# GRAIN CORN CULTIVATION: A POTENTIAL MECHANIZATION SYSTEM PACKAGE FOR MALAYSIA GRAIN CORN PRODUCTION

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## ABSTRACT

*Around 50 to 60 percent of the ingredients used to create animal feed are made of grain corn. Based on the present production of 5.8 tonnes of grain corn for one hectare of farmland in Malaysia, 4.01 million tonnes of animal feed worth RM6.15 billion were imported into the nation in 2020, with two million tonnes of grain corn contributing for the other half of that figure. Malaysia is seeking to decrease its reliance on imports by 30% by producing 600,000 tonnes of grain corn for livestock feed over the next ten years. Land preparation, planting, crop care, irrigation, and harvesting are the five key mechanised processes used in the production of grain corn. Mechanization is crucial for ensuring the sustainability and increasing the productivity of grain corn production, particularly on a large scale. Plantation operations become more productive through mechanisation, involving fewer labour, and increasing uptime. When grain corn production is mechanised, the various machines should be chosen in accordance with their suitability and the planting site's conditions. Mechanized planting techniques require a 1.5 ha/hour work rate. With a work rate of 3.5 ha/h, the work efficiency for spraying using machinery is between 50 and 70 percent. Although the work rate for fertilization with mechanised equipment is 1.0 ha/h with a work efficiency ranging from 70% to 80% according to the condition of the soil surface and the farm's layout.*

Keywords: *Grain corn, mechanization, planting, spraying, work rate, work efficiency.*

## INTRODUCTION

In accordance with Malaysia's current production of 5.8 tonnes of grain corn per hectare of farmland, the country imported 4.01 million tonnes of animal feed worth RM6.15 billion in 2020, with two million tonnes of grain corn accounting for the other half of that figure. Malaysia aims to reduce its reliance on imports by 30% over the next ten years by producing 600,000 tonnes of grain corn for livestock feed. Dethier and Effenberger (2012). The majority of productivity gains are contingent on intensification, the adoption of new technologies, a healthy land market, and access to land environmental challenges. Mechanization plays an important role in ensuring the long-term viability and productivity of grain corn production, especially on a large scale. Plantation operations become more productive because of mechanization, which requires less labour and increases time-consuming. Liu and Wang (2005) mentioned both labour and machines can be substituted for one another, but farm technology is more precise, has more power to carry out operations on time, and is thus preferred to replace labour. Mechanization has a significant impact on productivity, accounting for approximately 11.7% of total productivity growth. A mechanization technology package is one of the most important factors in the success of the agricultural activity, particularly in large-scale production systems (A.R Rohazrin and A.S Adli Fikri). When mechanizing grain corn cultivation, the various machines should be chosen based on their suitability and the cultivation site's conditions. Calibration should be performed to ensure that plant materials, such as seeds and fertilizers, are distributed in accordance with specifications. Grain corn cultivation consists of activities: land preparation, planting, crop care. The machinery used in the mechanization of grain corn production should be chosen based on. The following are some brief descriptions of machinery and machines used in grain corn production, as well as operational experience.

## MATERIALS AND METHODS

Among the topics covered is Malaysia's conventional corn production practices, which are based on studies conducted by responsible agencies such as MARDI, the Department of Agriculture, and universities. The objective of this study on mechanization system for grain corn cultivation is to optimize the production process by using mechanical equipment and

technology to reduce the labor required and increase the efficiency of the farming operation. The package discuss in this paper are machinery and equipment, which are, planters and crop maintenance machine that are designed specifically for grain corn production in Malaysia.

**Mechanization requirements (tractors)**

Mechanization of grain corn production necessitates the use of a tractor with at least 60 horsepower to carry out operations such as land preparation, cultivation, and plant care that require large and heavy machinery. The recommended distance between tractor wheels for corn planting operations is 1,500 mm. This distance corresponds to the distance between the corn plant rows. The tractor's minimum clearance (height between the axle and the ground surface) is 450 mm, which is sufficient to carry out plant care activities until the plant is 30 days old.

**Mechanization of planters**

Seed sowing and basic fertilizer application are done in the same operation. This is carried out with a pneumatic system seed nursery machine (Gaspardo type) tractor attachment equipped with four rows of seed seeder with feeder fertilizer (Picture 1). Before planting, the seed drill machine is set up to measure to obtain the recommended planting rate. The machine comes with a manufacturer-recommended adjustment table, but further verification is required to customize the machine for different local conditions. The number of seeds that fall from one distance of travel can be used to calibrate planting distance. If a planting distance of 20 cm is desired, 50-52 seeds should be obtained in a 10 m travel distance, which is equivalent to.

$$\text{Planting distance (cm)} = \frac{\text{Travel distance}}{\text{Seed Drop}}$$

Picture 1. Pneumatic system seed nursery machine (Gaspardo type) tractor attachment equipped with four rows of seed seeder with feeder fertilizer.

**Mechanization in crop maintenance**

Crop care mechanization for grain corn are divided into two methods: spraying methods for liquid chemical application for foliar fertilizer spray, weed, pest, and disease control, and mechanical methods for weed control and fertilizer application to plants.

**Spraying mechanization**

In the spraying of liquid chemicals and foliar fertilizer, a high clearance boom sprayer is used (Picture 2 and Picture 3). This machine has a height axle to ground of 70 cm, allowing it to run spray operations until the plant is 45 days old. Calibration of spraying rate as per below.

$$\text{Spraying rate (litre/ha)} = \frac{\text{water volume (litre)} \times 10{,}000}{\text{Travel distance (m)} \times \text{spraying width (m)}}$$

Picture 2. Pre-germination herbicide spray activity

Picture 3. Foliar fertilizer spraying activity

**Spreader mechanization between the boundary and the fertilizer distributor**

Grain corn plants are given a second fertilizer (top dressing) four weeks after planting, according to recommendations in the agronomic practices (Picture 4). This is accomplished by using a rotor machine between the boundary lines that is equipped with a fertilizer system like the system on the machine planter (Picture 4). A tractor is used for running this machine. The height of the corn plant at this stage is between 30 and 40 cm. Calibration of fertilizer rate as per below.

$$\text{Fertilizer rate (kg/ha)} = \frac{\text{Fertilizer drop weight (kg)} \times 10{,}000}{\text{Travel distance (m)} \times \text{fertilizer drop width (m)}}$$

Picture 4. Secondary fertilizer application with a spreader machine between the boundaries with fertilizer application system mounted on a tractor.

## RESULTS AND DISCUSSION

Grain corn in Malaysian field production systems typically follows a standard operating procedure of crop production system beginning with land preparation, planting, crop maintenance, irrigation system, and ending with harvesting activity. This article focuses on mechanization in grain corn cultivation systems, which includes mechanization in planting and crop maintenance.

### Mechanization of planters

When it comes to planting, the tractor's speed during the operation is 4 - 5 km/h, resulting in a work rate of 1.5 ha/h. However, in bad working conditions, rates of work can be as low as 1.2 ha/h. High speed can cause distance planting to be inaccurate, resulting in more missing points. With a seed rate of 18 - 20 kg/ha and a plant spacing of 75 cm between rows of plants and 20 cm in the row, plant density can reach 66,666 trees/ha. NPK compound fertilizer 15:15:15 (Green) was used at a rate of 400 kg/ha, which is equivalent to 60 kg/ha for single fertilizers N, $P_2$ $O_5$, and $K_2$ 0.

### Spraying mechanization

For spraying operation, in ideal conditions, the sprayer boom effective width of 12 m and a tractor speed of 3.6 km/h, the time consume for one hectare of area can be completed in 18 minutes (this does not include the time it takes to prepare the mixture and turn the tractor). This results in a spray work rate of about 3.5 ha/h.

However, in windy conditions, the tractor's speed should be reduced, and recalibration performed. The use of longer booms may help speed up the spray job but controlling it in the undulating ground area is difficult. After considering the time the tractor makes a turn, and refilling the water into the tank, the average efficiency of spray work is 50 - 70% with the work rates recorded range between 30 and 45 minutes per hectare. The layout of the farm also impacts the efficiency of a spraying operation.

### Spreader mechanization between the boundary and the fertilizer distributor

The tractor can still enter the crop area without causing crop damage if the crop height is in between 30-40cm. For this operation, urea fertilizer is dropped about 15 cm within the plant and sprayed by the interrow spring tine cultivator system throughout the crop line at a rate of 130 kg/ha equivalent 60 kg N/ha. Calibration is performed in the same way as with the machine fertilizer dispenser planter. The use of this machine indirectly aids in the control of weeds between rows of corn plants. At the ideal tractor speed of 5 km/h, the operating work rate is 1.0 ha/h, with a work efficiency of 70 - 80% depending on the condition of the soil surface and farm layout.

## CONCLUSIONS

Mechanization plays a major role in grain corn cultivation to ensure high yield. Planter’s machines are designed to plant seeds at the proper depth and spacing, resulting in improved crop emergence and uniformity. As a result, crop stands are more even, which improves weed control and nutrient management. Spraying herbicides machine, insecticides, and fungicides with a sprayer can help farmers control weeds, pests, and diseases more effectively and reduces crop damage. Mechanized fertilizer application ensures that grain corn plants get the right nutrients at the right time.

In conclusion, grain corn mechanization through the use of a planter, sprayer, and fertilizer application is a highly efficient and effective method for grain corn production. It assists farmers in increasing yields, improving crop quality, and lowering labour costs, resulting in increased profitability and sustainability.

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