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Injection System Cultiving Machine for Plant Soybean in Panduman Village, Jelbuk District, Jember District

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ABSTRACT

This low soybean production is caused by various factors, including farming technology that is still not good, the readiness and skills of soybean farmers are still lacking, The current conventional/traditional system used by farmers to grow soybeans is to make holes with a small hole or wood. After that put 2-3 soybean seeds in each hole and then cover it with soil, this kind of activity takes a long time, causing discomfort for farmers or farm workers. The target of this activity is farmers by encouraging them planting soybeans in Panduman Village which is still possible from a geographical point of view and directing profit-oriented farming in an effective planting time process. In the planting activity, the design prototype planted soybeans in 2 planting rows with a working capacity of ≤ 18 hours/ha with a seed output of 2-3 seeds/planting hole and a planting depth of 3-5 cm and regular spacing of 40 cm and the seeds were covered with soil cover. The design of the development of this planting machine is considered quite good in planting soybeans.

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INTRODUCTION

Based on the results of the 2020 population census, the population of Jember Regency was 2,536,729 people with an average density of 787.47 people/km2 (Anonymous, 2023). Based on Jember statistics 2023, the number of farmers in Jember district until 2020 was 60% of the total population or around 1,522,038 people for relatively narrow land ownership by farmers, most of the land ownership is under 0.5 Ha (BPS, Jember Dalam Angka, 2023). The area of Jember Regency reaches 3,293.34 km2 with the shape of the area in the north and east being hilly to mountainous and forming a vast fertile plain to the south. Based on data on land use in Jember Regency in 2020, the total area of paddy fields was 85,794 Ha, including 57,714 Ha of paddy fields planted twice a year and 28,057 Ha of paddy fields which could be planted once a year, while those temporarily not cultivated were 23 hectares. Ha. The area of dry land includes yards, fields/gardens, fields/grazing fields/pastures, community forests, state forests, plantations, uncultivated swamps, ponds, pools and others covering an area of 149,904 Ha (BPS, Jember Dalam Angka, 2023). One of the villages not far from the city of Jember towards Bondowoso is Jelbuk, Jelbuk District. This village is 304,684 ha in the highlands with the main potential is agriculture (BPD Jelbuk, 2021).

Nationally, in 2021, the projected area for the soybean harvest is 362,612 hectares, then the number will decrease by 5% to 344,612 hectares in 2022. The harvested area is expected to decrease by another 5.1% to 326,861 hectares in 2023, and further decrease by 5.2% to 309,849 hectares in 2024. The reduction in harvested area will have a direct impact on reduced soybean production. National soybean production is projected to be 594.6 thousand tonnes in 2022, which in fact is down 3.05% from 2021. Soybean production is also expected to continue to decline in the range of 3% per year, reaching 558.29 thousand tonnes in 2024. According to Ministry of Agriculture, the decrease in soybean harvested area occurred due to intense competition for land use with other agricultural commodities that have the same strategic value, such as corn and chili (Rizaty, 2022).

The development of soybean production in Jember itself has decreased from 2018 to 2021. Originally the harvested area was 5570 ha in 2018 to 3666 ha in 2021 with production of 13,886 tons in 2018 to 6,513 tons in 2021 (BPS, Jember Dalam Angka, 2023). Panduman Village, Jelbuk District, Jember Regency, not many farmers grow soybeans, they prefer to plant rice, corn and tobacco.

Soybean plants have good potential and prospects for planting in Panduman Village, because these plants are relatively easy to cultivate. In addition, the demand for national soybean production continues to increase both for food needs and for industry. This low soybean production is caused by various factors, including farming technology that is still not good, the readiness and skills of soybean farmers are still lacking, the provision of production facilities that are still not appropriate and the lack of capital to carry out the production process to marketing. For this reason, it is very interesting to disseminate the application of science and technology that is effective and efficient, such as the design of tools and machines for soybean farmers.

FORMULATION OF PROBLEMS FACED BY FARMERS

Farmers in Jember are starting to be less interested in planting soybeans, this can be seen from the decreasing area of soybean plants. This is due to the soybean cropping system as an alternate crop still using the traditional way of planting soybeans, namely by sowing and making holes using wood. thus requiring a long time and relatively large costs for labor costs, the highest component in the soybean cultivation business is labor wages which reach 53% of the total production cost (Wibowo, 2005), the components of labor costs include cutting, land preparation, planting , maintenance, harvesting and postharvest treatment. Labor costs for preparing land for soybean cultivation are around 17% of the total labor costs (Hendriadi dkk., 1998).

The current conventional/traditional system used by farmers to grow soybeans is to make holes with a small hole or wood. After that put 2-3 soybean seeds in each hole and then cover it with soil, this kind of activity takes a long time, causing discomfort for farmers or farm workers (AAK. 2000). Therefore, in order to increase productivity and capacity as well as facilitate the operation of planting soybeans with an effective and efficient planting device, technological engineering efforts have been carried out in the agricultural sector by making an injection system soybean planting device that is run using a DC motor. This tool is expected to save time when making holes, putting seeds into the holes and covering them with soil. The working principle of the planting machine is that there are five activities that are usually carried out, namely: 1) Making planting holes, 2) Setting out the seeds, 3) Placing the seeds at a certain depth, 4) Covering the seeds, and the last activity is 5) Compacting the soil around the planted seeds. Amsir and Subandi, (2003) states that local varieties when planted with the right technology will increase crop yields by 52-59%.

OBJECTIVES, TARGETS AND BENEFITS

The objectives of carrying out community service activities through a program of implementing appropriate technology for the Injection System soybean planting tool are:

1. Modify and
2. Test the performance of planting machines for growing soybeans.

The target of this activity is farmers by encouraging them to plant soybeans in Panduman Village which is still possible from a geographical point of view and directing profit-oriented farming in an effective planting time process. The benefits of the activity are the opening of opportunities for farmers to increase work productivity, overcome labor constraints, and increase income.

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RESULTS AND DISCUSSION

From the farmers' problems and from the results of a literature study of consultations also discussions with farmers in Panduman village who are currently less interested in cultivating soybeans with a conventional system that takes a long time and costs a lot, the solution offered is to help farmers in solving the problem is the application of technology by make a prototype of soybean injection system planting tool using a dc motor drive. The design for the development of applied technology is outlined in technical drawings and from these technical drawings a prototype is made and a performance study of soybean planting tools is carried out that can help farmers grow soybeans optimally or still need improvement. If the machine performance is above 80%, the machine can be used by farmers. To design a soybean planting machine with an injection system driven by a dc motor, design parameters with a functional design are determined according to field conditions. The designed machine system is capable of penetrating the soil as deep as 3-5 cm, so the machine is designed with injection polygons made of carbon steel pipes with sharp ends. The performance test in the field is to obtain actual data on the overall work of the machine, accuracy, work capacity and adaptability of the planting machine in the field/field.

As a first step in the activity, a technical discussion was held to explore the existing tools/machines prototype and discuss the steps to be taken. There are two activities that must be carried out by implementing researchers in describing these activities, including:

1. Determine the technique of planting soybeans
2. Technology design and production process

In the development of applied technology, applications for making prototypes of injection system planting tools with DC motor drives can be outlined in technical drawings then making prototypes with the stages of activities, namely:

- General planning
- Technical identification of injection system Soybean Planter prototype
- Design modification of the Injection System prototype using a DC motor drive.
- Initial field test of Injection System tools/machines
- Review the results of research on the manufacture of injection system tools/machines for growing soybeans.

Functional Design

The functional design of the tool/machine is made based on very general planning by collecting data, seeing/knowing existing soybean planting machines and having been made as a basis for identifying model sources so that in designing prototype modifications to the Soybean Planter/Machine Injection System prototype made using DC motor drive without reducing the function of the tool and the steps that must be taken in planting soybeans are as follows:

- This tool is in two rows with a spacing of 40 cm between rows of polygons
- Planting dose: 50 kg / ha
- Working speed of the tool: the same as the speed of people when planting
- Seed spacing in rows: 25 cm
- Seed spacing in the groove: 80 cm
- The distance between the fertilizer and the seeds planted is 10 cm
- When turning and transportation fatigue does not carry out planting.
- Operated by using a DC motor power
- Able to penetrate into the soil as deep as 3-5 cm

Basic Principles of Injection System Planting Tools/Machines
The main parts of the Injection System Soybean Planter Tool:

• Main Frame Attractor and Pitcher.

The construction materials consist of 50x50x5mm Holo iron, 30x30x3mm angle iron and 50x40x5mm UNP.

• Polygon Injector

This polygon is made of iron plate with a thickness of t: 4 mm with a number of sides of 6 pieces. The length of the sides determines the distance of the seed hole, which is 25 cm. The polygon will rotate when the DC machine rotates.

• Drive Shaft

The driving shaft is made of steel with a diameter of about 20 mm. The material roll is placed on the driving shaft.

• Hoppers

The hopper functions to accommodate soybean seeds to be planted, the construction material consists of a thick plate, t = 3 mm. This part is attached to one side of the polygon plate of the injector, in the hopper discharge section there is a rubber that regulates the amount of seeds. so that it does not exceed the capacity of the roll materialing hole.

• Injector Rod

The injector rod serves to make the planting hole as well as distribute the seeds from the measuring hole which fall by gravity. The construction materials consist of a BIP sch pipe with a diameter of ¾ inch and a strip plate with a size of 3/16 x 1.5 inch. The injector rod is divided into two parts, namely the constant injector rod and the movable one. Both are designed with sharp edges.

Table 1. Dimensional design results for the Soybean Planting Injection System/Machine

Injection System Planting Tool/Machine	
Length (cm)	155
Width (cm)	40
Height (cm)	60
weight (kg)	45
Number of Tools/Machine	1
Wheel diameter (cm)	50
The outside diameter of the polygon (cm)	48.72
Injector nose length (cm)	25
Wheel axle diameter (cm)	0.019
Axle length (cm)	65
Number of Hoppers	2
Capacity of each hopper (kg)	1.5
Driving Machine	DC motor

a

b

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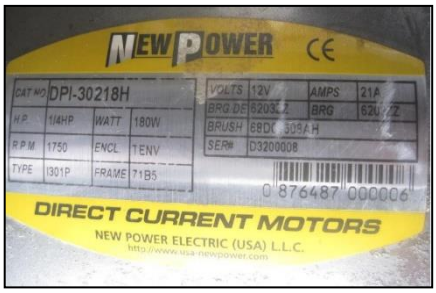
c

d



e

f

Figure 1. Components of Injection System Planting Tools/Machines: a. Framework; b Injection system tools/machines; c. The hopper; d Injection polygon and propulsion; e. Driving motor; f. Control

Figure 2. Equipment Testing When Planting Soybeans

In the planting activity, the design prototype planted soybeans in 2 planting rows with a working capacity of ≤ 18 hours/ha with a seed output of 2-3 seeds/planting hole and a planting depth of 3-5 cm and regular spacing of 40 cm and the seeds were covered with soil cover. Planter implementation must also be able to work well following the contours of the undulating ground surface.

After the above conditions are met, the planter machine development design is considered good enough, then a report is made to be socialized to farmers who are members of farmer groups in Panduman Jelbuk village and can be distributed to other farmer groups in other sub-districts as well as to agricultural extension workers in Jember district.

CONCLUSION

From this service activity, it can be concluded that:

1. The modified soybean planter prototype uses a DC motor drive capable of performing the planting function quickly.
2. This injection system tool/machine can work with a working capacity of ≤ 18 hours/ha with a seed output of 2-3 seeds/planting hole a planting depth of 3-5 cm and regular spacing of 40 cm and the seeds are covered with soil cover.

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