Organic Fertilizer Applicator Performance Test On Rice Field

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Abstract. Intensive use of paddy fields will cause a decrease in the fertility of the land and to reduce the content of organic matter in soil. Organic content in the soil affects the soil's ability to bind water and the efficiency of fertilizer absorption by plants. It’s as well as an important source of nutrients for plants [1]. On the other hand, the continuous use of chemical fertilizers will result in environmental pollution even though fertilization is one of the important things to increase production. Organic fertilizer applicator technology is able to fertilize quickly and precisely. The use of organic fertilizer alike compost has positive effect on physical and mechanical properties of the soil [1] and use of organic fertilizers as soil conditioner can increase soil organic matter content so as to maintain and increase the fertility of agricultural land. Fertilization using technology in the form of an organic fertilizer applicator is expected to maximize plant growth so that it can increase rice production. The purpose of this study was to determine the efficiency of the application of organic fertilizer on rice fields. This applicator uses a conveyor belt as metering device, so that the power for the operation of the applicator comes from the wheel rotation and chain transmission. The results show that the applicator can function well. The factors that influence the magnitude of efficiency include the speed and proficiency of the operator.

1. Introduction
Increasing productivity of agricultural products from time to time is a major concern of the government, start from the use of superior seeds, fertilizer and agricultural equipment and machinery or mechanization of agriculture. However, this is very difficult to reach, because intensive land use can lead to a decrease in nutrients in the soil coupled with excessive use of chemicals. One way to restore or improve the structure of the land is by using natural materials such as organic fertilizer, the use of organic fertilizer will provide benefits for soil, plants and the environment.

Rice is a carbohydrate-producing food consumed by almost all Indonesians (96.87% of the population) and contributes more than 90% of caloric needs [7]. With a population of about 250 people and annual population growth of 1.49% [8], national rice needs reach 38 million tons [8]. National production in 2013 based on the BPS of 71.29 million tons of dried unhull grain.

Fertilization is an important to increase production, even until now regarded as a dominant factor in agricultural production. Until the end of the 20th century fertilization is an important factor to increase production because there is no other alternative to replace [9]. The use of organic fertilizer arises mainly due to environmental pollution problems that adversely affect agricultural products [2].

Organic fertilizer is also very beneficial for increasing agricultural production both quality and quantity, reducing environmental pollution, and improving the quality of land in a sustainable [3].
use of organic fertilizer in the long term can increase land productivity and can prevent land degradation [3].

Organic fertilizer applicator is one alternative problems solver in the application of organic fertilizer on the farm. This study was conducted to modify the sugarcane plant compost applicator dry land pull by four-wheel tractor can be used in the paddy field pull by hand tractor. Organic fertilizer applicator design has previously been performed by [4] were used for the process of fertilization on sugarcane plantations. The Results of research, shown the rationing metering device mechanism using a type of conveyor belt has been able to function properly [4]. The spending rate of compost can be adjusted to the height of door openings regulator or the percentage of door openings regulator. The width of the door opening and the forward speed of the applicator can be adjusted to the rate of expenditure or dose of compost desired when the application of compost in the cane fields [5].

Recently, organic fertilizer (compost) has been considered the heart of organic farming systems [6]. The function of compost is as soil conditioner. In terms of increasing the soil bearing capacity, compost is clearly superior and environmentally friendly than synthetic chemical fertilizers because it can increase the content of organic matter in soil

The application organic fertilizer equipment or organic fertilizer applicator in the rice field is a specifically designed to apply organic fertilizer into the soil or in between the plants with specific dose of organic fertilizer. Organic fertilizer applicator is a trailer pulled by a hand tractor. The components of applicator are auger, pit where the discharge of organic fertilizer, regulator doors, conveyor belt as a metering device, and fertilizers bin as the main framework. Applicator will be operated by hand tractor [4]. Application organic fertilizer on agricultural land must be in large amounts (high dose), this is caused by the nutrient content of the compost is low when compared with inorganic fertilizer so that to get an equivalent dose of the nutrient needs of plants [5].

The problems of application organic fertilizer are needed manpower and considerable expense. So that, its needs an appropriate technology like mechanical equipment that is simple and easy to operate [11].

The working capacity of agricultural machinery can be defined as an ability to work a machinery to produce results (hectares, kilograms, liters) per unit of time. According to [10] there are several factors that influence field capacity, namely:

1. Roomy performance of agricultural machinery tools
2. Time lost to turn
3. Time lost is proportional to the area
4. Time is lost with regard to engine reliability

The purpose of this study was to determine the working capacity of organic fertilizer applicators in rice fields.

2. Materials and methods

2.1. Tools and materials
This research was conducted in the Village of Pa'rappunganta, North Polongbangkeng District, Takalar Regency, South Sulawesi

The tools used in this study were organic fertilizer applicators, two-wheel tractors (hand tractor), analytical scales, hanging scales, meters, stakes, ovens, checkers and cameras. The material used in this study is organic fertilizer.

2.2. Research methods
This study consisted of several parts, namely the field testing of the applicator to determine the
efficiency of the tool and the taking of soil samples to determine the effect of the administration of organic matter, this soil sampling was carried out at the beginning of the study and after harvesting the applicator.

1. Field Test Applicator
   a. Prepare the tools and materials to be used
   b. Considering organic material that will be applied using a hanging scale
   c. Connect the applicator connecting rod with the coupling point on the tractor
   d. Fill the applicator tub with the organic material that has been weighed
   e. Set the height of the applicator's discharge door opening
   f. Operate the applicator on the land, where the soil treatment pattern used is the edge pattern because it is more effective and in accordance with the conditions of the land
   g. Record the time used during the operation of the applicator

3. Results and Discussion

3.1. Field Capacity of Organic Fertilizer Applicators on Rice Field

**Static Test of Compost Applicator**

Static testing of organic fertilizer applicators is a test done when applicators are not operating on field, not using a tractor but using a crank, which aims to rotate the axle of the applicator wheel so that the belt conveyor belt to move and send the compost into the auger (cylinder rationing).

This test is done by blocking the applicator so that the applicator's wheel does not touch the ground and can move freely. The parameters measured are the rate of organic fertilizer discharges that are influenced by the height of the door and the speed of the tractor.

**Table 1. Organic fertilizer discharges rate at several height of outlet door**

| No. | Height of outlet Door (cm) | Revolution Number (n) | Fertilizer Weight (kg) | Discharges Rate (kg/rev) |
|-----|---------------------------|-----------------------|------------------------|--------------------------|
| 1   | 2.5                       | 56                    | 50                     | 0.893                    |
| 2   | 5                         | 43                    | 50                     | 1.163                    |
| 3   | 7                         | 36                    | 50                     | 1.389                    |

Table 1 showed that each the height of outlet door has different rate of discharge. At height 2.5 cm having a discharge rate of 0.893 kg/rev, at height 5 cm has a discharge rate of 1,163 kg/rev and at 7 cm outlet door height having rate of 1.389 kg/rev.

The rate of organic fertilizer discharges is increasing according the height of outlet door and the number of revolutions of the crank. This is in accordance with [5] which states that the discharge rate can be adjusted by the height of the adjustment of outlet door. The width of the outlet door and the applicator's forward speed can be adjusted to the rate of discharge or compost dose according crop requirement.

**Field Test of Organic Fertilizer Applicator**

This field test was conducted at Takalar regency. This test is a function of the applicator's width, actual speed and effective time consumed during operation. The applicator's working width is 1 m. Actual speed is influenced by several factors such as the applicator wheel design system, type and condition of soil, operator skills, and tractor attraction.
The effective time is the time spent during the operational of applicator that influenced by the number time loss (the time of setting or time repair the minor defects, turning time, and the time of adding the fertilizer).

The result shows that on the site of the test a distance of 40 m each row obtained an average travel time of 109.5. The speed of this organic fertilizer applicator is 1315.07 m/h, so that theoretical capacity of the applicator is 5.85 hours/hectare and the applicant's effective field capacity is 7.6 hours/hectare.

The field capacity is obtained from field test that are influenced by the total time spent during operation, by the amount of time lost such as the turning time using the edge pattern and the area of the experimental field. Factors affecting the field capacity include time lost to turn.

Efficiency of Organic Fertilizer Applicator
The test results show that the organic fertilizer applicator can function well, with efficiency of 77%. However, in the operation of this organic fertilizer applicator, there are still some weakness such as skill of the operator in operating the organic fertilizer applicator and at the time of turn. The reliability of time usage on individual machines becomes even more important if multiple machines or parts of the machine are used in combination. For an individual tool, the lost time is 5 or 10% due to damage, adjustment, setting, or other stops relating to the machine.

The height of the outlet door influenced the amount of discharge organic fertilizer to the auger cylinders, so that caused occurrence of solids, this is influenced by the type of compost used.

4. Conclusion
The results showed that the prototype model of organic fertilizer applicator for rice field conveyor belt type had been made. It is functioning properly. The efficiency of organic fertilizer applicator is 77% or 7.6 hour/hectare.

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