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Performance of a small plowing machine using gasoline power engine

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Abstract

The research aims to create a small grooving machine. To be able to work in a small space or greenhouse. It is designed to have 1 powered wheel for easy turning. And uses a belt to transmit power for transferring power from the engine to the gear room. Use a chain drive in the gearbox to reduce drag and ensure durability. Make a joystick to control the direction of turning. There is a throttle to accelerate or reduce speed. and uses a gasoline engine as power source because it is cost-effective, lightweight, and convenient to use. in a small area by small grooving machine a 6.5 hp engine was used as the power source and tested at 5 engine speeds: 1900, 2200, 2500, 2800, and 3100 rpm in an area of 1,100 square meters. The test results found that controlling a small grooving machine with a rotational speed of 2500 rpm, the driving speed is 2.40 km/h. Work time is 70 s, loss of turning time is 11 s, work ability is 0.71 rai/hour, work efficiency is 90.48%, oil consumption rate is 0.80 L/rai, the groove depth is 16 cm, the groove distance is 40 cm. It has the lowest oil consumption rate and get proper work space by working without causing fatigue while controlling the vehicle.

Keywords: Small Plowing Machine, Moldboard plow, Agricultural, Plow furrows

1. Introduction

In agricultural production many farmers still rely heavily on nature. Whether it is the time and amount of rain, sunlight, temperature and humidity of the air, etc., which often fluctuate and do not meet expectations. In addition, the crops grown are more diverse according to market demand. There are demanding conditions for growth. and produce different yields Therefore, there is always damage in both quality and quantity. One way that farmers to be able to expect quality and quantity as desired is to produce plants in controlled conditions. which is the origin of the house so that growers can plan vegetable production throughout the year. By choosing to produce vegetables that have a good price and vegetables that are grown outside of greenhouses that have a lot of insect problems. Therefore, insecticides are sprayed regularly. Able to schedule production in line with market demand. and create projects in a comprehensive manner consumers can be assured that the vegetables grown do not use chemical pesticides. Helps to preserve the environment. Including watersheds will be safe from the problem of toxic chemical residues. Thailand at present Therefore, many farmers are interested in growing plants in greenhouses. Because it is easy to maintain without using chemicals to prevent insects. To grow each type of plant, the area must be prepared to suit that type of plant. For example, when growing vegetables, the area must be prepared by making raised beds. To help in making farmers' plots must use human labor or use a walk-behind tractor. The location is not suitable for using a walk-behind tractor. Therefore, manual labor is required, which takes time. and many workers another way to help with lifting the groove. That is, use a power-saving tool to lift a small groove. For convenience and speed in lifting trenches and also reducing the cost of hiring people [1]

There have been many research studies on soil preparation, such as willingness to pay for walking tractor: evidence from smallholder farmer's in Northwestern Ethiopia [2]. The technical evaluation of three different types of tillage combined machines and compared them with individual tillage machines [3]. Analysis of the effect of tillage depth on the working performance of tractor-moldboard plow, system under various field environments [4]. Experimental investigation of plow-chopping unit [5]. The role of technology in small agricultural projects [6]. Development of a frontal plow for smooth, furless plowing with cutoffs [7]. Study on plowing of cotton soil using two-tier plow [8]. Studied the soil cultivator to eliminate weeds. It is a prototype that needs to be developed and improved. To be able to use more conveniently the machine consists of a 5-horsepower gas engine. To help provide resistance to movement, which reduces the tension on the handle while cultivating. and is the principle for designing this prototype. The soil plowing test set the engine speed at 2500 rpm and measured the operating pulling force of the prototype engine. By measuring the rear wheel bracket, the pulling force was 9.85 kilograms, which is less than the 15.88 kilograms for foreign-made machines. and operating speeds are similar It takes about 4 s and the forward speed is about 0.25 m per second. and both types of machines can work at 0.152 rai/h. Approximately when plowing by having the plowing lines of the underground blades overlap [9]. Studied finding the appropriate type of steel wheels. The appropriate type of steel wheels for walking tractors for use in farm conditions. By steel wheels, walk-behind

tractor diameter 70 cm, wheel width 16 centimeters, suitable for working in farm conditions. Because of the force required the lowest total wheel load is 1,301 newtons, the lowest rolling resistance is 757 newtons, the lowest energy loss is 823 watts, the maximum traction efficiency is 33.87%, and the working time efficiency is 84.66% [10]. And studied the physical properties of weeds in rice fields. Evaluate and improve the performance of manual push-pull weed-killing cultivators in rice fields. Considering the efficiency of eliminating weeds, it was found that square-tooth cultivator wheels are most suitable for eliminating weeds [11].

Therefore, the team created a small grooving machine. and test performance using a gasoline engine as the primary engine for driving power. It has one driving wheel. Made of steel wheels to increase adhesion in traction. Easy to turn the turning circle is narrower than using two wheels. The machine is small and can be used in greenhouses. Therefore, it can be easily controlled. Farmers do not have to exert much effort to control it because it has an engine. Helps reduce fatigue for farmers very well. A single worker can be used to do the work. and reduce the time spent on work.

2. Materials and methods

2.1 Build a small grooving machine. Powered by a gasoline engine

1. Building the tank, take the steel sheets and cut them into squares, 2 sheets, the first sheet 50 cm and the second sheet 55 cm. Steel plates that hold the first tank, size 60 cm in length, 2 sheets and 20 cm, 2 sheets, steel sheets that hold the second tank. Two, length 16 cm, 3 sheets and 20 cm, 1 sheet. Then, steel plates for use as a base to hold the power plant, length 60 cm, 1 sheet, width 20 cm and then welded to form the body.

2. Creating the control arm and gear room cover, take 2-inch round steel and cut it to a length of 140 cm, 2 pieces, cut to a length of 45 cm, 1 piece. Take steel sheets and cut them to a length of 110 cm, 2 sheets. Take the round steel and bend it to the desired size. Take steel sheet 1 and cut it to a length of 30×50 cm. Take steel sheet 2 and cut it to a length of 30×55 cm. Take steel sheet 3 and cut it to a length of 5×100 cm. Take steel. The cut sheets are connected together.

3. Creation of driving wheels by taking angle iron and cutting it to a length of 20 cm, totaling 16 pieces, taking square iron and cutting it to a length of 20 cm, totaling 8 pieces, taking sheet steel and cutting it to a length of 1.75 m, width 7.5 cm, and rolling it into a wheel with a diameter of 40 cm. Pre-cut steel is joined together.

4. Build a small grooving machine. Powered by a 6.5 hp gasoline engine with power transmission principles. From a 1-inch pulley to drive a 14-inch pulley, and the pulley sends power through a 1-inch shaft to drive a 14, 36, and 38-tooth sprocket and sends power through the shaft to drive.

2.2 Study of the performance of a small grooving machine powered by a gasoline engine

Preparing an area of 22 x 50 square meters, divided into 5 plots, 220 m^2 each, by testing the grooves at 5 speeds: 1900, 2200, 2500, 2800, and 3100 rpm, respectively, measuring the time for raising the grooves at each speed. and measure the groove distance and depth of the groove at each revolution speed and find the rate of fuel consumption in each speed by repeating the test 3 times per set at each speed.

2.3 Indicators of test results

1) Ability as in Equation (1)

$$C = \frac{A}{T_{th}+T_f} \quad (1)$$

With C is work capability (rai/h), A is work area (m^2), T_{th} is theory work time (sec), and T_f is work lost time (sec) [12]

2) Efficiency as in Equation (2)

$$FE = \frac{C}{C_{th}} \times 100 = \frac{T_{th}}{T_{th}+T_f} \times 100 \quad (2)$$

With FE is work efficiency (%), C is work capability (rai/h), and C_{th} is theory work capability (rai/h) [12]

3) Fuel consumption rate as in equation (3)

$$Fc = \frac{L}{A} \quad (3)$$

With Fc is Consumption rate (L/rai), L is fuel used (liters), and A is work area (m^2) [12]

4) Moisture content as in equation (4)

$$M = \frac{W_w - W_d}{W_w} \times 100 \quad (4)$$

With M is moisture content (%), W_w is weight of before drying (g), and W_d = weight of after drying (g) [12].

3. Results and discussion

3.1 Working principle of small grooving machine powered by a gasoline engine

Small grooving machine powered by a gasoline engine uses a 6.5 horsepower gasoline engine, a 1-inch pulley, transmits power through a B-groove belt, length 69 inches, drives a 14-inch pulley. The pulley transmits power through a 1-inch shaft to drive a 14-tooth sprocket, transmitting power through a chain no. 428, 40 joints long, drives a 36-tooth sprocket, transmits power through a shaft to drive a 14-tooth sprocket, transmits power through a chain number 428, 40 joints long, drives a 38-tooth sprocket, and transmits power through a shaft to drive the wheels, which has a grooving machine. small powered by a gasoline engine as shown in Figure 1

Figure 1 A Small Plowing Machine by Gasoline Engine

3.2 Performance test results of a small grooving machine powered by a gasoline engine

From the results of the study of the performance of a small grooving machine. Powered by a gasoline engine, it was found that the furrow depth was in the range of 15 - 18 cm, the furrow distance was 40 cm, with an average soil moisture content of 11.23%, which was an appropriate speed for work. The speed is 2500 rpm and the vehicle speed is 2.40 km/h. Work time is 70 s, loss of turning time is 11 s, work ability is 0.71 rai/h, work efficiency is 90.48%, oil consumption rate is 0.80 L/rai. It has the lowest oil consumption rate. And get proper work space by working without causing fatigue while controlling the vehicle, when compared to every rotational speed. The efficiency and capability have standard deviations of 0.22 and 0.2, respectively as shown in Table 1 and Figure 2.

Table 1 Result of performance of a small plowing machine by gasoline engine

Speed (rpm)	Drive speed (km/h)	Time (sec)	Loss Time (sec)	Groove depth (cm)	Groove distance (cm)	capacity (rai/h)	Efficiency (%)	Oil consumption rate (L/rai)	Soil moisture (%)
1900	2.03	76	13	18	40	0.63	88.79	2.04	10.58
2220	2.13	75	11	16	40	0.65	90.44	1.60	11.38
2500	2.40	70	11	16	40	0.71	90.48	0.80	11.19
2800	2.69	66	10	16	40	0.75	90.56	1.33	11.42
3100	2.90	71	10	15	40	1.45	92.93	1.33	11.56

This is consistent with a study to test the performance of a small tiller. The performance of a small tiller, it was found that using the tiller in 2nd gear was most appropriate for work. The average working capacity is 0.75 rai/h, work efficiency is 81.5%, average fuel consumption rate is 1.36 L/rai and working depth is 0.13 m. Important problems found include: Clogging of rice straw fragments at the rotating hoe blade area resulting in decreased work efficiency [13].

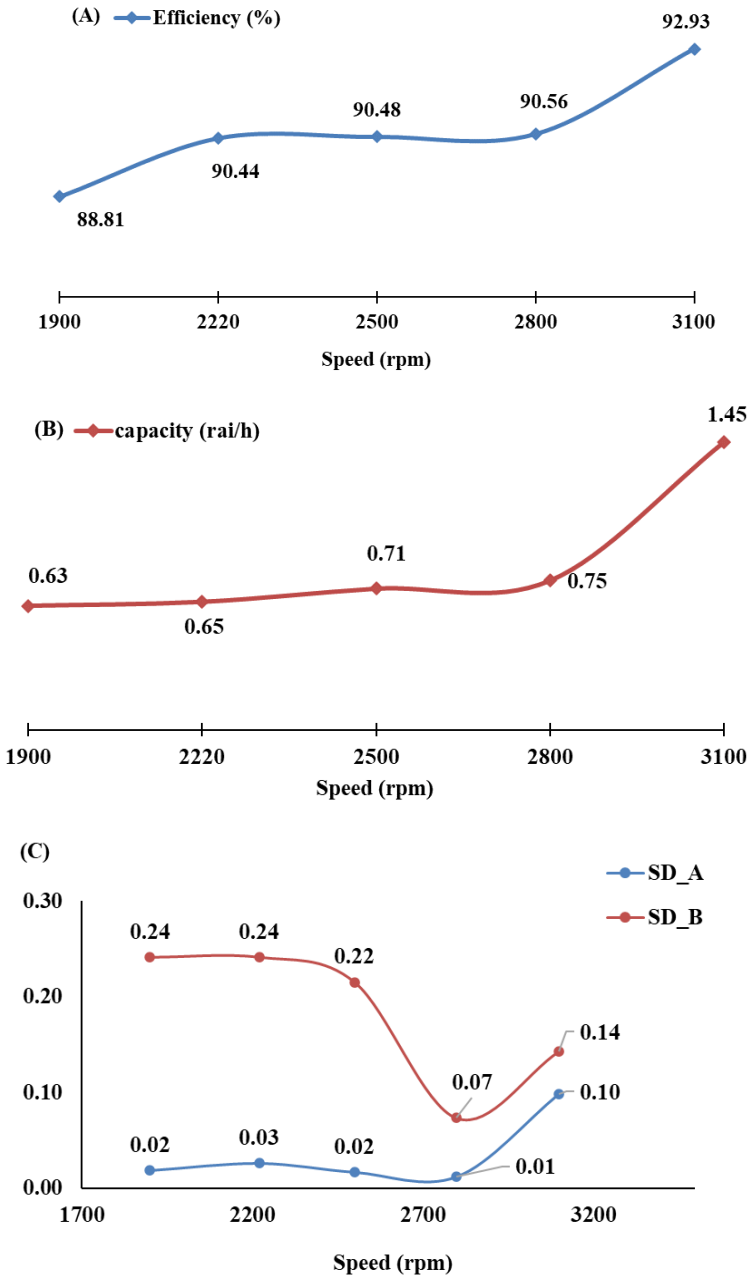

Figure 2 The Performance of a small plowing machine by gasoline engine of (A) Efficiency, (B) Capability, and (C) SD_A is the standard deviation of capacity, and SD_B is the standard deviation of efficiency.

4. Conclusions

Testing of a small grooving machine powered by a 6.5 horsepower gasoline engine with a rotational speed of 2500 rpm and a vehicle speed of 2.40 km/h. Work time is 70 s, loss of turning time is 11 s, groove depth is 16 cm, groove distance is 40 cm, work ability is 0.71 rai/hour, work efficiency is 90.48%, oil consumption rate is 0.80 L/rai. In work, it can work more flexibly at every speed cycle. It is an appropriate speed for the operator, not too fast and not too slow. This makes the operator not too tired and makes the work that is done not deformed and comes out according to the planned work pattern. small grooving machine powered by a gasoline engine It looks like one wheel. When working in large areas, fatigue occurs. Because it is difficult to balance, it causes the operator to use too much power to lift the small trench and is unable to lift the trench in areas with hard soil. The soil must be prepared before using the small trenching machine. which the small grooving machine suitable for operations in small plots. or greenhouse by reducing human labor and reduce the time required to perform work well.

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