Design and Manufacturing of Vacuum Generated Seed Sowing Machine

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ABSTRACT

India's economic security continues to be predicted upon the agricultural sector. Agriculture supports 58% of Indian population. To meet the rapid growth and increased food demand automation is necessary in farms. By using conventional seed sowing methods the seed wastage is enormous. By implementing our seed sowing system the wastage is reduced up to 90%. By introducing automation to this process has become convenient. The biggest benefit of automation is that it saves labor; however it is also used to save energy and materials & to improve quality, accuracy and precision. Some crops are required to grow saplings first before planting them In farm. These saplings are grown in a nursery. We've designed this system for nursery and poly house.

Keywords*:* agriculture, Seed, nursery

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1. INTRODUCTION

Agriculture is the most important occupation for most of the Indian families. In India, agriculture contributes about sixteen percent (16%) of total GDP and ten percent (10%) of total exports.One report from 2008 claimed India's population is growing faster than its ability to produce rice and wheat. Other recent studies claim India can easily feed its growing population, plus produce wheat and rice for global exports, if it can reduce food staple spoilage, improve its infrastructure and raise its farm productivity India is mainly an agricultural country. Green revolution began in India with an objective to give greater emphasis on Agriculture. The era of Green revolution that began in
1960s witnessed significant increase in the production of food crops. The introduction of improved methods of agriculture and high yielding varieties (HYV) seeds, mainly wheat, had resulted into remarkable improvement in agricultural outputs.

Poly house plays major role in green revolution. Poly house farming is an alternative new technique in agriculture used in rural India. It is better than traditional farming because it is less dependent on rain and makes optimum use of land and water resources.
The improvement in economy of farmers with the decreasing land holding is also possible through the protected cultivation by increasing production per unit area with some advanced techniques. Now a days to meet the future demand there must be some development in nursery and poly houses. For the betterment of nurseries and poly houses SEED SOWING MACHINE is very useful.

2.OBJECTIVES:-

1. Uniformity in the distribution of seed placement.
2. Proper utilization of SEEDS.
3. Time Reduction in Planting.
4. Per HECTOR Production increase.
5. Placement of seeds at proper depth.
6. Reduction in Man-Power.

3.LITERATURE REVIEW

1.Joginder Singh studied the effect of farm mechanization on Indian economy. He concluded that Production and productivity cannot be enhanced with primitive and traditional methods. Thus, selective mechanization is the need of the future.

2. Roshan Morode, Gajanan Tayade, Swapnil Agrawal Studied the agriculture scenario in india. They also survey on already existing seed sowing machine & their limitations. From those inventions they came to know some flaws like, No control over depth of seed placement, No uniformity in seed distribution & wastage of seeds. Over these flaws they found 'Design and implementation of multi seed sowing machine'.

3. Olimpia Pandiaa, Ion Saracinb, Ion Bozgaa, tefania Eliza Tanasie Studied disadvantage of manual Seed sowing. They did theoretical studies and laboratory experiments regarding pneumatic equipment for sowing small seeds in cups, highlighting the advantages of this type of equipment with superior parameters obtained from the considered crops. Equipment can be used in narrower spaces, being easily to handle and use, of driving the vacuum generator can be done electrically or thermically. By using this equipment, the productivity is increased, the space of establishing the seedlings is reduced, and the seeds norm is diminished. The germinating, rising and development space of plants is assured, equipment can be automated and built by minimum costs. Studies and experimental tests relating to the production index, consumption standard, the emerging degree and the plants percentage obtained will be continued.

4. Atul Ekad, Sonal Salunke, Sunaina Gawde & Archana Said Studied the existing problem at nursery like availability of labor, wastage of seed & availability of low cost seed sowing machine . By considering those problems in agriculture sector they designed & developed ' Pneumatically operated automatic seed sowing machine'. The mechanism consist Frame, Motor (1.DC Motor 2.Stepper Motor),Vacuum Pump and Nozzle, Conveyor Belt, Pulley, Seed Tray and Seedling Tray.

4. DESIGN AND CALCULATIONS

Selection and designing of the components required for the working of the model is based upon mainly the ergonomic considerations. The system design needs multiple components, some of which are available in standard specifications and cannot be manufactured but needed to be bought from these manufacturers. The component selection required for this model have been based on the calculations done upon considering the largest seed diameter which would ultimately also work for lesser diameters than the one considered.

1.Vacuum Pump

The operation of the vacuum pump is based on Bernoulli's principle. The formation of vacuum inside the pump allows the seed to get sucked through nozzle . Entry of seed in nozzle is avoided by appropriate selection of the nozzle.
The nozzle is selected in such a way that nozzle diameter is less than seed diameter. So changing the nozzles only can allow use of multiple seeds of various diameters.

Diameter of seed = 7.7 mm

Area of nozzle is calculated by

$A = \pi/4 \times d^2 = \pi/4 \times (0.0077)^2 = 0.0465$ mm

Measurement of the seed is done by electronically measuring the packet and dividing it by the number of seeds in the packet.

Mass of seed (m) = 0.2 gm

Weight of seed = m x 9.81 = $0.2 \times 9.81 = 1.96 \times 10^{-3}$ N Force

required (F) = weight = 1.96×10^{-3} N

Pressure required (P) = F/A = 0.4215 MPa

The vacuum pump available in the range of 0.4215 MPa is selected from the manufacturer's catalogue. Thus we selected Vacuum Pump having operating pressure in range of 0.1-0.6 MPa. As the seed diameter changes according to the application, the vacuum pressure also changes.

2. Motor selection

Choosing a suitable motor for the movements of the mechanical components of the most important part in an automation application. The selection of motors from a wide variety of motors like Servo Motors, Stepper Motors, Conventional DC motors, Induction motors, BLDC is really dependent upon the user end application. In our case since there is automation of the seed pick up, we require a programmable motor which can be controlled electronically using a controlled like Arduino Uno. The best suited motor will be a Stepper motor of 1/8 Step configuration since we do not require heavy loading conditions and precise control of position.

W = Total weight that has to slide + the pneumatic cylinder's weight = 98.23gms = 100gms

R= reaction to the weight taken by the motor

μ (coeff. of friction)= 0.76 (taken from charts)

F (frictional force)= μR= 0.76 X (0.1 X 9.81)= 0.7456N

d (diam. Of pulley)= 40mm= 0.02m

Now, required torque to rotate pulley is given as,

T= F X r= 0.7455 X 0.02 = 0.01491 Nm= 0.0152 kgcm

Thus, for optimum performance we have selected a stepper motor of 5 kgcm from the standard manufacturer's catalogue which would satisfy the torque requirements of the model.

3. Pneumatic cylinder

The Selection of movement in Z direction is done by a Double Acting Pneumatic cylinder. Since stalling of the cylinder in mid space is required a 4/3 AC Solenoid Operated DCV is used to control the movements of the cylinder. Since the DCV is solenoid operated is given signals from the electronic circuit by the controller as per the programmed values. The selection of the cylinder is done by calculating thr required pressure for its operation and the bore diameter.

Stroke= 25 mm

Mass of seeds (m_s) = 0.00126 kg

Mass of nozzle and mounting assembly (m_n)= 0.5 kg

total weight (W) =(m_s + m_n) x 9.81 = (0.00126 + 0.5) x 9.81 = 4.917 N Pressure

required for 25 mm stroke cylinder = 2 bar

Here the weight of the components is the total force required to be lifted. P = F /

A

200000 = (4.9173606)/ A A =

0.000024587 m2

therefore, Diameter (D) = sqrt((0.000024587 x 4)/ Pi)

Diameter(D) = 0.005590259m = 5.6 mm

As per the manufacturer's catalogue the standard sized bore near to the value of 5.6 mm is 10mm for the required stroke of 25 mm**.**

4. Frame

The material selection for the frame is based upon ergonomic considerations. There is a wide variety of materials to be selected from as the properties of each material is different and varied according to the composition. We required a material that is sturdy, good in compressive loading and less prone to corrosion. The important aspect of our material selection is economical aspect. So taking all the considerations above we have selected MS square bars and plates for our frame manufacturing. Coating it with paint will protect it from corrosion and moisture and increase its life.

The dimensions of the frame are 80cm x 35 cm x 18 cm.

5. Electronic Circuit

The electronic circuit is an essential component of the model. It provides automated movement with the help of a written program which is compiled into Arduino Uno controller. We have used an Arduino Uno controller as it is economic and it works precisely for small load applications and controls. The electronic circuit consists of an

i Arduino Uno Controller ii

SMPS

iii Toshiba Driver iv 2

Relays

v Step Down Transformer vi

Power Source Circuit

The SMPS is used for the starting of the whole circuit when power is given to it. The 230 V AC supply is stepped down by the Transformer to 12V AC supply which is further stepped down to 5V by the power supply circuit, as it is required by the stepper motor. Since the DCV is AC supply operated and stepper motor is DC supply operated, we require @ normally open relays for quick changing of the input supply according to the program. The Toshiba driver is used since it is the only efficient driver which works on the configuration of 12V and 5A as well as 5V and 5A and it is suitable for light to medium load applications. The Arduino Uno is the controller used in this system and it controls all the signals that have to be given to the motor, vacuum pump and AC solenoid 4/3 DCV for the smooth

and sequential operation. The program logic and code is written into the Arduino software and then compiled and run by using an external source.

5. MANUFACTURING AND ASSEMBLY

This system consist of various components as discussed above. This parts should be arranged in appropriate manner thus we need to manufacture frame, different mounting etc

The main steps during manufacturing are as following

1. Frame manufacturing
2. Pulley manufactring
3. Pulley mounting
4. Motor mounting
5. Vaccum pump attachment
6. Electronic circuit mounting

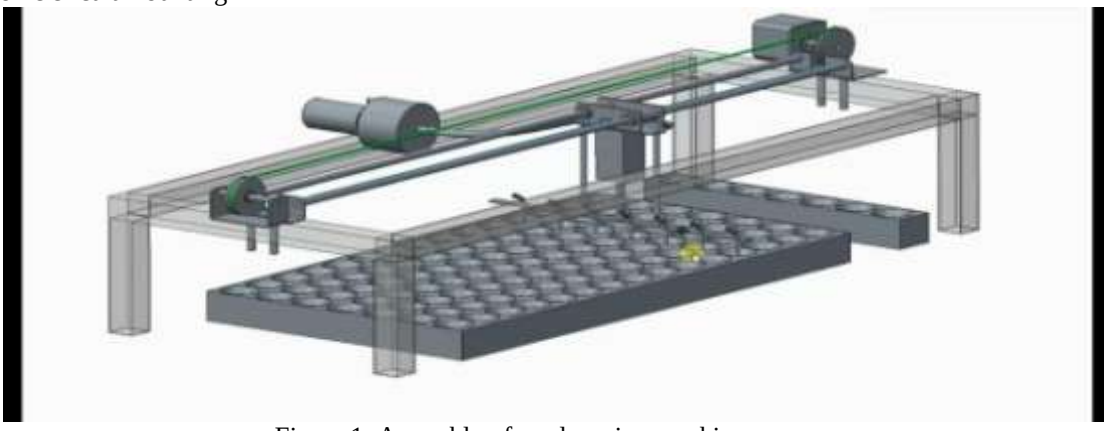

Figure 1. Assembly of seed sowing machine

According to the requirement firstly the square channel was cut into pieces of exact size, to manufacture the frame arc welding technique was used. pulley is made of aluminum and another made of polymer at the end and shaft placed at center. with the help of bolts dc motor is attached to the pulley shaft. Stepper motor is connected to shaft with nut and bolt housing is provided to motor. microcontroller used in system is Arduino UNO, the whole electronic part assembled on acrylic sheet with help of double tape, which consist of Arduino UNO board, stepper motor driver and relay circuit. Air control value is mounted on the frame side with two bolts. With help of air fitting pneumatic pipes are connected valve and vacuum pump. By providing support on the frame solenoid value is mounted on it. support clip is welded to the frame and value is bolted to the support clips .Seeds tray is provided at on end of the frame . Pneuma tic hoses are press fit type easy to remove and assemble.

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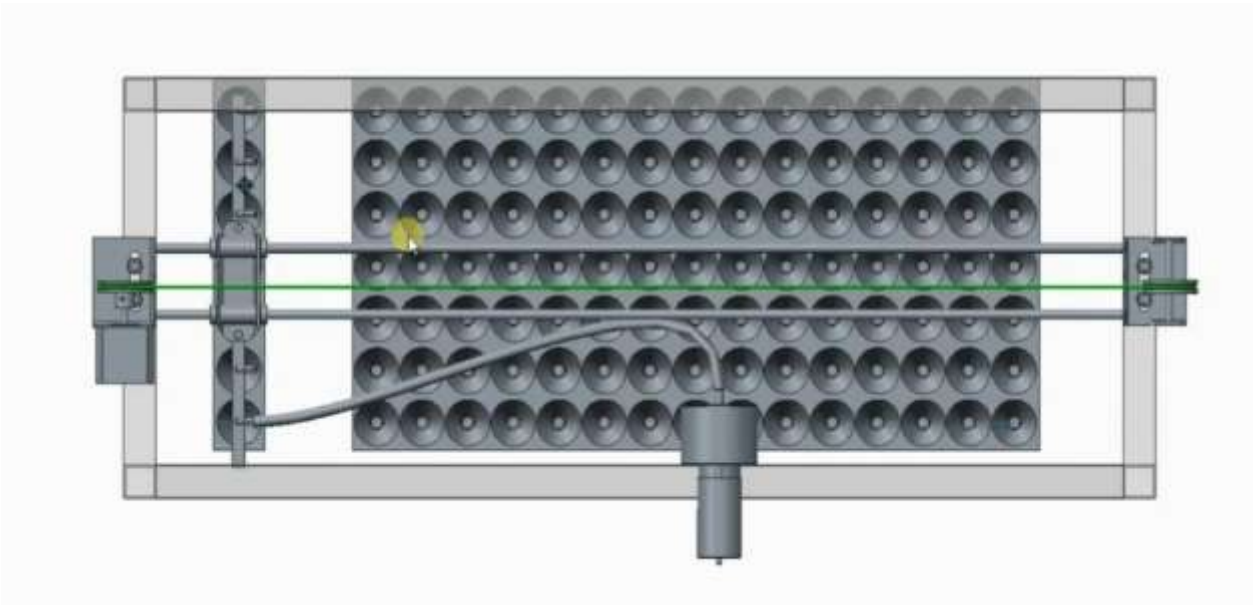
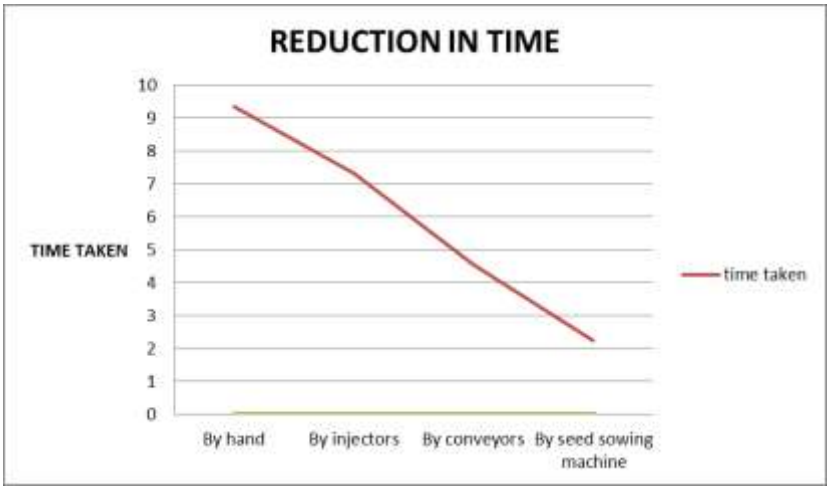


Figure 2. Top view of assembly

6.RESULTS

The following graphs were obtained the system was compared to other methods.



Graph 1

The cycle time got reduced from 9.36 min to 2.32 min.

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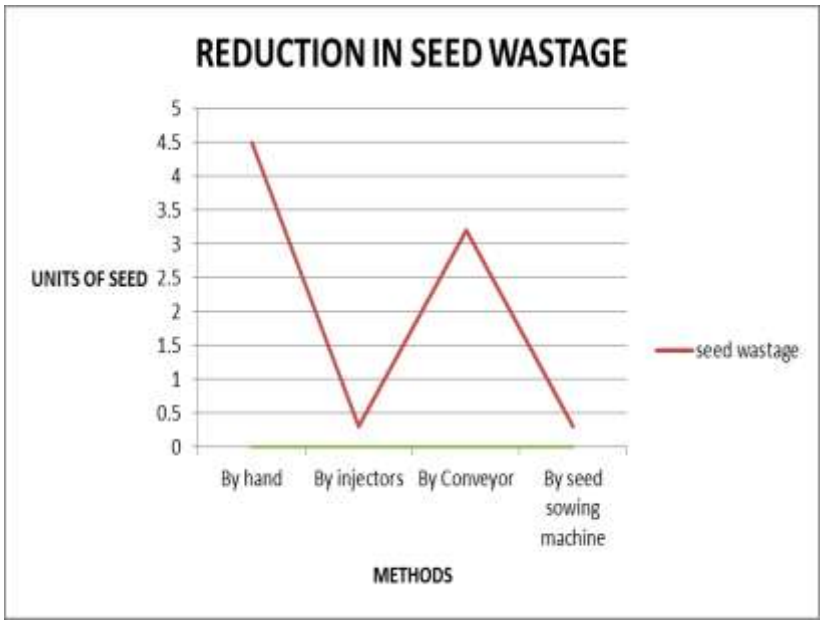

Graph 2

seed wastage got reduced to an enormous amount.

7. CONCLUSION

Problem eliminated with help of automatic seed sowing machine are as following its cost is less, availability of workers and wastage of seeds is avoided. Exact pick and place mechanism allow seed to drop in proper seedling tray .Space required for automatic seed sowing machine is less hence can be easily placed anywhere .accurate and precise positing of seeds in tray allow proper growth of plant. Variety of seeds can be sowed with this system by just changing the nozzles.

8. FUTURE SCOPE

PLC can be used in system for more accurate positioning of nozzles which will help in exact plantation. In large scale plantation plc will give more efficiency as number of seeds planted will be more in one single rotation. Use of conveyor belt will allow tray move automatically are filled this will reduced lead time. Wheels can be provided to the assembly so that it can be moved to any place easily mostly portable machines are preferred.

9. REFERENCES

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