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Hand-Controlled Mini Tractor Performance Results With Medium Capacity Motor

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Abstract:
The use of mini tractors or hand tractors for loosening soil in Indonesia is quite popular. The number of tractors in Indonesia is 180 thousand units. Until now, the use of mini tractors in Indonesia is still limited for the management of wet and dry land. Currently, land management on dry land has barely been touched by a mini 2-wheel tractor. Whereas the potential of lowland dry land suitable for seasonal crops is not less than 23 million hectares. In addition to the type of material, the design of the traction wheel greatly determines the effectiveness of the tractor in changing the engine force in rotary power into the ability to pull loads/equipment in the field, for example for plowing the ground. Therefore, it is necessary to make a soil loosening machine or mini tractor with the same function and smaller dimensions, to make it easier for farmers to manage agricultural land. In this test, the researcher tested the land with an area of $72m3$ with an average speed of 16 seconds per 9 meters using a supra GX 200 engine with a capacity of 6.5 hp. At the time after the testing process it was found that tractor plowing with a land area of $72m3$ with forward and reverse motion to the point position early engine performance is not good because the engine capacity is small. After the researchers tested the performance of the tractor plow, the researchers then tested the fuel consumption using a measuring cup and got 36 ml /$72m3$ .In the $72m3$ land area, processing time is obtained with a value of 2.09 minutes with an average speed of 16.65 seconds per stake.

***Key Word**: Tractor, field test, fuel, tractor speed, Engine.*

Introduction

The use of mini tractors or hand tractors for loosening soil in Indonesia is quite popular. The number of tractors in Indonesia is 180 thousand units. Until now, the use of mini tractors in Indonesia is still limited for the management of wet and dry land.

Currently, land management on dry land has barely been touched by a mini 2-wheel tractor. Whereas the potential of lowland dry land suitable for seasonal crops is not less than 23 million hectares. The main obstacles faced in the use of mini tractors on dry land in Indonesia include[1].

1. Tensile resistance of tillage in dry land in Indonesia is generally high (spherical draft >0.7kg/cm).
2. The pulling ability of a mini tractor with rubber wheels or standard iron wheels is inadequate for plowing work in dry land.

In fact, from the availability of engine power (which is generally 8.5 hp) installed, the hand tractor theoretically has a sufficient power source as long as the power can be channeled effectively[2]

In addition to the type of material, the design of the traction wheel greatly determines the effectiveness of the tractor in changing the engine force in rotary power into the ability to pull loads/equipment in the field, for example for plowing the ground[3].

Therefore, it is necessary to make a soil loosening machine or mini tractor with the same function and smaller dimensions, to make it easier for farmers to manage agricultural land[4].

With dimensions that are smaller than tractors in general, it will be owned by farmers because it saves production. Based on the description above, soil quality is very important so that a soil-loosening machine will be made. Currently, a 2 wheel tractor for plowing rice fields requires water to saturate the soil. Without saturation of the water first (usually the rice fields are irrigated 24 hours, the 2-wheel tractor is not strong enough to manage the soil in the rice fields. In theory with Studying the motion of the wheel fins relative to the ground, it

*Corresponding Author: Junaidi

can be seen the trajectory of the tread marks when the wheel enters the ground and when the wheel leaves the ground so that a rational curvature can be made which gives the best ground grip effect[5]

A mini tractor for loosening soil is a machine designed as a farming tool and farmer's business equipment. Mini tractor 2 wheel engine Gx 200 with a capacity of 6.5 Hp serves as a power source for propulsion, propulsion, and propulsion resources[6].

This agricultural tractor is the main resource in agriculture in developed countries. In Indonesia itself, where human resources are still the main resource in smallholder agriculture in rural areas, agricultural tractors have also been introduced, while in agricultural companies[7]. When tractors were first used to operate field equipment, All engines are towed behind the tractor. With the development of the power tap, other machines such as water sprayer pumps are installed and loaded on the tractor[8]. Then after being installed to raise and lower the work unit using the lever[9].

These mini tractor farming machines and tools can be grouped based on the type of work carried out, including soil management tools (harrowing plows), loosening tools, or soil sprayers and transport equipment. The source of its propulsion is through the Gx200 Supra 6.5 Hp[10].

Field capacity is the amount that a machine can do per hour. Field capacity can be distinguished in units of area. Field capacity is divided into two, namely effective field capacity (KLE) and theoretical field capacity (KLT). Effective field capacity is measured based on the area of work divided by the time needed in the field[11]. Theoretical field capacity is the product of multiplying the value of the tractor speed and the working width of the implement[11].

The use of fuel is a problem for farmers in determining the motor that is chosen to carry out soil loosening. In this test using a Supra GX 200 motor with a capacity of 6.5 HP using gasoline[12].

The fuel used by the mini tractor is gasoline with a tank capacity of 3 liters. Measuring fuel consumption is done by accelerating wheel rotation and rotary plow rotation. Motor rotation speed without load causes low fuel consumption[13].

Meanwhile with the burden of fuel consumption will be higher. Dry land in loosening can affect a small volume of fuel use than land that has a large water content such as in rice fields when loosening the soil. To calculate the fuel consumption Of the Tractor[14].

METHOD

Modification of two gear boxes is done to move the wheels in a clockwise direction on the mini tractor. Modifications were made because the gearbox component can move the front wheel and the rotary blade so that it can move the two components so that they ca work optimally in field testing[15].

The use of a gearbox for the front wheel ratio of 1:60 is useful for moving the front wheels so that it slows down the rotational rate of the wheels through the drive gear, while for the rotary blade gearbox, it uses a 1:50 ratio gearbox to speed up the rotation of the blades[16].

To get an idea of the components of the two gearboxes on the mini tractor, a literature study was conducted by searching for books on mini tractors and internet media to maximize the work of the gearbox components on the tractor[17].

Figure 1 Gearbox 1:50

Figure 2 Gearbox 1:60

Preparation on the tractor is done by checking its condition so that during testing there are no errors and obstacles, both technical and non-technical. Inspections carried out on the tractor are fuel, oil. Pullet and belt system, chain check, etc[18]. As well as the preparation of completeness of instruments such as measuring instruments such as penetrometer, roll meter, and other measuring instruments before testing is carried out. Prior to the test, the test area was also prepared[18].

The land must be clean of plants and level ground for the test to work optimally. The physical condition of the soil was observed by measuring the water content. Measurement of water content is carried out by taking soil samples in the test area[19].

Moisture content is the amount of water available in the soil in a certain mass. Soil water content is measured by taking a sample of the soil in the test with a ring sample[20].

The penetration resistance measurement is carried out so that the tractor blade is able to work properly. Rocky soil so as not

*Corresponding Author: Junaidi

to hinder the rotation of the knife, there is no need to loosen the soil too deep. Measurement[21]

This is done using a penetrometer by sticking the tip of the penetrometer 6 times at each observation point with a distance of 2, 4, 6, 8, 10, 12 m from 15-30 cm from the ground.

Figure 3 Penetrometer

RESULTS AND DISCUSSION

1. **Construction of Modified Components of Steering Gas System.**

Modification of the steering gas system on the mini tractor is done by holding the gas so it doesn't go up and down so that it is easy for th operator to work on the plowed land.

Figure 4. Steering gas system

Engine power delivery system through the axle to drive the gearbox and sprayer. In order to work maximally, it is carried out through the axle with the pulley conductor. The speed of the wheels and blades is determined by how much the engine is gassed and delivered through the axle to component 2 of the gearbox and sprayer[22]. The axle with a length of 1 meter is able to withstand the rotation of the rotating pulley[23].

Figure 5 Axle of power delivery shaft

Engine power delivery system through the axle to drive the gearbox and sprayer. In order to work maximally, it is carried out through the axle with the pulley conductor. The speed of the wheels and blades is determined by how much the engine is gassed and delivered through the axle to component 2 of the gearbox and sprayer[24]. The axle with a length of 1 meter is able to withst and the rotation of the rotating pulley The land used in testing the supra GX 200 tractor engine with a rotary plow implement has a size of 1.8 meters x 20 meters which means it is rectangular in shape and the condition of the surface vegetation of the land has traces of peanut plants and around the land there are rice plants which can allow congestion due to lumps of soil on the tool. because it is attracted or not cut off [25].

Figure 6 Land Measurement

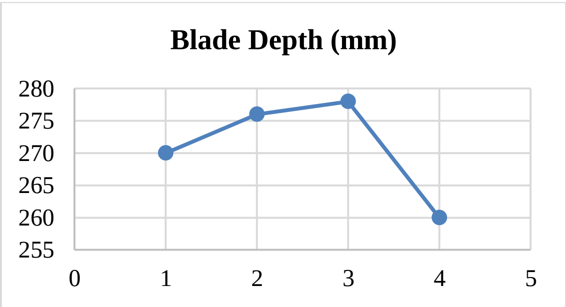
1. **Measurement of Dry Land Processing Depth**

Table 1 Stage 1 Depth of Dry Land Processing with a peg area of 9 m, a total area of 36 m with Advanced Condition

COORDINATES	Blade Depth (mm)
1	270
2	276
3	278
4	260

The measurement of the depth of dry land cultivation is carried out in 4 processing lines with 4 depth measurement points each with a distance of 9 meters wide between processing points. The average depth value of a total of 4 measurement points in processing with operator control is 271 mm.

Graph 1 Stage 1 Dry Land Area of 36 meters with Developed Condition.



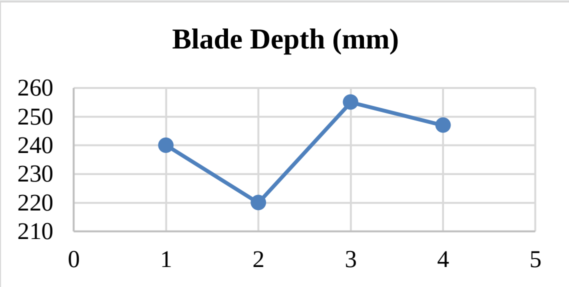
In graph 1 with an area of 36 meters dry land shows the deepest knife depth at stake 3 with a depth value of 278 mm, while the lowest knife depth is at stake 4 with a depth value of 260 mm.

*Corresponding Author: Junaidi

Table 2 Stage 2 Depth of Dry Land Processing Area 9 m stake with a total area of 36 m Reversal conditions to the starting point.

COORDINATES	Blade Depth (mm)
1	240
2	220
3	255
4	247

Graph 2 Stage 2 Dry Land Area of 36 meters with Detour Conditions to the Starting Point.



In graph 2 with a dry land area of 36 meters shows the deepest knife depth on the 3rd stake with a depth of 255 mm, while the lowest knife depth on the 2nd stake with a depth value of 220 mm.

Figure 7 Dry Soil Condition

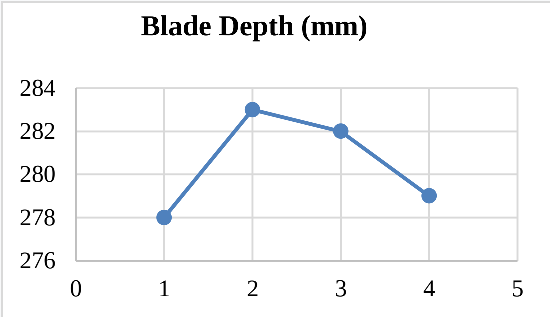
1. Wetland Treatment Depth Measurement

Table 3 Stage 1 Depth of Wetland Processing Area 9 m stake with a total area of 36 m with developed conditions.

COORDINATES	Blade Depth (mm)
1	278
2	283
3	282
4	279

The measurement of the depth of wetland processing is carried out in 4 processing lines with 4 depth measurement points each with a distance of 9 meters wide between processing points. The average depth value of a total of 8 measurement points in processing with operator control is 283 mm.

Graph 3 Stage 1 Wetland Land Area 36 meters with Developed Condition.

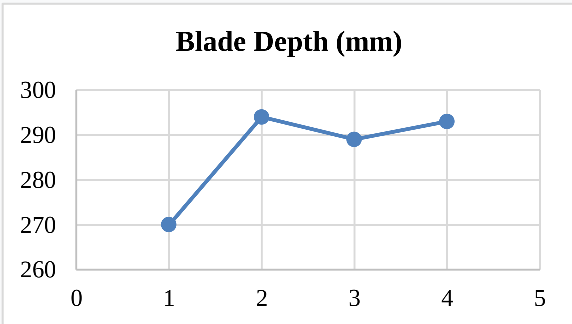


In graph 3 with a wetland area of 36 meters, it shows the deepest knife depth at stake 2 with a depth of 283 mm, while the lowest knife depth is at stake with a depth value of 220 mm.

Table 4 Stage 2 Wetland Treatment Depth Area 9 m with Total Area 36 m Detour Condition Towards Starting Point

COORDINATES	Blade Depth (mm)
1	270
2	294
3	289
4	293

Graph 4 Stage 2 Depth of Wetland Treatment Area 36 m Reversal Condition Towards Starting Point.



Graph 4 with a wetland area of 36 meters shows the deepest knife depth at stake 2 with a depth of 294 mm, while the lowest knife depth is at stake 1 with a depth value of 270 mm.

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Figure 8 Wetland Condition

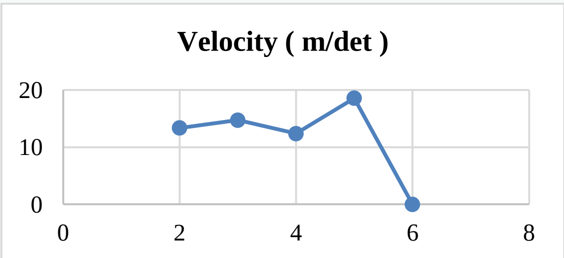
Measurement of Dry Land Velocity with an Area of 36 m with Forward Motion

Table 5 Stage 1 Measurement of Dry Land Processing Speed Area 9 m stake Total Total Area 36 m with Advanced Condition.

COORDINATES	Velocity (m/det)
1	13.35
2	14.74
3	12.38
4	18.57
Overall Coordinates Length = 36 m	Average Velocity Value = 14.76 sec

The measurement of the speed of dry land processing was carried out in 4 processing lines with 4 speed measurement points each with a distance of 9 meters wide between processing points. The average speed value of a total of 4 measurement points in processing with operator control is 14.76 sec.

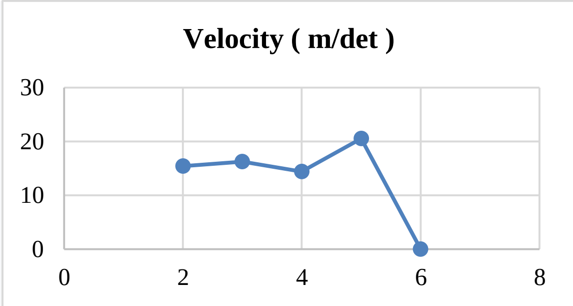
Graph 5 Stage 1 Measurement of Speed of Management Dryland Area of 36 m with developed conditions



Measurement of Dry Land Velocity with an Area of 36 m with Detour Conditions Towards the Starting Point.

Table 6 Stage 2 Measurement of Dry Land Processing Speed Area 9 m stake total Total Area 36 m with Detour Condition to Starting Point.

COORDINATES	Velocity (m/det)
1	15.43
2	16.25
3	14.40
4	20.53
Overall Coordinates Length = 36 m	Average Velocity Value = 16.65 sec



Graph 6 Stage 2 Measurement of Speed of Dry Land Management Area of 36 m with Detour Conditions to the Starting Point.

Figure 9 Mini Tractor Test Measuring Speed on Dry Land.

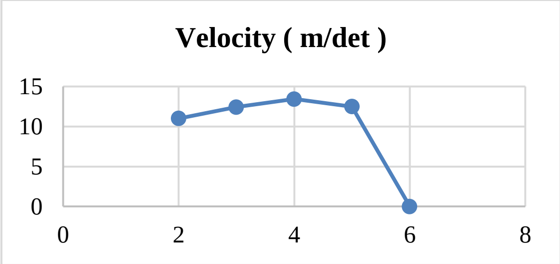
Velocity Measurement of Wetlands with an Area of 36 m with Forward Motion.

Table 7 Stage 1 Measurement of Speed of Wetland Management Area 9 m stake with a total area of 36 m2 with developed conditions.

COORDINATES	Velocity (m/det)
1	11.00
2	12.43
3	13.44
4	12.50
Overall Coordinates Length = 36 m	Average Velocity Value = 12.30 sec

*Corresponding Author: Junaidi

Graph 7 Stage 1 Measurement of Speed of Wetland Management Area of 36 m2 with Advanced Condition



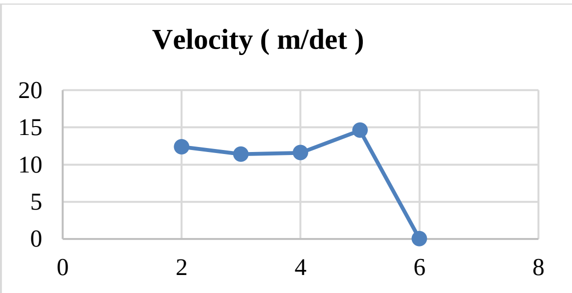
In graph 4.7 with a wetland area of 9 meters per stake with a total area of 36 meters shows the speed at the 3rd stake with a speed of 13.44 seconds while the lowest speed is on the 1st stake with a speed value of 11.00 seconds.

Wetland Velocity Measurement with an area of 9 m with a total area of 36 m with a Detour Condition to the Starting Point.

Table 8 Stage 1 Measurement of Wetland Treatment Speed Area 9 m stake with a total area of 36 m2 with developed conditions

COORDINATES	Velocity (m/det)
1	12.38
2	11.40
3	11.58
4	14.60
Overall Coordinates Length = 36 m	Average Velocity Value = 12.49 sec

Graph 8 Stage 2 Measurement of the Speed of Wetland Management Area of 36 m with the Condition of Detour to the Starting Point.



In graph 4.8 with a wetland area of 9 meters per stake with a total area of 36 meters shows the speed at the 4th stake with a speed of 14.60 seconds while the lowest speed at the 2nd stake with a speed value of 11.40 seconds.

Figure 10. Mini Tractor Test Measuring Speed in Wetlands.

Calculation of dry land fuel consumption.

Calculation of Average Fuel Consumption with Pure Gasoline Experimental testing on a motor fueled with pure gasoline, to find out how much fuel consumption rate is required for a combustion engine in unstable gas conditions so that it affects the use of fuel. The test was carried out with dry and wetland with forward and reverse motion to the starting point with a width of 1.8 m × length of 40 m, a total area of 72 m with 8 stakes per stake 9 m wide.

Table .9 Data on Calculation of Dry Land Fuel Consumption with 9 m peg area total 72 m.

Coordinates	t (Time)	V(ml)	Area of Plowed Land (m)
1	13.36	100	9
2	14.47	100	9
3	12.38	100	9
4	18.57	100	9
5	15.43	100	9
6	16.25	100	9
7	14.40	100	9
8	20.53	100	9
	Total time processing = 125.66 sec		Total Land Area =72$m3$

Wetland Fuel Consumption Calculation.

Table 10 Calculation of Data on Wetland Fuel Consumption with a peg area of 9 m2 Total Total Area 72 m.

Coordinates	t (Time)	V(ml)	Area of Plowed Land (m)

*Corresponding Author: Junaidi

1	11.00	100	9
2	12.43	100	9
3	13.44	100	9
4	12.50	100	9
5	12.38	100	9
6	11.40	100	9
7	11.58	100	9
8	14.58	100	9
	Total time processing= 99.33sec		Total Land Area $=72m3$

CONCLUSION

1. At the time after the testing process was carried out, it was found that the tractor plowing with a land area of $72m3$ with forward and reverse motion to the initial position of the engine performance was not good because the engine capacity was small.
2. After the researcher tested the performance of the tractor plow, the researcher then tested the fuel consumption using a measuring cup and got 36 ml /$72m3$.
3. On a $72m3$ land area, processing time is obtained with a value of 2.09 minutes with an average speed of 16.65 seconds per stake.

ACKNOWLEDGMENT

1. Further research is needed to move the components to work optimally by replacing a larger engine capacity. It is necessary to further research the clutch and braking system so that the operator can work optimally.
2. It is necessary to further research the clutch and braking system so that the operator can work optimally.

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