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Two-Wheel Tractor Performance Test With Variations Of Soil Trilling Patterns In Rice Land, East Lombok

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Abstract. The purpose of this experiment was to determine the effect of variations in soil cultivation patterns on the performance of two-wheeled tractor plows in rice fields. The research experiment was conducted in Kotaraja Village, Sikur District, East Lombok Regency. The type of soil at the location is clay textured with an area of 0.09 Hg. The research was carried out in January 2022. The method used in this study was an experimental method with a Completely Randomized Design (CRD) which was repeated three times. The experimental activities were carried out by comparing variations in soil cultivation patterns (a. Edge cultivation pattern, b. Middle cultivation pattern and c. Close alternating cultivation pattern) on rice fields so that different effects were obtained from each soil cultivation pattern. The research parameters observed were fuel requirements, work speed, and soil cultivation efficiency. Based on the results and discussions, several conclusions can be put forward, namely that the land cultivation pattern has an effect but is not significant on speed, fuel consumption, theoretical field capacity, effective field capacity and field efficiency. In addition, the edge pattern has a high working speed of 1.27 m/s and a processing time of 0.16 hours and more efficient fuel consumption compared to other patterns, namely 2.25 L/hour. The field efficiency value of the three soil processing patterns is relatively low, ranging from 34.30% to 52.04%. Therefore, in this study, it is recommended to use the edge pattern as an effective and efficient method in soil processing.

Keywords: Two-wheeled tractor, soil processing pattern, processing efficiency.

INTRODUCTION

Rice fields have a strategic function, because they are a planting medium for plants, especially food crops for the population in Indonesia. The standard area data for rice fields in West Nusa Tenggara Province is 239,552 Ha, while in East Lombok Regency it is 44,568 Ha. In utilizing the potential of the raw rice field land, proper processing is needed and is the beginning of agricultural cultivation activities. This land processing activity must be attempted to remain optimal, effective and efficient in its use, because it can affect soil quality, agricultural production, land processing time and costs incurred by farmers. So that it is hoped that the potential of large rice fields can be utilized optimally (Sulnawati et al., 2016).

In Indonesia, rice cultivation is very massive in all provinces which is carried out conventionally. Land processing activities are generally carried out using livestock (cows, buffaloes and horses). The tools used to process the land are hoes, machetes, sickles and others. Along with the development of the times, processing activities are replaced with more sophisticated technology. So that land processing can be done quickly, effectively and efficiently for farmers (Desi, 2019). Generally, land processing activities in rice fields are quite heavy

activities, activities require considerable energy and costs for agricultural machinery maintenance, so to minimize conventional processing constraints it is important to use technology. According to (Rizma, 2016), the main purpose of using machines in agriculture is to increase farmer work productivity and change heavy work into lighter work. Furthermore (Murti et al., 2016), states that agricultural mechanization can improve the quality of crop production. The type of agricultural machinery needed for processing is a tractor.

Tractors are one of the agricultural tools and machines used for agricultural cultivation. Two-wheeled tractors have long been known by farmers in Indonesia and have general benefits, namely pulling, moving soil processing tools, pulling agricultural machinery and driving other machines. This type of tractor is widely used by farmers to plow rice fields. The latest data for the population of hand tractors in West Nusa Tenggara Province in 2015 was 14,116 units (BPS, 2015). When viewed from an economic perspective, the use of two-wheeled tractors, especially on the island of Lombok, is superior and more effective because the agricultural land is small and narrow. So it is very appropriate for use by farmers to facilitate the soil processing process. According to (Mardinata & Zulkifli, 2014), it states that the soil processing patterns that are widely known and carried out are the close back and forth pattern, the circling pattern, the spiral pattern, the edge pattern, the middle pattern and the alpha pattern. The problem that often occurs for farmers is how to optimally, effectively and efficiently cultivate the soil. The goal is to perform minimal processing, but produce good soil and optimal plant growth at low cost (Wirasantika et al., 2015).

Based on the description above, differences in processing patterns will have different effects on the performance test parameters of two-wheeled tractors. Therefore, it is necessary to conduct research on effective and efficient soil processing patterns to be applied by farmers, especially in rice fields. The purpose of this experiment is to determine the effect of variations in soil processing patterns on the performance of two-wheeled tractor plows in rice fields.

RESEARCH METHODE

Time and Location of the Research

The research experiment was conducted in Kotaraja Village, Sikur District, East Lombok Regency. The type of soil at the location is clay textured with an area of 0.09 Hg. The research was carried out in January 2022.

Research Tools and Materials

The tools used in this study include 1 unit of a two-wheeled tractor, Quick G-1000 ZEVA brand, single plow, ruler, meter, stopwatch, camera and writing instruments. While the materials used in this study are diesel fuel.

Research Method

The method used in this study is an experimental method with a Completely Randomized Design (CRD) which was repeated three times. Experimental activities were carried out by comparing variations in soil processing patterns in rice fields so that different effects were obtained from each soil processing pattern.

Research Stage

a. Preparation

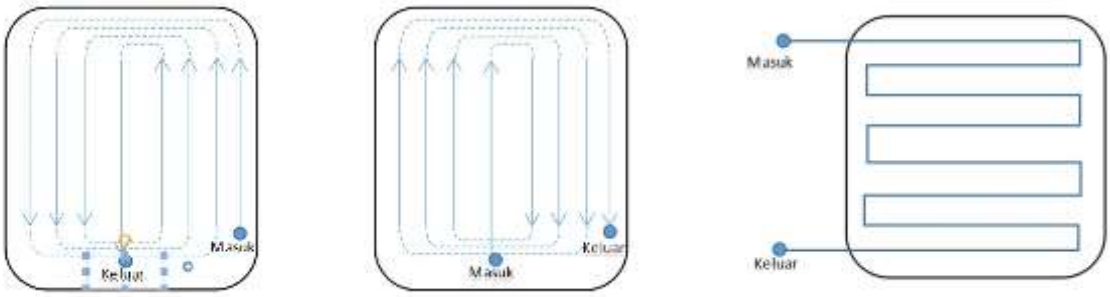
Activities include observation of the land to be cultivated, provision and checking of tools and materials, preparation of work matrices, technical consultation and direction on the operating method of two-wheeled tractors.

b. Implementation

The performance test of two-wheeled tractors with various soil cultivation patterns is carried out in the following stages:

1. Prepare and cultivate the land using two-wheeled tractors with different soil cultivation patterns.
2. Test the performance of two-wheeled tractors with various soil cultivation patterns on rice fields that have been irrigated until saturated with the following stages:

- Carry out the irrigation process one day before plowing until the soil is saturated so that the water becomes stagnant.
- Prepare and cultivate the land by implementing soil cultivation patterns.
- Observe the indicators to be measured
- Analyze and process data from the results of the two-wheeled tractor performance test with various soil cultivation patterns.
- Scheme of two-wheeled tractor test plots with edge cultivation patterns (a) on rice fields, middle cultivation patterns (b) and close back and forth cultivation patterns (c) by doing three repetitions.



(a) (b) (c)

Figure 1. Soil processing pattern testing scheme

Observation Parameters

a. Fuel Requirements (liters/hour)

Fuel measurement is done by filling the fuel tank on the tractor before it is used for each soil processing. Then after the soil processing is complete, the fuel tank is refilled until it is full as before, where the amount of fuel added is measured in a measuring cup, in this way the amount of fuel needed for each processing will be known.

b. Working Speed (m/s)

To determine the average speed of the tractor, it is known from how long it takes the tractor to travel 10 meters using a stopwatch with three repetitions. The formula used in this study is as follows:

Average speed = Distance traveled (m) / Time required (m/second)

c. Soil Processing Efficiency

Theoretical field working capacity of the tractor

The equation used to calculate the theoretical field working capacity for soil processing (Zulpayatun et al., 2017).

$$Kt = W \times V \text{ Ha/hour}$$

Kt = Theoretical field working capacity (Ha/hour)

W = Working width (Plow width) (m)

V = Working speed (m/second)

0.36 = Conversion of m^2/second to Ha/hour (1 m^2/second = 0.36 Ha/hour)

Effective field working capacity of tractor

Observations were made by calculating the total time used to operate the tool on a certain area unit. Effective work capacity can be calculated using the formula

Ke = A/T, Ha/hour

Ke = Effective field work capacity (Ha/hour)

T = Total time used (hour)

A = Total land area used (Ha)

Soil processing efficiency

The following equation is used to calculate soil processing efficiency:

E = Ke / Kt x 100%

Ke = Effective field work capacity (Ha/hour)

Kt = Theoretical work capacity (Ha/hour)

Observation Parameters

The experimental data were analyzed using Analysis of Variance (Anova) at a 5% significance level using the Minitab application and for significantly different treatments, they will be further tested with an honest significant difference (HSD) of 5%.

RESULT AND DISCUSSION

Overview of Testing

The land used is 10m x 10m in the form of a square with three repetitions to obtain accurate results. The condition of vegetation on the surface of the land, there are still remnants of rice harvest waste that has not been cleaned and grass that grows because the soil has not been processed (Figure 2.).

Figure 2. General conditions of the test location.

In Figure 3. above is the land processing process using a variety of soil processing patterns in rice fields. Generally, the soil processing pattern commonly used by farmers is the edge pattern on land that is not too wide and is easier to plow by the operator, while the middle pattern is usually used on land that has a curve in the middle of the rice field. In determining the soil processing pattern before processing the land, it must be in accordance with the conditions and size of the land to be more effective and efficient. This is in accordance with the statement (Salsabilla, 2022), in carrying out soil processing, it is necessary to adjust the size

and condition of the land to determine the processing patterns, so that the time during turning is not wasted and gets effective and efficient processing results.

(a) (b) (c)

Figure 3. (a). Edge Pattern; (B). Middle Pattern; (C). Back and forth Meeting Pattern

Speed and Fuel Consumption

Based on the results of the Anova test (Table 1.), the treatment of edge patterns, middle patterns and dense alternating patterns showed non-significant results. In this experiment, it was found that higher speeds and shorter processing times were able to minimize fuel consumption, so the work capacity was low, and the work capacity was directly proportional to fuel consumption.

Based on the calculation results above (Table 1.) it shows that the highest speed in the processing pattern is the edge pattern of 1.27 m/s, the lowest in the middle pattern of 1.25 m/s, and the highest fuel consumption is in the dense alternating pattern of 2.78 L/hour for 0.24 hours and the lowest is the edge pattern of 2.25 L/hour for 0.16 hours.

Table 1. shows that the magnitude of the working speed in land processing using various processing patterns is 1.27 m/s for the edge processing pattern, 1.25 m/s for the middle processing pattern, and 1.26 m/s for the alternating processing pattern. The difference in speed is thought to be due to the difference in the patterns used on each land. Although the land area is the same, different tillage patterns can also cause differences in processing speed. A good tillage pattern is a tillage pattern that can minimize wasted time. Tillage using the edge pattern obtained a faster processing time of 0.16 and the highest working speed compared to the back and forth compact processing pattern of the middle processing pattern.

Table 1. Results of calculations of theoretical, effective and field efficiency field capacity.

Processing pattern	Working speed (m/s)	Soil processing time (hour)	Fuel consumption (L/hour)
Edge Pattern	1,27	0,16	2,25
Center Pattern	1,25	0,19	2,68
Tight Back-and-Forth Pattern	1,26	0,24	2,78

This is because in the edge pattern processing process, the tractor operator finds it easier to arrange the second plowing after the first plowing is completed and so on by turning the tractor to the left on the side of the first plowing result. The land space for turning is also wider and maximal when using the edge pattern compared to the other two processing patterns. While in the middle pattern and the close alternating pattern, there are still remaining unplowed land spaces due to the difficulty of following the pattern. In addition, this pattern can damage the embankment if the operator is not professional and the time when turning causes the work speed to decrease and the soil processing time to increase, so these obstacles are closely related to fuel consumption.

The highest fuel consumption results with a land area of 100 m2 were obtained in the close alternating pattern soil processing of 2.78 liters / hour. The second highest fuel consumption was obtained in the middle pattern, namely 2.68 L / hour, and the lowest fuel consumption in the edge pattern, namely 2.25 L / hour.

The difference in fuel consumption in the three types of patterns is due to several factors, namely when turning. For the middle processing pattern and the back and forth processing pattern, both use up the operator's energy and concentration and when turning. In line with the statement (Mardinata & Zulkifli, 2014), that the dense alternating pattern has a number of turns of around 28 times and the edge pattern has a number of turns of around 22 times. In this case, turning time is a time that is detrimental to farmers because it affects fuel consumption, so a good soil cultivation pattern is a pattern with a small number of turns. This statement is supported by (Saputra, 2023), that the lost time is closely related to the soil cultivation pattern because of the turning process during soil cultivation. Based on the results of the analysis above, the edge pattern is more recommended than the middle pattern and the dense alternating pattern.

Field Efficiency

Based on the results of the Anova analysis (Table 2.), the treatment of edge patterns, middle patterns and dense alternating patterns showed non-significant results. In this experiment, the field efficiency value was obtained which was highly dependent on the theoretical field capacity and effective field capacity. Field efficiency is the comparison of effective field capacity and theoretical field capacity expressed in percent (%) (Rinata & Alen, 2016).

Based on the results above (Table 2.), it shows that the highest field capacity, theoretical and field efficiency in processing using edge patterns are 0.1235 Ha/hour, 0.0625 Ha/hour and 2.25%. While the lowest is the dense alternating pattern of 0.1232 Ha/hour, 0.0416 Ha/hour and 34.30%. According to (Widata, 2015), the field efficiency value of 56.1% is relatively low, so it can be said that the work of two-wheeled tractors for soil processing using singkal in variations in soil processing patterns needs to be improved again so that it will be more effective.

Table 2. Results of calculations of theoretical, effective and field efficiency field capacity.

Processing pattern	Working speed (m/s)	Soil processing time (hour)	Fuel consumption (L/hour)
Edge Pattern	0,1235	0,0625	52,04
Center Pattern	0,1219	0,0536	44,99
Tight Back-and-Forth Pattern	0,1232	0,0416	34,30

From the results above, the edge tillage pattern dominates the theoretical field capacity, field and land efficiency. This capacity illustrates how much the optimum tractor capability is in processing the actual land in the field. These results indicate that edge tillage is more effective and efficient both in terms of time and soil processing results. In line with the statement (Aisyah, 2015), that the wider the land that is completed in a shorter time, it is said that the work of cultivating the land has high soil efficiency. In soil processing, there are several obstacles that are commonly experienced by tractor operators that can affect effective field capacity, including: (a). Time lost at the end of the row when turning or turning, (b). Time lost to clear the land or congestion; (c). Time lost due to overlapping and slipping. One of the constraints that greatly influences the treatment of the tillage pattern is the time lost when turning or turning. When viewed from the theoretical, effective and field efficiency values, the middle pattern and the dense alternating pattern are lower than the edge pattern. This is because soil processing in the

middle and dense alternating patterns has a greater number of turns, resulting in low field capacity. In addition, the operator's skill level is required to turn, where turning in a tight alternating pattern requires a good level of skill. The degree of turning is also influenced by the operator's stamina. A high degree of turning at the beginning of processing such as the middle and tight alternating patterns will make the operator tired more quickly so that the operator's concentration and stamina decrease. This is in line with the statement (Sinaga et al., 2015), that turning at the end or corner of a field results in a loss of time that is often very significant, especially in short or narrow fields.

From the results of the study above, it shows that the performance test of two-wheeled tractors with variations in soil processing patterns in rice fields has no real effect on speed, fuel consumption, theoretical field capacity, effective field capacity and field efficiency.

CONCLUSION

Based on the results and discussion, several conclusions can be put forward, namely that land processing patterns have an effect but are not significant on speed, fuel consumption, theoretical field capacity, effective field capacity and field efficiency. In addition, the edge pattern has a high working speed of 1.27 m/s and a processing time of 0.16 hours and fuel consumption that is more efficient than other patterns, namely 2.25 L/hour. The field efficiency value in the three land processing patterns is relatively low, ranging from 34.30% to 52.04%.

Therefore, in this study, it is recommended to use the edge pattern as an effective and efficient method in land processing. The results of the experiment showed that land processing using the edge pattern is highly recommended for use by farmers and still maintains the existence and maintenance of agricultural machinery, especially assistance. So that the assistance can be useful from year to year. However, it is necessary to re-test on dry land and equipped with time parameters wasted when processing the land. So that it will be easier to find the source of the problem related to the use of tractors with variations in land processing patterns.

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