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A comparison between the AE bed form seed planter and the system of bed former device conjunction with double disc opener seed planter

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Abstract

Soybean plantation has been used to increase mineral in soil for many crop. United Farmer & Industry Company Limited has chosen soybean as a rotation plant with sugarcane. The original soybean planting system has two stages, then it has been developed a machine that can work 2 steps at once. Therefore, this study aims to compare 2 soybean planting system; AE Bed Form Planter, and bed former working with Double Disc Opener Planter. The field experiments were done to compare performance, germination rate and operation cost between those 2 systems. The result showed that, the first system using AE Bed Form Planter had the higher field capacity and performance, and lower fuel consumption than the second system. On the other hands, the first system had germination rate slightly less than the second system. Considering costs, the first system had total costs lower than the second system, 318,034 bath/year when the soybean plantation area was 3,100 rai/year averagely.

Keywords: Soybean planting system**,** AE bed form planter**,** Double disc opener

1. Introduction

The general process of sugarcane cultivation typically begins with soil preparation and soil rest period before planting. Additionally, factories or companies cultivate cover crops to replenish soil minerals. Regarding cover crop cultivation, factories focus on leguminous plants, commonly yellow beans, using either self-designed or imported planting machines to save time [1].

Ruenthai Kaset Industry Corporation, a subsidiary of MitrPhol Sugar Corporation, operates in sugarcane procurement for the MitrPhol Green Sugar Factory. Besides procuring sugarcane for the factory, the Ruenthai Kaset Industry Corporation also cultivates sugarcane themselves. The company aims to procure and cultivate at least 15 tons per rai. In the past, the company's sugarcane cultivation did not involve cover crop cultivation, resulting in a yield of only 8 tons per rai. However, from 2013 to 2014, the introduction of cover crop cultivation increased the sugarcane yield to 9.2 tons per rai [2].

In this regard, there are several types of cover crops that are commonly planted, but the preferred type is soybean cultivation. Planting soybeans not only enriches soil minerals but also allows the seeds to be sold. Therefore, planting a large quantity of soybeans in line with the cover crop planting period is crucial [3-4]. The importance of the soybean planting machine is significant because using a machine saves much more time compared to hiring labor. However, machine usage also has its limitations. Traditionally, the process involves lifting equipment first before using the Double Disc Opener seed dropper, imported from Australia by the company, which requires multiple steps. Subsequently, the agricultural machinery department has developed the AE Bed Form Planter for soybean seeding, which can both soybeans and distribute fertilizer while lifting beds in a single operation. This innovation might help reduce workload and expenses compared to the traditional system. Therefore, a study should be conducted to compare the yellow bean seeding systems between the AE Bed Form Planter and the combination of lifting equipment with the Double Disc Opener seed dropper.

2. Materials and methods

First, study the process and procedures for cultivating mung beans, including the types of mung bean varieties and the equipment used for cultivation, to analyze and conduct experiments. The main equipment used for the study includes a tractor and two types of mung bean planting systems. As for the tractor, it is a Massey Ferguson MF 470 with a horsepower of 120, and the mung bean planting machine and bedformer (bedform) as shown in Figure 1. For the testing process of the planting system's performance, there are four main aspects to test: Ability to work, Fuel consumption, Germination rate and Characteristics of bed formation and planting depth each aspect is tested [5] as follows.

Figure 1 A Massey Ferguson MF 470 with a horsepower of 120, and the mung bean planting machine and bedformer (bedform)

2.1 Field capacity

Park the tractor at the starting point to refuel it. Then, conduct the test by having the tractor run around the designated plot. Start the timer when the tractor leaves the starting point and stop it when the tractor stops working. Measure the area of work by measuring the length and width of the area.

2.2 Fuel consumption

Park the tractor at the starting point to refuel it. Conduct the test by driving the tractor back to the starting point and refueling it with 1 liter of fuel at a time until the tank is full. Record the amount of fuel refilled each time.

2.3 Germination rate before using the planter

Randomly select 5 samples of mung bean seeds, each sample containing 100 seeds. Plant them in a seeding tray with one seed per hole. After approximately 1-2 weeks, observe the germination and count the number of germinated seeds [6].

2.4 Germination rate after using the planter

Mix mung beans with sodium rhizobium at a ratio of 200g of sodium rhizobium per 10 kg of mung bean seeds. Plant them in the company's field using drip irrigation, approximately 1-2 weeks. Count the population in an area of 1m x 1.85m at 10 random points [6].

2.5 Characteristics of bed formation and planting depth

Measure the depth of the planted beans by randomly selecting 10 measuring points and averaging the depth to record the bed depth. Also, measure the width of the bed by randomly selecting 10 measuring points and averaging the width. Measure the distance between the beds at 10 random points to ensure it is standard at 185 cm. Check if the equipment of the planting machine can cover the soil completely and record the observations.

2.6 Cost of systems

Additionally, a study was conducted on the expenses of both cultivation systems to compare costs and utilize them for future developments. Determining the expenses of cultivating mung beans involves two main components: fixed costs and variable costs [7].

Fixed Costs:
Depreciation Cost = (Initial Purchase Price - Resale or End-of-Life Price) / Years of Service Life
Investment Cost = [Initial Purchase Price + Resale or End-of-Life Price (in Baht)] x 0.5 x Interest Rate Note: Interest Rate is 5% based on data from the Siam Commercial Bank.

Variable Costs:
Labor Cost = Labor Wage (Baht/Day)/ Area Covered (Rai/Day)
Fuel Cost = Fuel Price (Baht/Liter) x Fuel Consumption Rate (Liters/Rai)
Repair and Maintenance Costs are set at 10% of the Initial Purchase Price per year.

3. Results and Discussion

From testing the performance of both systems, it was found that the operating time for System 1 was 12 minutes per rai. The actual working area capability was 4.95 rai per hour, with an operational efficiency of 22.12 percent. The fuel consumption rate was 1.98 liters per rai, and the germination rate before and after using the planting machine was 77.80 percent and 49.54 percent, respectively. System 2, on the other hand, required 32.40 minutes per rai. The actual working area capability was 1.85 rais per hour, with an operational efficiency of 15.82 percent. The fuel consumption rate was 3.45 liters per rai, and the germination rate before and after using the planting machine was 77.80 percent and 56.04 percent, respectively.

Table 1 the performance evaluation of both cultivation systems

Performance	cultivation systems 1st	cultivation systems 2nd
	AE Bed Form Planter	Utilizing bedform equipment in conjunction with the Double Disc Opener seed planter
- Time of work (min/rai)	12.00	32.40
- Field capacity (rai/h)	4.95	1.85
- Field efficacy (%)	84.84	72.30
- Fuel consumption (L/rai)	1.98	3.45
- Germination rate before using the planter (%)	77.80	77.80
- Germination rate after using the planter (%)	49.54	56.04

The characteristics of bed elevation and planting depth in System 1 are as follows: the bed elevation ranges from 14 cm to 100 cm, and the planting depth is 3.05 cm. In System 2, the bed elevation ranges from 11.75 cm to 100 cm, and the planting depth is 4.16 cm. Regarding depreciation and interest expenses in investment as show in Figure 2, System 1 incurs annual depreciation and interest expenses of 7,920 baht and 2,420 baht, respectively. System 2, however, has annual depreciation and interest expenses of 54,249 baht and 16,576 baht, respectively. The difference between the two systems amounts to 60,486 baht annually.

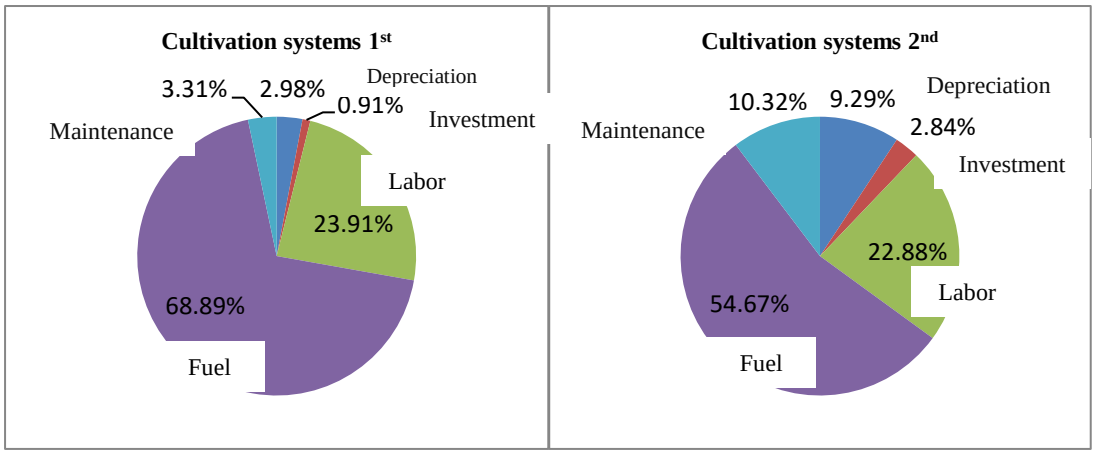

Figure 2 Comparison of various expenses of cultivation systems, including System 1 and System 2

4. Conclusions

From the study results, it was found that the work rate and efficiency of System 1 are better than System 2 because the Australian planting machine in System 1 operates in two steps: bed forming and planting. This differs from System 2, where the bed forming and planting are done simultaneously, saving time and reducing fuel consumption. Additionally, the planting quality is better in System 1.

However, System 1 has a disadvantage compared to System 2 in terms of germination rate because the machine has deficiencies in the soil covering equipment and a higher percentage of breakage compared to System 2, resulting in a lower germination rate. Therefore, the company should improve and upgrade the soil covering equipment.

In terms of expenses, System 1 has lower fixed expenses than System 2, with annual fixed expenses of 60,486 baht and variable expenses of 83.08 baht per acre. When considering the total expenses for an area of 3,100 acres per year, the difference between the two systems is 318,034 baht per year because System 2 involves multiple steps, leading to increased expenses.

In summary, if the company needs to purchase or acquire additional planting machines, it should choose machines from the factory because they have lower initial costs than machines from foreign sources and provide production yields similar to those of foreign machines.

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6. References

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