Analysis Of Hand Tractor Performance Using Moldboard Plow Based On Different Plowing Patterns

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ABSTRACT

Inappropriate selection of plow patterns can cause a lot of time lost due to the many turns during tillage. Plowing patterns are chosen with the aim of minimizing as much as possible the lift of the implement to reduce turn time, the more lifting of the tool when turning, the lower the efficiency. And it takes a lot of time, effort and money. This study aims to determine the performance of hand tractors in different plowing patterns. the stages of this research are problem identification, identification of plotting patterns, performance testing and data analysis. Plowing patterns used are edge patterns, middle patterns and spiral patterns. The research parameters used are wheel slip, actual working capacity, theoretical work capacity and work efficiency. The results show that the edge pattern is the best pattern with the highest working capacity value of 87% and the lowest wheel slip of 12% and the highest work efficiency of 92%.

INTRODUCTION

Hand tractors are the most widely used machines for tillage in Indonesia, hand tractors are agricultural machines used for tillage and other agricultural work, for tillage activities. the hand tractor can flip and cut the soil simultaneously so that the hand tractor has high efficiency [3]. According to [6], tractor population data in 2016 - 2020 population of hand tractors in Indonesia reached 118,817 units and for North Kalimantan as many as 298 units.

The purpose of tillage with a hand tractor is to create soil physical conditions suitable for plant growth. Soil tillage consists of two stages, namely, the first tillage (primary tillage) and the second tillage (secondary tillage). The first tillage is the tillage stage to prepare the land and clearing weeds by cutting, turning the soil and burying plant debris and weeds. The second processing aims to destroy large chunks of soil resulting from the first tillage into small or fine pieces to speed up the process of decaying weed residues [5]. There are many factors that affect the performance of the hand tractor in cultivating the soil, one of which is the pattern of tillage.

The selection of an improper tillage pattern can cause a lot of time lost due to the many turns during tillage. The tillage pattern is chosen with the aim of minimizing as much as possible the lift of the implement to reduce turning time, the more lifting of the tool when turning, the lower the efficiency. And it takes a lot of time, effort and money. Hand tractors can save labor time from 142 hours/ha to 17 hours/ha [2]. Tillage patterns commonly used include edge patterns, middle patterns, tight alternating patterns, alpha patterns, spiral patterns and circular patterns, spiral patterns are the most widely used because plowing is carried out continuously without lifting tools [3]. Based on the explanation above, this study aims to determine the most effective working capacity based on different soil tillage patterns.

METHOD

Time and location

This research will be carried out in the Mambirdan Village, East Tarakan District, Tarakan City, precisely on the land of the Mapan Sejahtera Farmers Group and the Mechanization Laboratory of the Faculty of Agriculture, University of Borneo Tarakan, North Kalimantan in January - April 2022

Tools and materials

The tools used in this research are hand tractor type Yanmar TF65L, stopwatch, meter, stationery, and documentation tools, optical tachometer, industrial infrared thermometer, sigmaplot application and 3D graphic design application Inventor 3D License. While the material used is diesel fuel
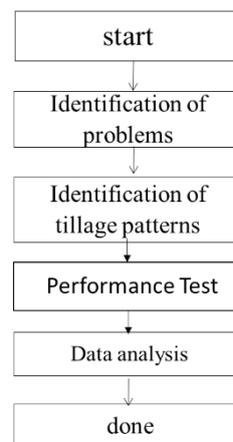
Procedure

Figure 1. Flowchart research

Identification of problen

The problem obtained is that the condition of the hand tractor, hand tractor will definitely experience a decrease in workability, especially if the hand tractor is used on extreme land such as wetlands and without proper maintenance. So it is necessary to know whether the hand tractor is new or old, this greatly affects the working capacity of the tractor, tractor damage can also take time, effort and cost. In addition to the condition of the tractor, the selection of an improper tillage pattern can result in a decrease in the efficiency of tillage because the selected tillage pattern must be adapted to the conditions of the land, for example, the middle pattern is suitable for long and narrow land, while for the edge pattern, this pattern is suitable for shaped land. square, and the land is not too wide. In addition, there are several factors that affect the working capacity of the tractor, including the size and shape of the plot, the topography of the area, the state of the vegetation, the state of the soil, and the skill level of the operator.

Identification of tillage patteern

Based on the shape of the land, the suitable tillage pattern is the middle pattern, this is because this type of pattern is suitable for long and narrow land. Land is needed to turn (head land) at both ends of the land, this pattern will result in a back furrow, namely the plow grooves facing each other, so that there will be a buildup of plowed throws in the middle of the land. With a land area for a rectangle has a size of 10 x 10 m.

In addition, the edge pattern of land cultivation is also suitable for use on this land because this pattern is suitable for square land, and the land is not too wide. This is in accordance with the type of land to be used. For the land to be used with a size of 10 x 10 m, this land will also be used for a spiral pattern. The total area of this land is ± one hectare but is divided into several plots of land. The land that will be used in this research is wet land (paddy field), using 9 peteks of paddy fields with an area of 10 x 10 m, with a slope of about 0 – 7º, using a surface irrigation system.

Figure 2. Land to be used

Performace Test

The performance test aims to determine whether the hand tractor is working optimally, before taking data, a functional test will be carried out first to determine whether the condition of the hand tractor functions as expected. The performance test aims to determine whether the hand tractor is working optimally, before taking data, a functional test will be carried out first to determine whether the condition of the hand tractor functions as expected.

The process of testing the hand tractor stages is carried out in the following way:

1. Prepare the hand tractor.
2. Prepare the hand tractor instrument.
3. Fill the tank of the Yanmar TF65L hand tractor to the brim before starting.
4. Turn on the tractor engine.
5. Then do a functional test to make sure all components run well. then run the hand tractor using the edge pattern according to the size of the land that has been determined with three repetitions.
6. Then apply also to the middle pattern and spiral pattern repetition three times.
7. During the tillage process, the hand tractor wheel rotation (m) and the actual working width (m) are measured.

Research Parameter

1. Tractor wheel slip

$$S= \frac{\pi.D.N-L}{\pi.D.N} X100$$

Information :

S = Wheel slip (%)

D = Wheel diameter (m)

N= Many wheel spins

L = the distance traveled by the tractor when the wheels are rotating N times without load or with load (m)

2. Actual Speed

$$V\ akt = \frac{L}{t}$$

Informatio:

Vakt = Actual speed (m/ second)

L = Mileage (m)

T = traveling time (second)

3. Theoretical field work capacity

Kkteo = 0,36 . Vtoe . w

Information:

Kkteo = theoretical field work capacity (ha/ o'clock)

Vteo = Theoretical Working Speed (m/s)

W = tillage working width

4. Actual field work capacity or effective field work capacity

$$KKe = \frac{A}{T}$$

Information =

Kke = Effective working capacity

A = total land area(ha)

T = total time (o'clock)

5. Field Work Efficiency

$$E = \frac{KKE}{KKteo} X\ 100\ \%$$

Information =

E = Field work efficiency (%)

Kke = effective working capacity

Kkteo = Theoretical working capacity

Data Analysis

The data analysis method in this study used quantitative descriptive analysis. Quantitative descriptive analysis was conducted on the results of hand tractor effective capacity, hand tractor wheel slip, actual speed, theoretical field work capacity, effective work capacity, field work efficiency, and fuel consumption.

RESULT AND DISCUSSION

Table 1. Result Of Analysis

No	Parameter	Central Pattern	Spiral Pattern	Edge Pattern
1	Tractor Wheel Slip	24,00%	28,34%	40,47%
2	Actual Speed	0,52 m/s	0,34 m/s	0,36 m/s
3	Theoretical Field Work Capacity	0,035	0,0054	0,044
4	Actual Field Work Capacity	0,072	0,296	0,082
5	Work Efficiency	79%	62,50%	46%

Source : data analysis, 2022

The tillage pattern will affect the performance of the hand tractor during the tillage process, the selection of the tillage pattern is based on the shape and size of the land used. The city of Tarakan is a small island so the land for plant cultivation is not too wide, so the right patterns are used for tillage, namely the edge pattern, the center pattern and the spiral pattern. [7] The right tillage pattern to be used in Tarakan city is the edge pattern, the center pattern and the spiral pattern. In measuring wheel slip, the center pattern has the smallest wheel slip value, which is 24%, while the largest wheel slip value is the edge pattern with 40.47%. The smaller the wheel slip value, the better the tractor performance will be, this is because the wheels do not experience a decrease in power during the tillage process. The middle pattern gets the highest value, which is

0.52 m/s on the actual velocity calculation, while the edge pattern and spiral pattern get the values of 0.36 m/s and 0.34 m/s. this shows that the middle pattern is the best pattern because it has the highest value of 0.52 m/s. The greater the value of the actual speed, the greater the value of work efficiency on a machine [8]. Based on the calculation of the actual field capacity and theoretical field capacity, the work efficiency values of the hand tractor were obtained, namely the center pattern 79%, spiral pattern 62.50% and edge pattern 46%. The middle pattern is the best pattern with the highest value, which is 79%, this is in accordance with the opinion [2] that the greater the work efficiency, the better the engine performance, and will accelerate the tillage process.

CONCLUSION

Based on the results of the study, it was concluded that the central pattern is the best pattern to be used to cultivate the land using a hand tractor, with a work efficiency of 79%

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REFERENCES

[1] Catur, Cahyawan, Edi Margana, Sirajuddin Haji Abdullah. 2014. Studi Kinerja Lapang Berbagai Traktor Tangan Pada Budidaya Kacang Tanah (Arachis Hypogeae L). Jurnal Ilmiah Rekayasa Pertanian dan Biosistem 2 (2): 64–72.

[2] Coffman. B.A. et all. 2010. Testing Fuel Efficiency Of A Tractor With A Continuously Variable Transmission. Biological system Engineering. 26 (1)

[3] Handayani, T R I. 2017. Efisiensi Penggunaan Bahan Bakar Pada Traktor Roda Dua Terhadap Pengolahan Tanah. Jurnal Hijau Cendekia 2: 83–86.

[4] Mardinata, Z., & Zulkifli, Z. 2014. Analisis Kapasitas Kerja dan Kebutuhan Bahan Bakar Traktor Tangan Berdasarkan Variasi Pola Pengolahan Tanah, Kedalaman Pembajakan dan Kecepatan Kerja. *agriTECH*, *34*(3), 354-358

[5] Margana, C. C. E., & Putra, G. M. D. 2017. Performansi Traktor Tangan Roda Dua Modifikasi Menjadi Roda Empat Multifungsi (Pengolahan Dan Penyiangan) Untuk Kacang Tanah Di Kabupaten Lombok Barat. Jurnal Ilmiah Rekayasa Pertanian dan Biosistem, 5(1), 296-302.

[6] Marlia, Y., Hersyamsi, H., & Triana, A. N. 2017. Uji Kinerja Bajak Singkal Yang Dilapisi Lembaran Tembaga Pada Pengolahan Tanah Ultisol *Skripsi* (Doctoral dissertation, Sriwijaya University).

[7]   Kementan. (2019). Statistik Sarana Pertanian Tahun 2018 Statistics Of Agricultural Facilities.

[8]   Santoso, D. & Rahajeng, G.Y & Wijaya, R. 2020. Identifikasi Kebutuhan Alsintan Tanaman Pangan (Padi Dan Jagung) Di Kota Tarakan. Jurnal Ilmiah Inovasi. 20 (3)

[9]   Santoso, D. & Murdianto D. 2022. Artificial Intelligence in the Perspectives of Agricultural Technology Development in Indonesia. Budapest International Research and Critics Institute (BIRCI-Journal): Humanities and Social Sciences. 5 (1)