

## EVALUATING THE PERFORMANCE OF A TWO-ROW PINEAPPLE TRANSPLANTER IN PEATLAND CONDITIONS

Adli Fikri Ahmad Sayuti 1\*, Rohazrin Abdul Rani1, Mohd Taufik Ahmad1, Siti Nooraliah Baharom1, Badril Hisham Abu Bakar1, Mohamad Fakhru Zaman Omar2, Mohammad Aufa Mhd Booker3, Mohd Nizam Zubir4, Muhammad Hariz Musa1, Mohd Zamri Khairi Abdullah1, Noraznal Mohd Zainal1, Norhafizi Mansor1, Norahsheikin Abdul Rahman1 and Ibrahim Embong4

1 Engineering Research Centre, MARDI Headquarters, 43400 Serdang, Selangor

2 Engineering Research Centre, MARDI Sintok, 06050 Bukit Kayu Hitam, Kedah

3 Engineering Research Centre, MARDI Seberang Perai, 13200 Kepala Batas, Pulau Pinang

4 Horticulture Research Centre, MARDI Pontian, 82000 Pontian, Johor

\*Corresponding author email: adlifikri@mardi.gov.my

### ABSTRACT

Peat soil exhibits notable characteristics such as elevated organic matter levels, acidity, and inadequate drainage. Predominantly, pineapple cultivation occurs in areas with peat soil conditions. In 2022, Malaysia cultivated a total of 16,205 hectares of pineapples. A proficient worker can plant up to 3,000 suckers per day, requiring fifteen workers to plant a single hectare, which amounts to 43,500 suckers. The agricultural sector encountered a shortage of labor in 2021 due to a confluence of global circumstances, demographic shifts, and policy dynamics. The integration of technology and machinery in agriculture has enabled the automation of tasks traditionally performed manually. Mechanization holds promise for substantial enhancements in productivity, cost-effectiveness, and operational efficiency. The Malaysia Agriculture Research and Development Institute (MARDI) responded to labor shortages by developing a semi-automatic two-row pineapple transplanter. This equipment requires three operators: one to operate the tractor, and two to manually insert suckers into the cylinder distributor mechanism situated at the back of the transplanter. Utilizing power take-off (PTO) as its primary power source, the transplanter employs a Kubota model L4400 tractor for evaluation, conducted at MARDI Pontian, Johor. The machine can plant pineapples at a rate of 6.6 hours per hectare, with the tractor traveling at a speed of 1.04 kilometers per hour. The operational rate of the machine is 0.15 hectares per hour. The mechanization approach is approximately 5.3 times more time-efficient than the conventional method and it achieves the same planting operation in significantly less time and with fewer operators.

Keywords: Performance evaluation, peat, rows pineapple transplanter, pineapple suckers, planting

### INTRODUCTION

The characteristics of peat soil, which is distinguished by its high organic matter content, acidity, and inadequate drainage. Peat soil conditions are predominantly associated with pineapple cultivation. Malaysia, renowned for its pineapple production, recorded 16,205 hectares of pineapple cultivation in 2022, according to statistical reports (Laporan statistik tanaman, 2020-2022). Notably, the MD2 pineapple variety is highly esteemed for its vibrant color, sweet taste, and low acidity. Pineapple plantations are concentrated in states such as Johor, Selangor, and Perak, contributing to Malaysia's increasing export figures, as evidenced by records from LPNM: RM642 million in 2020, RM1.1 billion in 2021, and RM1.2 billion in the preceding year. The Agriculture and Food Security Ministry, through the Malaysian Pineapple Industry Board ([www.mpib.gov.my](http://www.mpib.gov.my)), aims to elevate pineapple-based exports to RM1.3 billion by 2023 ([www.thestar.com.my](http://www.thestar.com.my)).

Traditional manual pineapple planting methods necessitate the employment of 15 workers to plant one hectare, involving the insertion of 43,500 suckers (Rahim et al., 2007). In response to labor challenges, the Malaysia Agriculture Research and Development Institute (MARDI) developed a two-row pineapple transplanter, representing a semi-automated solution. This study aims to assess the performance of the transplanter machine to enhance planting operations. A pilot experiment evaluated the transplanter's performance under peat soil conditions in the field.

### MATERIALS AND METHODS

#### *Study area and material*

The study took place at MARDI Pontian in Johor, Malaysia. The experimental area spanned 150 square meters (0.015 hectares), divided into subplots measuring 10 meters by 1.5 meters, each replicated ten times (see Figure 1). Planting distances were set at 60 cm between rows, 30 cm between crops, and 90 cm between boundaries.

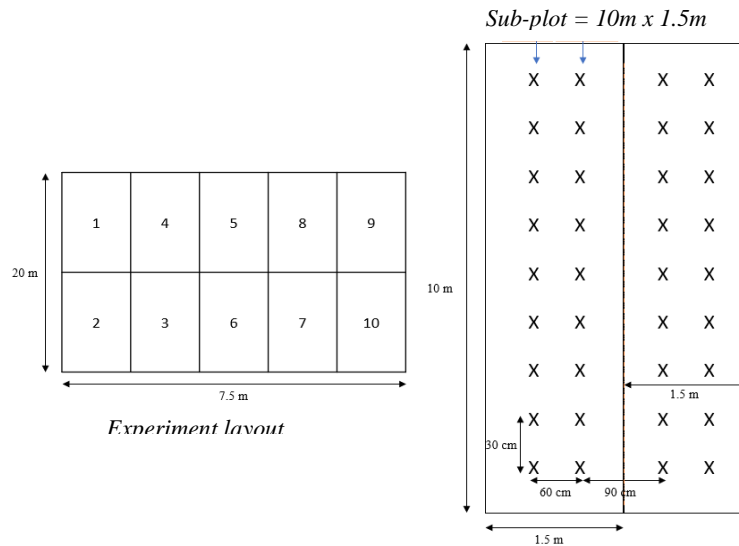


Figure 1. Experimental plot design

This experiment utilizes 820 pineapple suckers (refer to Figure 2). These suckers, classified as A size, typically exhibit a girth of approximately 17-18 centimeters. Prior to planting, the leaves of these suckers are trimmed to achieve a length ranging between 25-30 centimeters (as depicted in Figure 3).



Figure 2. Pineapple sucker's



Figure 3. Pineapple sucker been trimmed

**Two rows pineapple transplanter**

The manual/semi-automatic two-row pineapple transplanter (see Figure 4) has been developed and utilized for pineapple planting operations. This machine is a tractor-mounted transplanter featuring two rows for back planting and necessitates three operators: one serving as the tractor driver and the remaining two positioned at the rear of the transplanter to manually insert pineapple suckers into the rotating perforating cups distributor mechanism. Subsequently, the pineapple suckers are discharged into the rotating cylinder type feeding mechanism and implanted into the soil. The planting material bin is designed to accommodate 2,500 pineapple suckers. The transplanter primarily relies on a Power Take-Off (PTO) operating at 540 revolutions per minute (rpm) to power its various mechanisms. Evaluation of the transplanter involves the use of a Kubota model L4400 tractor, which operates at a speed of 500 rpm with gear 2 set to Low.



Figure 4. Tractor Kubota L4400 attach to two-rows pineapple transplanter

**Determined of Field Work Rate (FWR)**

The transplanter's planting efficiency is indicated by the Field Work Rate (FWR). According to theory, "the width of the cutter bar and the speed" determine the work rate. However, the size, form, and crop conditions of the fields all affect how quickly work is done.

$$FWR = \frac{Area(ha)}{EOT}$$

Where; EOT = effective operation time in second

**RESULTS AND DISCUSSION**

Regarding Table 1, the outcomes present the performance evaluation carried out during the planting process employing a two-row pineapple transplanter. According to the data, a 10-meter distance yielded an average time of 34.3 seconds. The cumulative time required for the planting operation across 10 replications amounted to 344 seconds.

Table 1: Time taken for each sub plots

No. Plot	Time (Second)	Total time taken (Second)
1	28	344
2	30	
3	36	
4	34	
5	36	
6	33	
7	36	
8	37	
9	36	
10	38	
	Average =34.3	

operational efficiency of 0.15 hectares per hour, with an average tractor speed of 1.04 kilometers per hour. These calculations are derived from the total duration of 344 seconds, equivalent to 0.095 hours. Notably, the study was conducted under wet season conditions in peat terrain, leading to instances of tractor wheel slippage, which in turn lowered the tractor's speed during the planting process. This may pose challenges to the transplanter's smooth operation. Nonetheless, the experiment plot (refer to Figure 5) has been successfully planted with a total of 830 pineapple suckers. Table 2 presents the Field Work Rate (FWR) for the two-row pineapple transplanter's field operation. The analysis reveals an

Table 1: Field work and speed of tractor during planting operation

Operation	Operation work rate (FWR) (hectare per hour)	Average speed of tractor (km per hour)
Planting -Two rows pineapple transplanter	0.15	1.04



Figure 5. Pineapples are planted in an experimental plot

## CONCLUSION

In summary, employing a two-row pineapple transplanter presents a notably more efficient method for planting pineapple suckers, offering enhanced operational efficacy compared to traditional techniques. The outcomes are influenced by the specific attributes of peat soil and the prevailing wet season conditions. Optimal results are more likely during the drier summer season, which mitigates issues such as tractor slippage and enables faster acceleration, thereby reducing overall time consumption.

Theoretically, utilizing this transplanter can accomplish pineapple planting tasks for a 1-hectare area in approximately 6.6 hours per hectare, requiring three operators. This equates to a total time of 19.8 hours per hectare. In contrast, the conventional approach demands fifteen workers and 7 hours per hectare, totaling 105 hours per hectare. Mechanization proves to be approximately 5.3 times more time-efficient than conventional methods, accomplishing the same planting tasks in significantly less time and with fewer operators. The implementation of this machine significantly enhances efficiency, reduces labor costs, boosts productivity, and minimizes time consumption, often leading to superior overall outcomes. Future research will focus on further exploration of peat soil, with additional experimentation under mineral soil conditions.

## REFERENCES

- Laporan statistik tanaman (sub-sektor tanaman) 2020-2022, Jabatan Pertanian Ministry through the Malaysian Pineapple Industry Board (LPNM) <https://www.mpib.gov.my/en/marketing/> <https://www.thestar.com.my/news/nation/2023/05/18/agriculture-ministry-targets-rm13bil-exports-of-pineapple-products-this-year>
- Abd Rahim Hassan, A.R. Rohazrin, M.Noor Al-Anuar. 2007. Development and performance of pineapple transplanter for commercial scale production
- I.H. Rukunudina, C.H. Muhammad, H. Abd. Rahim and A.R. Rohazrin. Field Evaluation of Mechanization System for Large Scale Pineapple Production on Mineral Soils in Malaysia. DOI: 10.17660/ActaHortic.2011.902.33
- JP-RM-0352 - Development of a planting mechanism for automated pineapple transplanting/
- Internet**
- The Star (2023). Agriculture Ministry. Retrieved on 18 May2017 from <https://www.thestar.com.my/news/nation/2023/05/18/agriculture-ministry-targets-rm13bil-exports-of-pineapple-products-this-year>  
<https://chat.openai.com>