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Design and Fabrication of Manually Operated Seed Sowing Machine

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ABSTRACT: The goal of this project is to create a seed sowing machine that is lightweight, affordable, and dependable in order to boost agricultural productivity. Additionally, the project aims to construct a better mechanical device to aid the agriculture industry by minimizing the quantity and kind of labor required for a single crop. Therefore, in this project, we have chosen to design and construct a machine that small-scale farmers may purchase at a lower cost, which will simultaneously lower their expenses and increase their profit margin. The primary feature of this project is its ability to easily plant cotton seed. The agricultural sector must find ways to improve outdated farming methods and swap them out for more effective ones. We attempted to design and build a machine in this project that would lower the targeted energy input more effectively than we had in the previous one. This method offers enormous advantages for small-scale farming. Now that we have a new generation of equipment, we can proceed. We now have the chance to create a new line of agricultural equipment based on tiny intelligent machines that can act appropriately in the appropriate location at the appropriate time. This is made possible by the development of autonomous system architecture. It will boost output and cut costs in the agricultural industry.

KEYWORDS: Dispenser wheel, seed, sowing, speed ratio, seed spacing, grooves, ground wheels, etc.

I. INTRODUCTION

The agricultural sector will increase rapidly in the modern era. Planting crops involves putting seeds in the ground, dispersing seeds across the field's surface, or transferring seedlings through the soil while maintaining the ideal soil moisture and temperature. The proper number of seeds sown at the right time at the right depth and spacing in the soil will produce large yields. Typically, the capacity of the seed to emerge and the availability of moisture determine the depth of sowing.

The growth of the plant and its dispersal within a certain region determine the distance between its seeds. However, a plant's space demand is modified between the rows in such a way that the crops can subsequently use interculturing tools. Larger seeds are typically placed at a relatively deeper depth, and plants require broader spacing between each other.

The size of the seed, the pace of germination, the quantity of cover at maturity, and whether or not grain or fodder will be gathered from the plant all affect how many seeds need to be sown per unit area. Most crops are planted on level terrain in conditions of optimal rainfall. When the rainfall is excessively high or low, the seed is sown in ridges or furrows.

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terrain in conditions of optimal rainfall. When the rainfall is excessively high or low, the seed is sown in ridges or furrows.

Dibbling, or creating holes or slits with a stick or other object and manually dropping seeds, is a common method of sowing in tiny areas. Hand seed metering and multi-row traditional seeding equipment are favorites among seasoned farmers. When seeds are sown by hand, a uniform dispersion of seeds is not achievable.

Even if a farmer plants at the recommended seed rate, there may still be bunching and gaps in the field because of the uneven seed distribution both within and between rows. The following are the drawbacks of traditional sowing techniques:

- It is impossible to obtain consistent seed dispersal when sowing by hand.

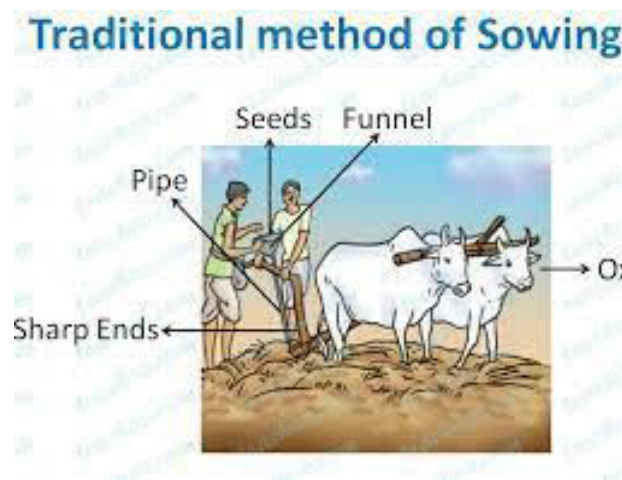


Fig. 1 – seed metering and dropping mechanism

The current machine's limits are as follows:

1. The machine has a greater weight.
2. Suitable for driving tractors.
3. There is no depth control arrangement.
4. No plans to prepare the seed bed.
5. Inadequate soil compaction in the furrows.
6. The row spacing has been adjusted incorrectly.
7. The machine is more expensive.

II. RELATED WORK

1. Mahesh R. Pundkar and A. K. Mahalle is presented review provides brief information about the various types of innovations done in seed sowing machine available for plantation. The seed sowing machine is a key component of agriculture field. The performance of seed sowing device has a remarkable influence on the cost and yield of agriculture products.
2. According to Pranil V. Sawalakhe and colleagues, all sectors, including the agriculture sector, are growing quickly in the modern era. Farmers must adopt new practises that won't alter the soil's texture but will boost crop productivity overall in order to fulfil future food demands. The numerous seed sowing and seed placement techniques utilised in India are the subject of this essay.
3. The review by Mahesh R. Pundkar and A. K. Mahalle is presented and gives a brief overview of all types of advances made to seed-sowing equipment for plantations. The seed sowing machine is an essential tool in the agricultural sector. The efficiency of seed sowing equipment significantly affects the price and output of agricultural products. Currently, there are many approaches for determining a seed-sowing device's performance.
4. Pranil V. Sawalakhe and et. al., are investigated the today's era is marching towards the rapid growth of all sectors including the agricultural sector. To meet the future food demands, the farmers have to implement the new

techniques which will not affect the soil texture but will increase the overall crop production. This Paper deals with the various sowing methods used in India for seed sowing and seed placement.

5. Presently there are many approaches to detect the performance of seed-sowing device Laukik P. Raut and et. al., studied to meet the food requirements of the growing population and rapid industrialization, modernization of agriculture is inescapable. Mechanization enables the conservation of inputs through precision in metering ensuring better distribution, reducing quantity needed for better response and prevention of losses or wastage of inputs applied. Mechanization reduces the unit cost of production through higher productivity and input conservation.

III. METHODOLOGY

1. We use these procedures to create farm projects.
2. Paying the farmers a visit and getting to know their problems is the first step.
3. The next step is to choose a problem.
4. The third step is to identify a solution to the problem.
5. Selecting the gear design for the appropriate seed distance is the fourth step.
6. The fifth step is determining the best approach at the lowest possible cost.
7. The sixth step involves locating every component that is required in the appropriate dimensions.
8. The seventh phase marks the start of fabrication.

Theory We have discussed seed metering technology, planter capacity estimation, seed drill varieties, and sowing procedures in this chapter. Additionally, a thorough explanation of the seed-sowing machine's design has been provided. Techniques for Planting "Seeding" or "sowing" refers to the art of putting seeds in the ground for the best possible germination in a field. A perfect sowing is achieved by distributing the proper amount of seed per unit area.

- a. The appropriate depth to plant a seed in the ground.
- b. Plants and rows should be spaced appropriately apart.

Methods of sowing seeds:

1. **Broadcasting:** Broadcasting is the process of dispersing seed on a seedbed's surface at random. It can be done manually or mechanically. The uniformity of the seed is determined by the skill of the worker performing the broadcasting by hand. Soon after they are dispersed, the seeds are covered with planking or other techniques. Higher seed rates are usually achieved using this method. Broadcasters that are mechanical are used for large-scale work. With the use of this apparatus, the seeds are dispersed at predefined rates across the surface of the seedbed.
2. **Dibbling:** Planting and covering seeds is the process of "dibbling," which involves creating holes in the seedbed. With this technique, holes that have previously been drilled are filled with seeds at a predetermined depth and spacing. A "dibbler" is the term for the equipment used in dibbling. It is a conical instrument used for drilling exact holes in the ground. A frame is used to hold multiple conical projections that are combined to create small hand dibblers. Little seeds are not the greatest option because this approach takes a long time. It's how most plants are seeded.
3. **Drilling:** After drilling, the seeds are placed into the holes and covered with earth. One can measure seeds automatically or by hand. There may be one or more plant rows. This method is very useful for figuring out the right depth, spacing, and quantity of seed to plant in the field. There are three techniques to drill: behind the plow, using bullock-drawn drills, and using tractors to pull seed drills.
4. **Transplanting:** In order to transplant, seedlings must first be prepared at a nursery and then planted in a field that has already been prepared. For paddy, vegetables, and flowers, it is customary. The process takes a long time. Transplanter is the name of the equipment used to put seeds in the ground.
5. **Hill dropping:** With this method, seeds are dropped at preset intervals rather than continuously. Consequently, there is a constant spacing between every plant in a row. Drills release seeds continually, and a row of plants has irregular plant spacing.

6. **Check row planting:** This kind of planting calls for uniform distances between rows and plants. This method ensures that seeds are placed correctly along straight, parallel furrows. Every time, the rows run parallel to one another. The tool used for check row planting is called a check row planter. For our project, we have decided to use the dribbling method out of the aforementioned techniques.



Fig. 2 – seed metering and dropping mechanism

Working Principle: A seed sowing machine operates on a very basic concept.

A seed dispensing wheel is a wheel with several holes around its diameter that is rotated at a set pace by the ground wheels using a chain drive. A portion of the wheel's circumference enters the hopper, holding the seed, and is positioned directly beneath it. A seed that has been struck in the circumferential hole is pulled out of the hopper by the wheel as it revolves and dropped into the tilled ground. The front of the machine has an adjustable plough installed. After the seed is dropped, the machine's rear end features a leveller that smoothes the soil that has been ploughed. A chain drive powers the shaft on which the seed dispensing wheel is fixed. The seed dispensing wheel receives power and rotation from the ground wheels. As the machine advances, the seed becomes lodged in the dispensing wheel's peripheral grooves. Seed dispensing wheel size and number of grooves can be adjusted to manage the amount of seed by adding or removing seeds.

IV. EXPERIMENTAL RESULTS

Calculations of Sowing Machine:

- Speed ratio of ground wheel to dispensing wheel is given by,

$$\text{Speed ratio} = \frac{Z_2}{Z_1}$$
 where Z_1 – No. of teeth on sprocket mounted on ground wheel,
 Z_2 - No. of teeth on crank of dispensing wheel.

$$= \frac{Z_2}{Z_1} = \frac{44}{18} = 2.44$$

For every 1 rotation of ground wheels, the seed dispensing wheel rotates 2.44 times.

- For demonstration purpose we are using dispensing wheel of groundnut seed Circumference of wheel = $2 \pi r = 2 * 3.14 * 120 = 754$ mm, therefore, when the ground wheel completes one rotation 754 mm linear distance is covered on ground.

- The seed spacing for groundnut is 140 mm.

Number of grooves on the wheel (dispensing wheel) = $\frac{\text{Circumference}}{\text{seed spacing}} = \frac{754}{140} \approx 6$ Therefore 6 grooves are required for groundnut.

- The seed spacing can be changed by changing seed dispensing wheel.

For different seed, dispensing wheels with different groove sizes can be used.

- Volume of hopper- The hopper is made up of frustum of a square pyramid, whose volume is given by,

$$\begin{aligned} \text{Volume of hopper (V)} &= \frac{1}{3} h (a^2 + b^2 + a b) \\ &= \frac{1}{3} \times 380(400^2 + 110^2 + (400 \times 110)) \\ &= 27372666.66 \text{ mm}^3 \\ &= 27372.666 \text{ cm}^3 \\ &= 0.02737266 \text{ m}^3 \end{aligned}$$

Design of Seed Metering Mechanism: In this project we used four 205 mm dia, 40 mm thick plastic wheel as a seed dispensing wheel. This wheel has six number of identical holes (dia 15 mm), at a circumferential distance of 140 mm.



Fig. 3 – seed metering and dropping mechanism

Design of Ground Wheel:

Diameter of ground wheel (D) = 410 mm

Effective radius of ground wheel (R) = 410/2 = 205 mm

Distance travelled by machine in one revolution of ground wheel i.e.

Periphery of ground wheel = $2 \pi R = 2 * 3.14 * 205 = 1288$ mm.

Components used:

Main shaft: A shaft is a rotating machine component that transmits power from one part to another or from a machine that creates power to a machine that absorbs power. The main shaft carries the dispensing wheel and crank on it, which is manufactured of C.I. Power is transferred from the ground wheel to main shaft by means of a chain drive. The main shaft is mounted on bearings at the end. Shafts are typically circular in cross section. Mild steel is the material used to make standard shafts.

Material of shaft: When high strength is required, an alloy steel such as nickel, nickel-chromium or chromium-vanadium steel is used. Shafts are generally formed by hot rolling and finished to size by cold drawing or turning and grinding. Dia 12 mm, length 250 mm.



Fig. 4 – Main shaft

Chain & sprocket: The type of chain drive most frequently used for mechanical power transmission on a variety of home, industrial and agricultural machinery, including conveyors, wire- and tube-drawing machines, printing presses, cars, motorcycles and bicycles, is roller chain or bush roller chain. It is made up of several short cylindrical rollers connected by side links. It is propelled by a sprocket, a wheel with teeth. It is a straightforward, dependable, and effective method of transmitting power. Tensile strength is the most popular way to assess the toughness of roller chains. A chain's tensile strength indicates how much strain it can sustain before bending under a single load. The fatigue strength of a chain is as crucial to tensile strength



Fig. 5 – Chain & sprocket

Ground Wheel: A pair of idler wheels on either side aid in the precise adjustment of seed placing depth while the ground wheel supplies the necessary power for the seed metering mechanism to function. To raise and lower the ground wheel during turns, a lever mechanism is also available. The tool is easily towed by a pair of bullocks. Mild steel is used for the grinding wheel. The seed metering mechanism and ground wheel are connected and are located at the box's base. Seed metering is the process that extracts seeds from the seed box and places them in the seed tube.



Fig.6 - Ground Wheel

Hopper: Hopper, a frustum of a pyramid which is placed on the upper side of the sowing machine. Hopper is used to store the seeds. The storing capacity of hopper may vary according to the requirement. Made of MS sheet. Base length – 110 mm, Top length – 400 mm and Height – 380 mm.

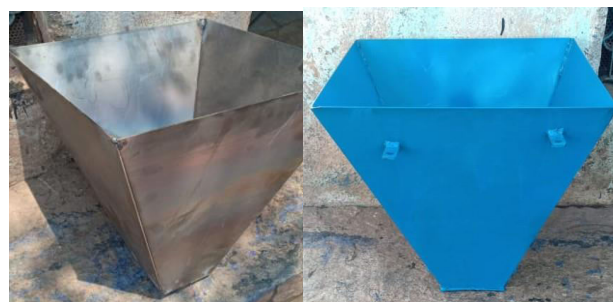


Fig.7 - Hopper

Seed Dispenser wheel: An agricultural tool called a seed dispenser is used to plant seeds for crops by placing them in the ground and burying them to a predetermined depth. This guarantees that seeds will be dispersed uniformly. Seed dispenser wheel dia 205 mm, thickness 40 mm with 6 holes of dia 15 mm for accommodating seeds (ground nut seed).



Fig.8 - Seed Dispenser wheel

Bearing: Bearing are the machine elements used to support rotating shafts. Here we have used a sealed ball bearing of specification 6202Z, i.e. bearing bore of 10 mm.



Fig.9 - Bearing and bearing holder

Plough: A plough is a farm instrument used to turn or soften the soil before to planting or spreading seeds. Traditionally, horses and oxen pulled the plough. A blade linked to a wooden, iron, or steel frame is what a plough uses to cut and loosen dirt. It has been essential to farming for the majority of time. Ploughs are primarily used to turn over the top soil, bringing new nutrients to the surface while burying weeds and crop residue for later decomposition. Made of 10 mm MS round rod, and length 250 mm.



Fig.10 - Plough

Leveller: Leveller is a device attached at the rear end of the machine, which is used to level the soil which ploughed after sowing the seed into it. It is just dragged on the ground, above the soil. Made up of a 32 mm square pipe, fitted with a cycle chain and fastened to main chassis.



Fig.11 - Leveller

Advantages:

1. Machine is easy to fabrication & assembles.
2. Machine is profitable & easy to operate.
3. Maintenances cost of machine is low.
4. Multiple operations can be performed at a time.
5. No need of skilled operator &controlling of operation easy with Smooth working.
6. It minimizes time & cost of man power.

Applications:

1. Includes scientific farming techniques. Sequence spacing seed sowing machine has more advantages than regular seed sowing machine. Involves precision forming and fool proofing technology.
2. By using this machine, a single seed can be placed in the desired spacing, so that the wastage of the seeds will be reduced. This will reduce the thinning operation during the germination time.
3. Suitable for all types of seed sowing application. Low cost, it's the lowest priced agricultural equipment ever built. Multitasking seed sowing done simultaneously.

V. CONCLUSION

While concluding this report, we feel quite fulfilled in having completed the project assignment well on time, we had enormous practical experience on fulfilment of the manufacturing schedules of the working project model. We are therefore, happy to state that the in calculation of mechanical aptitude proved to be a very useful purpose. Although the design criteria imposed challenging problems which, however were overcome by us due to availability of good reference books. The selection of choice raw materials helped us in machining of the various components to very close tolerance and thereby minimizing the level of balancing problem. Needless to emphasize here that we had lift no stone unturned in our potential efforts during machining, fabrication and assembly work of the project model to our entire satisfaction to solve the problem in agricultural field for social welfare. This manual machine has considerable potential to greatly increase productivity. The main task now is to promote this technology and have available to farmers at an affordable price. The manual machine can be readily made from local components in workshops. The only specialized items required which can be sourced at an inexpensive price from local promoter can easily be manufactured. By using of this machine, achievement of flexibility of distance and depth variation for different machine in farming is possible. In this way we conclude that, the different operation can be performed at a time without polluting the environment. Hence, we selected the topic “MANUAL SEED SOWING MACHINE” to contribute for sustainable agricultural machine. The various components required for building the agricultural equipment has been designed as planned. The single system which can perform multi operations like Sowing and inter cultivation. It will reduce external charges like fuels; electricity etc. And this will be helpful for poor farmers. It will be single system which contains multi attachments and can be easily assembled and dismantled comfortably. All the fasteners used in the equipment are of the same size. The equipment weight is around 10 to 12kg (Excluding attachment) thus it can be carried easily in farmland. The equipment can do the work of most of labour a day which reduces the labour cost of the farmer.

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