and Development Institute (MARDI) has developed innovative techniques like raised bed planting to improve drainage and soil conditions. Raised beds offer advantages over conventional planting methods, particularly in managing water drainage and preventing waterlogging, especially during wet weather conditions.

This paper explores the adaptation of raised bed planting and conventional methods in grain corn production in Malaysia, considering factors such as soil type, climate variations, and resource availability. By examining the benefits and challenges of these planting techniques, this study aims to contribute valuable insights for sustainable and efficient grain corn production in diverse agroecological conditions.

MATERIALS AND METHODS

The experiment took place at the grain corn experiment plot situated in MARDI Seberang Perai, Penang. This plot, covering 1 hectare, was specifically chosen due to its problematic waterlogging issues. Following secondary tillage, a 4-disc conventional disc ridger implement (Figure 1) was attached to a 90hp tractor, featuring discs measuring 660mm x 6mm in diameter, set at a ridge depth height ranging from 330mm to 400mm, with a maximum width between ridges of 1500mm (refer to Figure 2). The chosen ridge depth was deliberately set below the soil hardpan layer, located approximately at a depth of 30 cm. The conventional grain corn planting area was set at 3000mm.

To implement raised bed planting for grain corn production, a rotor was applied on top of the two raised beds that had been created. This modification allowed for the development of a 3000mm planting area suitable for grain corn planting and compatible with conventional planting and top-dressing machinery. Data pertaining to crop establishment, measured at 15m x 3m with three replications for each plot, were recorded every 15 days throughout the experiment duration.

Grain Corn Cultivation

Following the application of the disc ridger, a rotor tiller was connected to a 90hp tractor through the power take-off (PTO) mechanism to cultivate the soil atop the two raised beds, each spanning 3000mm, in preparation for planting (Figure 3). A pneumatic grain corn planter equipped with a fertilizer applicator and suitable for a planting area of 3000mm was employed for the planting process (Figure 4).

Statistical Analysis

The statistical analysis was conducted using SAS statistical software (SAS, USA), employing a t-test to compare means between crop establishment data before and after the implementation of the raised bed technique. The results of the t-test, along with the standard deviation (SD), were reported to assess the impact of the raised bed technique on crop establishment.

Figure 1. Raised bed with 4-disc conventional disc ridger implement.

Figure 2. Experiment Plot Layout (1 ha) and design of the raised bed planting area

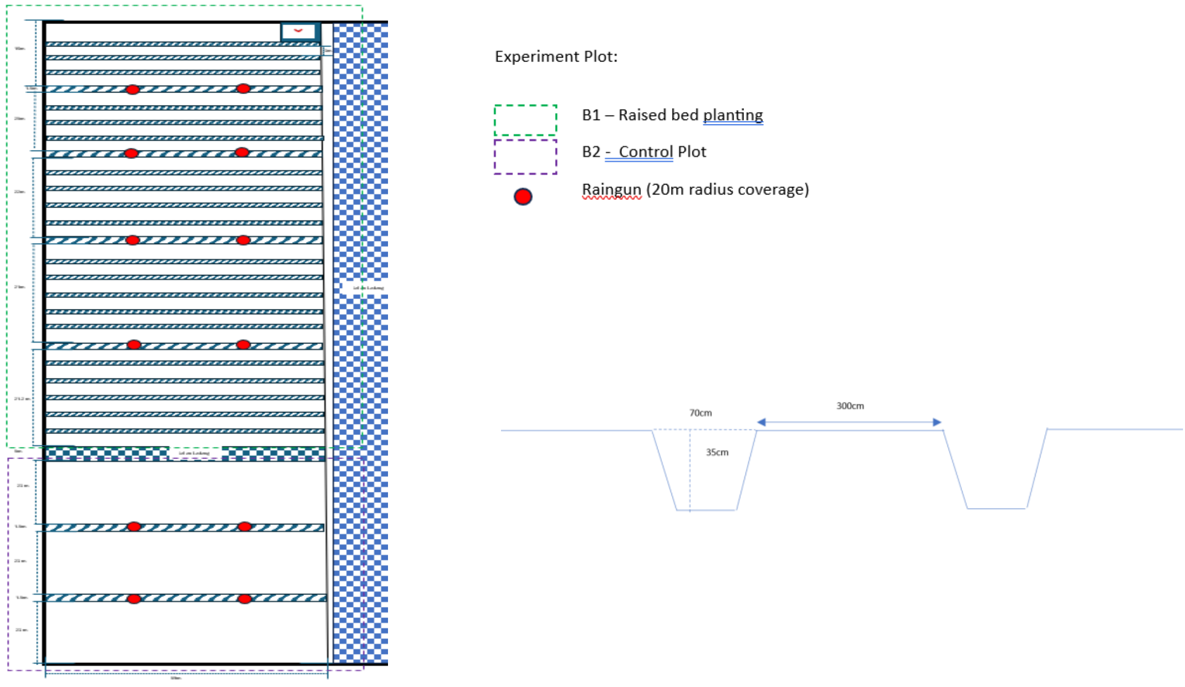

Figure 3. Raised bed implement attach on 90hp tractor to develop 3000mm raised bed planting technique.

Figure 4. (a) Planting on raised bed , (b) Planting on conventional land preparation

(a) **(b)**

RESULTS AND DISCUSSION

Figure 9. Grain corn crop establishment

In the discussion of the experiment's results at 110 days after planting (DAP) (Figure 9), comparing crop establishment between the raised bed and conventional planting techniques, the T-test analysis revealed no significant differences in plant height, cob number, and plant number. However, a significant difference was observed in cob weight. Refer to Table 1 for detailed data analysis.

It's significant that the modified raised bed planting technique facilitates efficient grain corn planting, with the capacity to construct one raised bed path measuring 3000mm x 5900mm in just 2 minutes and 16 seconds. This adaptation involves covering the ditch in the center of the raised bed with a rotor, creating an optimal 3000mm planting area for corn planter machinery. Each raised bed is 3m wide, with a ditch trench depth of 400mm and a planting distance of 700mm.

The modification of raised bed planting technology addresses challenges faced in grain corn production, allowing for smoother operation of planting machinery. The decision between raised bed and conventional planting methods hinges on various factors such as soil type, climate conditions, and resource availability. These considerations underscore the importance of adopting tailored planting techniques to optimize grain corn production outcomes in diverse agricultural settings.

Table 1: Crop establishment between planting with raised bed technique and conventional techniques

	110DAP									
	P value = 0.01746		P value = 0.035432		P value = 0.28741		P value = 0.230312		P value = 0.421	
	Cob weight with Husk (kg)		Cob weight No Husk (kg)		Cob No.		Plant No.		Plant Height	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
B1 (Raised bed planting)	19.07	0.64	17.93	0.81	86.33	3.21	92.33	7.23	235.00	11.53
B2 (Conventional)	16.70	1.27	15.00	1.41	85.00	1.41	87.00	2.89	234.00	38.89

CONCLUSIONS

From this study, we can summerize that adopting raised bed planting for grain corn in Malaysia requires a thorough understanding of local climate, soil properties, and water resources. While raised beds can improve drainage and minimize soil compaction, they may also necessitate careful monitoring of soil moisture levels and regular irrigation to prevent drying out. Despite their weed control benefits, manual weeding may still be required. However, raised beds can reduce water usage and are advantageous in regions with inconsistent water availability or heavy, poorly draining soils prone to waterlogging.

Although raised beds may require additional labor for preparation, they offer long-term benefits such as reduced tillage needs. However, the suitability of raised bed planting depends on the specific conditions of each region. Conventional planting may be more appropriate for well-drained soils and stable climates, while raised beds are advantageous in water-limited areas. Ultimately, the choice between raised bed and conventional planting techniques should be based on a thorough assessment of local environmental factors to optimize grain corn production sustainably.

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