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Design and Fabrication of Automatic 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. The present review provides brief information about the various types of innovations done in seed sowing equipment's. The basic objective of sowing operation is to put the seed and fertilizer in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed. The recommended row to row spacing, seed rate, seed to seed spacing and depth of seed placement vary from crop to crop and for different agro-climatic conditions to achieve optimum yields. The basic aim of this paper is to study and know the research gap between the use of traditional method and the automation system in India, along with the parameter related to the manual seed sowing, design of automatic seed sowing machine.

1. Introduction

Agriculture has been the backbone of the Indian economy and it will continue to remain so for a long time. It has to support almost 17 percent of world population from 2.3 percent of world geographical area and 4.2 percent of world's water resources. The present cropping intensity of 137 percent has registered an increase of only 26 percent since 1950-51. The net sown area is 142 Mha. The basic objective of sowing operation is to put the seed and fertilizer in rows at desired depth and spacing, cover the seeds with soil and provide proper compaction over the seed. The recommended row to row spacing, seed rate, seed to seed spacing and depth of seed placement vary from crop to crop and for different agricultural and climatic conditions to achieve optimum yields and an efficient sowing machine should attempt to fulfill these requirements. In addition, saving in cost of operation time, labor and energy are other advantages to be derived from use of improved machinery for such operations. A traditional method of seed sowing has many disadvantages. This is about introducing automation system which will be majorly used in nursery

1.1 Green House & Poly House Cultivation? Why

After the advent of green revolution, more emphasis is laid on the quality of the agricultural product along with the quantity of production to meet the ever-growing food and nutritional requirements. Both these demands can be met when the environment for the plant growth is suitably controlled. The need to protect the crops against unfavourable environmental conditions led to the development of protected agriculture. Greenhouse is the most practical method of achieving the objectives of protected agriculture, where natural environment is modified by using sound engineering principles to achieve optimum plant growth and yield. Poly house cultivation has become an important policy of Indian Agriculture. Our country is self dependent on food grain production but to fulfill the nutritional security, the gap between increasing demand of horticultural produce has to be filled. This gap cannot be filled by the traditional horticulture which required large area under horticulture to increase the production for the ever growing population. Green house technology has potential to produce more produce per unit area with increased input use efficiency. Therefore, this problem can be coped up by adopting green /poly house technology for the horticultural production. For example if one lakh hectare area under vegetable cultivation is brought out under poly house cultivation the annual availability of vegetable will be increased by at least 100 lakh tons. Besides this it will also increase the significant jobs opportunity for the skilled rural men, youths and rural women. Total production of vegetables in India is next to China, but per capita availability of vegetables is much lower than required. The productions of vegetable crops are to be increased to meet the demand of the ever growing population otherwise per capita availability of vegetables will further go down. There is lot of pressure on cultivable land caused due to industrialization, urbanization and expansion of the rural villages. Therefore, it is utmost necessary to improve the productivity of crops including vegetables by adopting intensive cultivation, hydroponics and poly house cultivation. Adopting poly house cultivation the productivity of vegetable crops can be increased by 3-5 times as compared to open environment. Besides productivity, the better quality of produce is also obtained under poly house cultivation.

2. Literature Survey

Onion is considered as the one of the major export vegetable crops in Egypt. The total cultivated area of onion crop is about 111,000 Feddan's. This area produced about 1.4 million tons. Most of this area (84%) is cultivated in the old land by tradition methods Results of several studies indicated that, there are many disadvantages of planting onion by traditional methods **(El-Sahrigi, 1985)** as a compared with the mechanized methods. Moreover, there was another problem associated with using the imported mechanical machines of planting onion seeds under Egyptian conditions due to the following reasons: 1) the design of these machines is not suitable to plant most of the local onion seeds, 2) they did not give the appropriate plant populations, especially for export fresh shoots onion production, and 3) they are not proper for small holdings in terms of power, size and cost..**El-Shal (1987)** reported that using the mechanical metering mechanisms cause seed damage due to the friction forces between the mechanical part and the seeds. He added that the pneumatic metering mechanisms may deal gently with the seeds and no damage during planting can occur. He also studied the effect of disc speed and vacuum suction on the see. Seed uniformity for sunflower and sesame seeds. He found that the optimum uniformity of seed distribution was obtained at 15-rpm disc speed for both seeds. The suitable vacuum suctions were 0.04 and 0.01 kg/cm^2 for sunflower and sesame seeds, respectively. **Bosoi et al., (1987)** reported that any planting machine must have hoppers with an optimum capacity in order to feed seeds uniformly and continuously to the seeds metering mechanism. They added that the trapezoidal form is the most widely used hoppers of planting machines.

To optimize the design and operating parameters for cotton seed planting, **Singh and Sarawat (2005)** found that the lower miss indices were observed at higher vacuum pressure and lower disc speed. However, lower multiple indices were obtained at lower vacuum pressure and higher disc speed. They added that the highest values of the quality of feed index (94.7 %) were obtained at 0.42 m/s disc speed and at 2 kPa vacuum pressure. The lowest values of coefficient of variation in spacing (8.6 %) were obtained at 0.42 m/s disc speed and at 2 kPa vacuum pressure. **Lan et al., (1999)** developed an Opto-electronic seed spacing measurement system for fine seeds. This system measured time intervals between the seeds and detected front and back seed drop location events to determine the seed spacing uniformity of a planter in the laboratory. The space measurement obtained based on time intervals between seeds drop events were strongly correlated with the space measurements obtained on a greased belt test stand. They added that the accuracy of seed spacing is depending upon the size of the seeds. **Onal(1987)** reported that the fine seed distribution uniformity depends on the constructional properties and materials of seed tubes and the physical properties of seeds. In the application, the vertical angle of the seed tube must not be bigger than 15°*.*

Parish et al., (1991) compared between two types of precision seeders.They found that a belt-type seeder resulted in the better uniform seed spacing of spherical seed such as cabbage seed, but spacing of elongated seeds such as cucumber seed was more uniform with a vacuum seeder. **Bracy and parish (1998)** assessed the uniformity of metering size-graded and un-graded turnip seeds with precision belt-type and vacuum-type seeders. They concluded that the belt-type seeder should effective cingulated the seeds if the seeds are spherical and uniform because the holes are specifically sized. Seeds that are not graded for size uniformity may not be simulated effectively by a belt-type seeder. A vacuum-type seeder should meter a wider range of seed size more uniformly than a belt-type seeder, since the holes in the seed plate must only be smaller than smallest seeds in the lot.

Barut and Ozmerzi (2004) studied the effect of the peripheral velocity of seed plate on the seed holding ratio for maize. They found that an increase in the peripheral velocity of the seed plate gave a decreased of seed holding ratio for different maize varieties. The effect of planting speed on metering and seed accuracy was studied by **Chhinnan et al.,(1975)**. They found that higher planting speeds resulted in more skip,higher speed placement errors, and higher average spacing. **Giannini etal., (1967)** developed a vacuum-type seeder for precision planting of lettuce that used vacuum principles for planting single seeds. They compared the precision seeder with the standard bulk metering seeder and they found that the vacuum seeder used less seeds and also it is reduced time and resulting in improved yields. **Wanjura and Hudspeth(1969)** found that pattern efficiency of vacuum plate differed most atl ower or higher vacuum pressures and faster wheel speeds. They also found that the 8 mm seed drop height consistently produced a better seed pattern than 15 mm drop height with a precision vacuum seeder. They recommended that the metering device on a seeder should be located as low as possible and that seed should fall freely to the bottom of the soil trench.

Acknowledge the supporters and people involved in research process

3. Objectives

The basic aim of this paper is to study and know the research gap between the use of traditional method and the automation system in India, along with the parameter related to the manual seed sowing, design of automatic seed sowing machine. This includes benefits and requirements in order to achieve higher productivity and yield. Hence we aim to study about vaccum seed sower, there benefits, requirements and help to popularize it amongst the people especially amongst small scale labours in our country so as to minimize cost of production , time and have better quality of plantation.

4. Necessity

India is the most developing country all over the world, it is very important to improve in each and every field. Agriculture is the major business in India and hence there is requirement to develop it. For that we have worked on the plantation process of rice, tomatoes, onions and we find that the manual rice transplantation process is slow and also the cost is more. Hence it is very important to find some automation in this process so that the plantation will be more effective and economical.

5. Scope

In the future, the system can be improved by using the conveyor system in order to change the portray automatically. This will make the system fully automated and totally eliminate human involvement. Also can increase the flexibility by making it open for all kinds of seeds used in polyhouses. Bluetooth controlling of the device can be made possible. More number of nozzles can be used in a large Machine for increasing productivity. Hence less time will required for plantation. Telescopic cylinder can be use in large machine for coverage of more number of seedling trays at a time. Telescopic cylinder will provide the ability to vary the number of plantation. PLC can be used for the Automatic seed sowing machine for large scale plantation, where number of seeds can be planted in a single rotation. PLC will provide the most accurate positioning of nozzle for proper plantation of trees. Wheels can be provided to the machine which will be helpful for the easy transportation of machine. Sometime it is important to move the machine due portability issues, in that case portable machine will be useful.

6. Present Situation

The present situation of the plant nursery and their way of working are discussed as below.

Nursery is the part of agriculture. So as in farm the feeding of all parts of seeds are not feasible because in the farm proper environment will not present, the wastage of seeds are possible. Also the chances of falling of unnecessary seeds during sowing are possible. Hence in the nursery by maintaining proper environment required for growing of plants care is taken. After growing of plants those plants are taken and then they are used to plant in farm. For this the plants are produced by using a tray which has number of holes as per the requirements in those whole the coco-peat powder is used to fill half of the hole and is followed by the seeds in those holes. Again the powder is filled. As per requirements of customers the nursery produces different kinds of plants. Now a days in Nursery seed feeding is done manually which affects on productivity of the Nursery. The seed feeding activity takes more time which results in less plantations of the seeds.

7. Methodology

The plantation of seeds is being done by manually with the help of labor in the Nursery. The sizes of seeds are very small. What is exactly being done in nursery to complete the plantation of seed is that first in the box which has number of holes near about 104. The time required for this process is 3 to 4 minutes for 9 to 10 boxes. Then after completing all the process the tray is kept in proper environment and water is being fed when required. The sufficient height of plants in the tray will grow then it is supplied to customers.

- Design
  - MECHANICAL SYSTEM
  - Vaccum Cylinder
  - Motor And Pulley Arrangement
  - ELECTRONICS SYSTEM-
  - Arduino controller, Toshiba driver
- Analysis
  - Vaccume Pressure
  - Weight Of Seeds And Nozzle
  - Interpolation Of Result
  - Change Required Parameter
- Fabrication
  - Prototype
  - Machining Process
  - Welding
  - Painting
- Testing
  - See what is working & what is lagging behind
  - Make required correction

8. Design considerations

The Belt-Pulley are mostly used to transmit motion and power from one shaft to another, when the center distance between their shafts is short

The Speed (velocity) ratio (S.R.) of a Belt-Pulley drive is given by

$$S.R.= \frac{n}{N} = \frac{D}{d}$$

Where, N = Speed of rotation of bigger pulley in rpm,
n = Speed of rotation of smaller pulley in rpm,
d = diameter on the smaller pulley in mm, and
D = diameter on the larger pulley in mm.

$$S.R.= \frac{n}{25} = \frac{100}{40}$$

n = 62.5 rpm

The average velocity of the belt is given by

$$V= \frac{\pi DN}{60}$$

Where D = diameter of bigger pulley in mm, and
N = Speed of rotation of bigger pulley in rpm,

$$V = \frac{\pi dn}{60}$$

Velocity ratio = D/d = 100/40 = 2.5

Length of Belt and Centre Distance

The center distance is given by

$$L= 2C + \frac{\pi(D+d)}{2} + \frac{(D-d)^2}{4C}$$

Putting
D = 100 d = 40
We get C = 270.92mm
Centre distance between the two pulley = 270.92mm
The average velocity of belt is given by
$V= \pi DN60$
V = (π x 0.1 x 25) / 60
V = 0.1 m/s

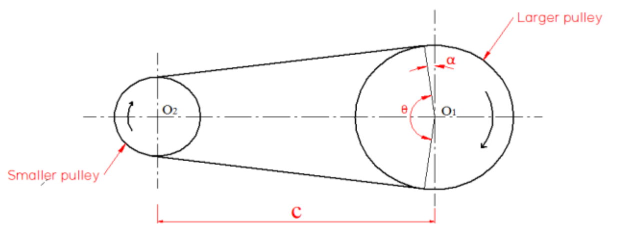

Fig.1 center distance between two pullys

7.1 Bernoulli's principle:

Diameter of seed = 3 mm(from measurement using vernier caliper)

Area of nozzle is calculated as follows

A = π/4 ×d^2

$= \pi/4 \times (0.003)^2$
$= 7.06 \times 10^{-6}\ m^2$

Mass of seed is measured by using electronic weighing machine which is given as follows

Mass of seed = 0.05 gm
Weight of see = 0.05 × 9.81
= 0.4905 N
Force required (F) = weight
= 0.4905 N

7.2.Pressure required] = 0.69 Mpa

As the diameter of seed changes pressure (Vacuum) required also changes.

Thus we have selected Vacuum Pump having operating pressure of 0.1-0.6 Mpa.

2. Motor calculations: w [total weight that has to slide (includes weight of slide and pneumatic cylinder)]= 1.5kg R= reaction to W

μ (coeff. of friction) = 0.5
F (frictional force) = μR
=0.5 X (1.5 X 9.81)
= 7.3575N
μ=0.8
F (frictional force)= μR
=0.8X(1.5X9.81)
=11.772 N
F(mean)=9.564 N

d (dia. Of pulley)= 40mm= 0.04m

Now, required torque to rotate pulley is given as,

T= F X r= 9.564X 0.02= 0.19128Nm = 1.9498kgcm Thus, considering optimum performance, motor selected as- 5 kgcm torque

7.3 Pneumatic Cylinder

Assumptions
Stroke= 25 mm
Mass of seeds = 0.005 kg
Mass of nozzle and mounting assembly = 0.5 kg
Total weight= (0.005 + 0.5) x 9.81 = 4.954
Pressure = 2 bar

Pressure = total weight/ Bore area
200000 = (4.954)/ Area

Area = 0.0000247 m^2
Therefore, Diameter = sqrt((0.0000247 x 4)/ Pi)
Diameter = 0.005590259 M = 5.6 mm

Cylinder selected:
Stroke 25 mm
Bore diameter 10 mm

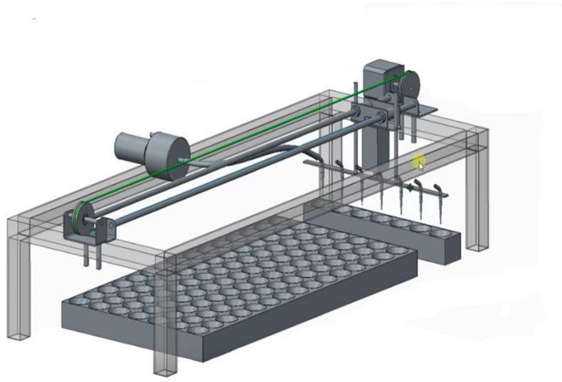

Fig.2 Assembly of vacuum seed sowing machine

9. Seedlings

Seeds normally transplanted because much better results are gained when seedlings are raised in a nursery. There are three methods of raising seedlings in the nurseries which can be used:

Fig.3 Sowing in the plug/ pro trays

Fig.4 Sowing in the poly house

10. Conclusion

- Thus we studied that using this design we can improve productivity in agriculture field.
- Invest automation in agriculture field
- Avoid wastage of seed
- Time and human effort also saved

References

1. Barut Z B; Ozmerzi A (Effect of different operating parameters on seed holding in the single seed metering unit of a pneumatic planter. Turk. J. Agric., (28): 2004),pp435-441
2. Chhinnan M S; Young J H; Rohrbach R P (Accuracy of seed spacing in peanut planting, Transactions of the ASAE,18(1):(1975), pp828-831.
3. Giannini G R; Chancellor W J; Garrett R E Precision planter

using vacuum for seed pickup. Transactions of the ASAE, 10 (5): (1967), pp607-750

4. El-Sahrigi A F Socico-economic evaluation of farm machinery introduced in project villages from 1980 to 1984. Working paper No (19). Ministry of Agriculture, Cvacuumo, Egyp(1985),pp335-342
5. Shaaban Y A Development of an appropriate pneumatic planter for small holding in Egypt. Unpublished Ph. D. Thesis. College of Agric, Benha Uni.(2009),pp245-249
6. R S. Khurmi & j. K. Gupta, a textbook of machine design, s chand publishing house pvt. Ltd.
7. V. B. Bhandari machine design data book, mc graw hill publication
8. Fluid Mechanics,- Dr. R.K. Bansal- Laxmi Publication (P) Ltd. New Delhi
9. http://www.ijesrt.com/issues%20pdf%20file/Archive-2018/January-2018/3
10. https://www.quora.com/What-is-the-difference-between-a-polyhouse-and-a-green-house