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Design and Fabrication of Seed Drill using Dibbler and Picker Wheel Mechanism

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***Abstract*: In recent years, there are various improvement in the field of planting and maintaining the crops. Seed sowing is an important and time bound operation for crop cultivation. Early or delayed sowing effects the yield of the crop. Placement of seeds in the optimum living area is important to guarantee more yields and high quality of crops. At present the plantings are done manually by broadcasting, dibbling, putting seed behind the plough and other methods or with the help manual, animals and tractor drawn seed drills/planters. These techniques have lot of problems such as, lower efficiency and poor quality seed placement. Presently, among difference showing techniques, dibbler planting provides more uniform and adjustable seed spacing then other methods for sowing of costly hybrid seeds. Thus, keeping in view the importance of low land holding of Indian farmers and considering obvious advantage of dibbler mechanism for crop like maize was developed minimize the problems of existing dibbler planter. The maximum efficiency was achieved while the Seed drill was operated at 4 km/h. The setup was driven by battery powered DC motors. The accuracy and precision is maintained by the circuits.**

***Keywords*: Seed Drill, Dibbler and Picker**

1. Introduction

A. Traditional method for seed drilling

The traditional methods involve drilling a hole and placing a particular number of seed in the hole. This conventional process seeding takes enormous amount of time and lots of work is involved. Separate tools are maintained for drilling, placing seed and closing the hole. Sometimes these tools used for seeding may cause some serious damages to the human hands. But this setup eliminates the maintenance of separate tools for punching and closing the holes. This setup is also portable and does not cause any to the human hands.

B. Industrial profile

1) About the industry

Established in the year 2012, "Renaaissance Industries Pvt. Ltd."is a prominent manufacturing , export supplies of agricultural products the industry is producing different types of machines and producing special Products includes power weeder ,automatic power tiller, brush cutter ,farm kart and many more. The company exports 30 % of the products to Africa and middle east.

2) Infrastructure facility

A sophisticated infrastructure facility across 2000ft2 of area has been the strength through the endeavour in offering the clients quality range of processing of units quality assurance unit and in house designed unit and thereby meeting the exact demands of the clients.

Fig.1. Traditional seed sowing method of maize

C. Objectives

The objective is to develop the seed drill in compact size and to develop an equipment that can be easily handled. To reduce the time consumption when compared to the conventional way of seed drilling. To develop automatic seed drill to reduce the efforts involved in seed drilling.

D. Scope of the project

The scope is to make the seed drill setup available for small scale farmers at affordable cost. This also eliminates the huge setup that are previously used in seed drilling process driven by heavy machineries. It also reduces the wastage of seeds while drilling it into the soil.

2. Review of literature

Review of literature is a systematic survey of the facts and figures of previous researches on a particular topic. It is a collection of major findings of past researches on a particular topic. It is useful to understand what has been done on the topic during the past period. In every research, there are certain preliminary works and the review of previous literature is one among them. It is secondary Source in the data collection aim store view the critical points of current knowledge including substantive finding as well as theoretical and methodological contribution to a particular topic.

Mostly, review of literature is associated with academic oriented literature; usually it precedes a research proposal and result section. Aim of the literature review is to bring the reader

up to date with current literature on a topic and form the basis for another goal. A well Literature on the utilization of digital and printed resources and other related issues is given below. Structured literature review is formed by a logical flow of ideas, current and relevant references with consistent, appropriate referencing style; and proper use of terminology and an unbiased and comprehensive view of the previous research on the topic.

This chapter deals with research work done in past by various investigators on the related topics under study. The planter and seed-drill for various crops have been of published work on seed drill or planters used for various crops along with different designed and developed by several researchers but very little emphasis has been placed on the sowing or planting equipment for cotton and maize in India.

A. Seed Drill or Planter Used for Various Crops

Solie (1991) indicated that by decreasing the row width, drilling increased the yield of small grains significantly. In the roller design, groove shape and the numberof grooves were important design parameters. He further reported that the groove shape was considered to be the most important factor affecting the seed dropping process from the groove.

Heege (1993) evaluated four different planting methods in cereals, rapeseed and beans based on uniformity of planting depth and uniformity of seed distribution over the unit area. He found that the precision drilling method had the best uniformity of planting depth and the broadcast-sowing method had the best uniformity of seed distribution per unit area.

Kachman and Smith (1995) stated alternative measurements of accuracy in seed placement for seeders. These measurements were based on the theoretical seed spacing and included the multiple index, missing index, quality of feed index and the precision in spacing. They recommended using these measurements for summarizing the uniformity of seeder metering rather than meaning or sampling coefficient of variation.

Pradhan et al. (1997) studied the development of power tiller operated groundnut planter cum fertilizer drill. They reported that the actual field capacity of the machine was 0.160 ha/h with a field efficiency of 80.94 %. A net saving of ₹237.47 can be achieved per ha by using the planter cum fertilizer drill over the manual dropping of seed behind the plough.

Kamble (2003) developed a multi power operated planter for planting delinted cotton to be operated by a pair of bullocks as well as tractor. The unit was consisting of two furrow openers, inclined plate seed metering devices, ground wheels and hitch. The performance of the machine was studied both in laboratory and in field conditions. The actual field capacity and field efficiency of the planter was 0.138 ha/h and 66.34 %, respectively when operated by bullock power and 0.312 ha/h with68.87% respectively, when operated by tractor power.

Kumar and Nair (2005) evaluated modified tractor drawn cotton planter for finger millet sowing and compared the performance with bullock drawn seed drill on a red sandy soil. The tractor drawn mechanically metered planter covers 0.6 ha/h and drop seeds at a depth of 2.0-2.5 cm, whereas, the bullock drawn manually metered seed drill covers 0.18 ha/h and drop seeds as a depth of 2.5-3.0 cm. Field capacity of tractor drawn planter was 0.6 ha/h with a field efficiency of 85 % as against 0.18 ha/h with a field efficiency of 90 % in bullock drawn seed drill.

Maheshwari and Verma (2007) modified and evaluated performance of manually operated garlic planter and found that at 1.8 km/h operated speed field capacity of 0.0181 ha/h and field efficiency were 78 %. The average plant population (65 plants/m2) of garlic sown by planter compared to 75 plants/m2 by traditional method. The germination (%) of garlic after 10 days of sowing by manually operated garlic planter was 69.6 % against 75.6 % by traditional method. The average yield by manually operated garlic planter and manual planting was 60.83 and 64.68 q/ha, respectively.

Veerangouda and Shridhar (2010) studied the effect of planter forward speed and depth of operation on draft and ground wheel slip. The draft of the seed planter was measured at four speeds viz; 1 .05, 1.74, 3.60, and 4.90 km/h and five depths of planting viz; 0, 2, 4, 6 and 8 cm of the planter. It was concluded that the draft of the planter increased with increase in depth of operation at all speeds. The draft of the planter increased with increase in speed of operation at all depths. The ground wheel slip decreased

B. Development of dibbler type planter.

Molin et al., (1998) developed a prototype punch planter for no till corn to provide different seed spacing. Plant population was adjusted by changing the planter wheel of different diameter which is 650, 825, and 1,000 mm so that different seed spacing obtained such as 136, 165, and 210 mm respectively. Laboratory and field tests were conducted at speeds of 1.5, 2.0, and 2.5 m/s to evaluate the effect of the punch lengths and speeds. Field tests were conducted in three different residue covers (corn, grain sorghum, and soybean). Finally, they conclude that, the length of the punches in the tested range did not affect the performance of the prototype. The results also indicate the necessity of improved synchronization between the seed meter and punch wheel.

Miles and Reed (1999) in this paper a lightweight dibbler drill employing a simple, pneumatically actuated, dibbler plunger system has been designed, tested and successfully proven in field trials. A novel method of delivering precise, small quantities of granules (e.g. pesticides), into the ground, adjacent to each individual seed has been developed. In trials using lettuce as the test crop, the dibbler drill produced a nominal 10 % improvement in final emergence when compared with a standard coulter drill.

Vinchuet al., (2006) develop manually operated single row cotton dibbler for cotton dibbling. The equipment was developed at the Department of Farm Machinery and Power, College of Agricultural Engineering, Marathwada Agricultural University (MAU), Parbhani and tested for its performance.

They conclude that, the field efficiency of M.A.U. dibbler was about 86 %, more than that of hand dibbling method. The working of seed dropping mechanism was satisfactory and desirable depth of sowing was obtained.

Adisa and Braide (2012) they were designed manually operated template row planter and developed to improve planting efficiency and reduce drudgery involved in manual planting method. Also it increased seed planting, seed or fertilizer placement accuracies and it was made of durable and cheap material affordable for the small scale peasant farmers. The operating, adjusting and maintaining principles were made simple for effective handling by unskilled operators (farmers). The planting rate of the template row planter was found to be 0.20 ha/h. Template seed filling efficiency was found to be 88 % and draft requirement was found to be 85 N at average speed of 2.16 km/h.

C. Performance of dibbler type planter.

Singh and Singh (2003) developed and evaluated a two-row bullock drawn Zero-till Fertilizer-seed Drill. They tested the machine in laboratory as well as in the field and found the field capacity of drill for hilly region is 0.05 ha/h whereas it was 0.06 ha/h for plain. They found 5.1 % increase in yield of the wheat as compared to conventional method whereas the cost of sowing was found 400 % lower as compared to conventional method.

Matinet al., (2008) developed power tiller operated inclined plate planter from locally available materials. The performance of the planter was evaluated and profitability of using the planter was compared with traditional practice. They found that the average field work rate capacity was 0.19 ha/h, saving 32.8% total cost and 79.2 % labour costs over traditional practice. In addition, 18 % yield increase was also observed in mechanical method

Aikinset al., (2010) evaluate the performance of jab planters for maize. The experiments were arranged in a completely randomized design. For each of the 30 jab planters, there were 10 replications (jabs) to determine the number of seeds and the quantity of fertilizer delivered. The poor seed and fertilizer metering of the jab planters showed that there was no control of quality in the manufacture of the metering unit of the jab planters. The study draws attention to the need to consider quality control in the manufacturing of the metering unit of planters and fertilizer application equipment.

Kurhadeet al., (2010) studied on the soil disruption by animal drawn seed drill shoe type furrow openers to improve soil conditions in sandy loam soil using four sizes of furrow openers at four lift angles (00o, 50o, 100o and 150o) at operational speed and depth of operation of 0.69 m/s and 0.05 m, respectively. It was found that, Tool 4 gave more spoil furrow width, spoil furrow depth, crescent height, spoil area and trench area at all lift angles and Spoil and trench area were directly proportional to the lift angle and tool size for the all tools.

3. Materials and methods

Table 1
Materials

S.NO.	Part name	Quantity(Nos.)	Material
1.	Frame	-	Mild steel
2.	Spur gear	3	Cast iron
3.	Dibbler	2	Iron
4.	Picker wheel	2	Mild steel
5.	Cam	2	Mild steel
6.	Bearing	6	Chromium
7.	Hopper	2	Mild steel

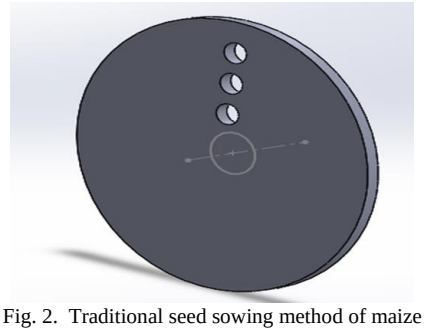

Fig. 2. Traditional seed sowing method of maize

A. Cam

A cam is a rotating device or a sliding piece in a mechanical linkage used especially in transformation rotary motion into linear motion. It is often a part of a rotating wheel (e.g.an eccentric wheel) or a shaft (e.g. a cylindrical with irregular shape that strikes a lever at one or more points on its circular path .the cam can be simpler tooth, as is used to deliver pulses of power. A shape that produces a smooth reciprocating motion in the follower, which is lever making contact with the cam.

B. Bearing

Fig. 3. Bearing

Bearings hold rotating components such as shafts or axles within mechanical systems, and transfer axial and radial loads from the source of the load to the structure supporting it. The simplest form of bearing, the plain bearings consists of a shaft rotating in a hole. Lubrication is often used to reduce friction. In the ball bearing and roller bearing, to prevent sliding friction, rolling elements such as rollers or balls with a circular cross-section are located between the races or journals of the bearing assembly. A wide variety of bearing designs exists to allow the demands of the application to be correctly met for maximum efficiency, reliability, durability and performance.

C. Picker wheel

Fig. 4. Picker wheel

It is a rotating circular plate with a seed picker attached to it at the circumference. It is connected to a circular shaft which is powered by a DC motor through a spur gear. It is used to pick seed from the hopper and transfer it to the square pipe. The number of seed picker attachment determines the number of seeds placed in the single dibbed hole.

D. Dibbler

Fig. 5. Dibbler

Dibbler is a sharp tool made up of steel rods sharped at one end and attached to the cam follower at the other end. This dibbler bears the entire thrust applied on it by the cam wheel. The main purpose of the dibbler is to punch the hole on the surface of the soil.

E. Spur gear

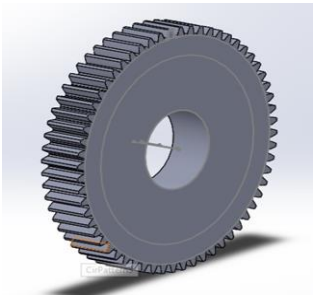

Fig. 6. Spur gear

The spur gears, which are designed to transmit motion and power between parallel shafts, are the most economical gears in the power transmission industry. Spur gears or straight-cut gears are the simplest type of gear. They consist of a cylinder or disk with teeth projecting radially. These gears mesh together correctly only if fitted to parallel shafts.

F. DC motor

An electric motor is a machine which converts electrical energy to mechanical energy. Its action is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a magnetic force whose direction is given by Fleming's left hand rule. When a motor is in operation, it develops torque. This torque can produce mechanical rotation. DC motors are also like generators classified into shunt wound or series wound or compound wound motors.

Fig. 7. DC motor

G. Circuit

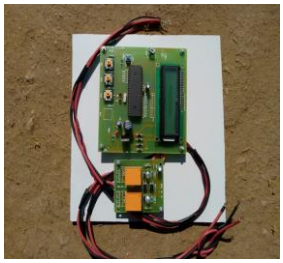

Fig. 8. Circuit

Circuit is an electronic setup used to prevent the drag of the dibbler while the forward movement of the seed drill.

H. Micro controller

Fig. 9. Micro controller

Micro controller is used to store the given time interval and process the operation of the DC motors according to the need. This stores the provided data by the user and helps in the processing of DC motor.

I. Capacitor

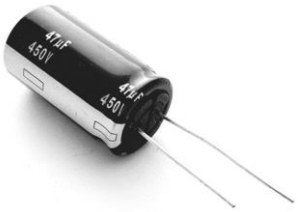

Fig. 10. Capacitor

The capacitor is a passive two terminal electronic component that stores electrical energy in an electric field. The

effect of capacitor is known as capacitance.

J. Relay

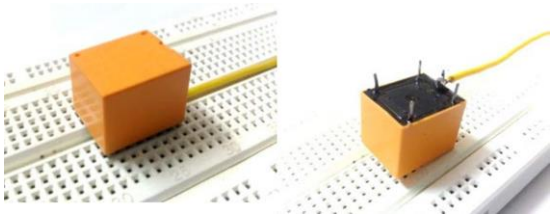

Fig. 11. Relay

K. Working principle

The working principle of our model will start by motor power transmission through cam and link arrangement mechanism. Here motor power shaft is connected to rear axle of the wheel where it produces the torque produces movement of the vehicle and we can control the speed of the machine by controlling the throttle provided in the machine. Simultaneously another cam of same size in rear axle is used to maintain the same speed to provide the rotational effect to the another shaft which is below the seed sowing machine equipment the shaft rotates at the same speed as that of rear axle rotates. Here cam and link mechanism is used to provide rotational effect to seed sowing machine shaft. As this shaft consists of two circular plates and made a slot at specified distance to easily pick the seeds from the hopper as the rear axle wheels turns due to power transmission of engine the seed are dropped by the circular plate. The circular plates are turned in clockwise direction as the rotational effects provided by shaft and seed are dropped into ground. We are maintaining the speed of the machine very low so it produces maximum amount of torque. Hence the model can be run smoothly on agricultural land. Circuit prevents the drag of the seed drill dibbler and also allow us to set up time for the forward movement and the rotation of the picker wheel and cam setup.

L. Assembled view

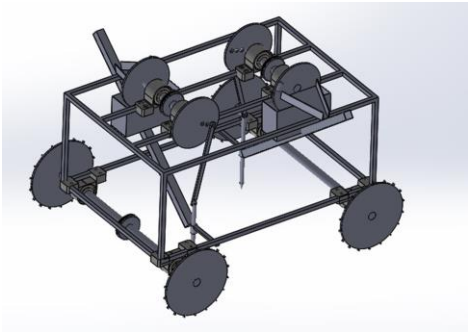

Fig. 12. Assembled view

M. Calculation

Number of teeth on the DC motor = 8
Number of teeth on the spur gear = 41
Gear ratio = 1 : 5.125
Distance covered by one rotation of the wheel:
Circumference of the wheel = 2 * pi * Radius
Wheel radius = 65mm
Traction plate width = 20 mm
Radius of the total wheel = Wheel radius + traction plate
= 65 + 20
= 85 mm
Circumference of the wheel = 2 * 3.14 * 85
= 533.8 mm
Distance covered by one complete revolution of the wheel = 533.8 mm
Number of combination of dibbler with the cam = 3 * 3
= 9

Table 2
Combination in dibbler

Cam hole	Dibbler	Depth of hole punched
1	1	15 mm
2	1	20 mm
1	3	25 mm
2	3	30 mm
3	3	35mm

1) Combinations of depth variation

N. Time calculation

The wheel will be operated only for 2 seconds
Number of teeth covered in 2 seconds = 2 * 8
= 16
Distance covered in one teeth movement = Circumference / total teeth
= 533.8 / 41
= 13.019 mm
Therefore, on 2 seconds = 13.019 *Teeth covered on 2s
= 13.019 * 16
= 208.16 mm
Distance between two dibbler = 250 mm
Area covered on one dibbing operation = 250 * 208.16 mm^2
= 52000 mm^2
Time required for one acre(s) = (area of one acre / area in one Operation) * time for one operation
= (4.047 * 109 / 52 *103) * 6
= 77826.93 * 6
= 466961.538 s
Area that machine does not want to cover = 466961.538 / 4
Time required in hour = 32.85 hrs.

O. Exploded view

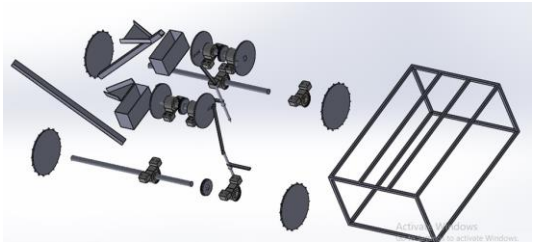

Fig. 13. Exploded view

4. Result and discussion

Seed drill is designed and fabricated as explained in the above chapters.

A. Cost estimation

Table 3
Cost estimation

S. No.	Part Name	Quantity	Amount
1	Frame	1	2000
2	Dc motor	3	6000
3	Battery	1	2000
4	Bearing	6	600
5	Spur gear	3	500
6	Control unit	1	2000
7	Cam and link	2	1000

B. Labour cost

Lathe, Drilling, Welding, Grinding, Power hacksaw , Gas cutting :

Cost = 2700

C. Overhead charges

The overhead charges are arrived by "Manufacturing cost"

Manufacturing Cost = Material Cost + Labour cost
= 14000+2700
= 16700

Overhead Charges = 20% of the manufacturing cost
= 3300

TOTAL COST

Total cost = Material Cost + Labour cost + Overhead Charges
= 14000+2700+3300
= 20000

Total cost for this project = 20000 Rupees

1) Manufacturing process

- Frame
- Welding process
- Hopper
- Dibbler

2) Frame

Frame is made up of mild steel with size of 20mm sides. The square rod was cutted into required dimensions using cutting machine and the square rods are joint together by welding process. The frame supports the primary components of the machine.

3) Welding process

Welding is a process of joining of two materials. In this process arc welding is used. The filler rod is heated upto 3000-3500c by producing an arc with help of electricity.

4) Wheels

Wheels are made of sheet metal with thickness of 3mm. The wheels are cutted into required dimensions using laser cutting process. The laser cutting process helps in acquiring accurate dimensions.

5) Hopper

Hopper is made up of sheet metal with thickness of 2mm and the hopper is manufactured by bending process. The main purpose of hopper is to hold the seeds and deliver it.

6) Dibbler

Dibbler is made up of steel and it is sharp at the end which helps to make hole in the soil for the seed. The dibbler is made by the machining process in the lathe.

D. Material removal process

Material removal process is the process of removing excess metal present in the surface. Material process will give the material a good surface finish.

E. Prototype

Fig. 14. Prototype

5. Summary

A. Summary

Bheem industries is in need of producing a new system which will reduce the time of planting the seeds in agriculture field. Seed drill system is designed and fabricated so it would serve for the agricultural purpose. The dimensions were then marked on the raw material bought for manufacturing of the machine and a number of processes were carried out which were explained in chapter3. The manufacturing was done with considering the safety measures. After completing the fabrication, a trail run was conducted.

B. Learning from the project

- Day by day engineering concepts will solve many industrial problems.
- Designing and fabricating of the prototype.
- Field study of other products.
- Discipline, punctuality, dedication and time management.

The project work has provided more information and gives experience to implement the knowledge gained during our course regarding, planning, purchasing, assembly, machining. While doing this project work it gives angood solution to bridge the gates between institution and industry.

C. Scope for future work

- Increasing the equipment strength and quality to it's peak.
- Having multipurpose agriculture equipment for life

time usage.

- Number of dibblers can be increased and time consumption can be reduced according to the number of dibblers.

6. Conclusion

The fabricated product is tested on the fields. Based on the speed and time tests are made. The development of the project and usage of the tool will be more efficient. Our team has successfully combined many ideas from various fields of mechanical engineering and agriculture knowledge to improve the yield and by reduce the labor effort and expenses.

- The functioning of seed drill in the field is good.
- It is easy to use and it reduces the time for farmers.
- Reduce labour cost.

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