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Design and Development of Manually Operated Multi-Seed Sowing Machine using Scotch Yoke Mechanism

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Abstract — Agriculture plays significant role in overall economy of India. Mechanization is necessary for the growth of Indian economy. More than 75% people depend on the agriculture. Manual seed planting is one of the operation which is very time consuming and more labours are required for this operation, but availability of labour are less for field work. This machine reduces requirement of human for operation of seed sowing. The ultimate objective of this project is to improve sowing equipment by achieving precise seed distribution within the row.

Keywords- Agriculture, Multi seed, Scotch Yoke Mechanism, Sowing seed, Decrease labour cost

I. INTRODUCTION

As India is agricultural country so growth in the agricultural sector is very important. But traditional method have a drawbacks like low seed placement, variation in spacing and serious back ache for farmers. Also economically, farmers are very poor due to which they are unable to purchase tractors and other costly equipments hence they use traditional method of farming [1].Nowadays, seed sowing is done with the seed sowing machines in most of the agricultural area. As day by day the labor availability becomes the huge concern for the farmers and labor cost is more, this machine reduces the efforts and total cost of sowing the seeds. Increase in population demand also increases to meet the requirement new techniques of cropping have to be implement in farming sector [2].

Comparing the different traditional seed sowing methods with the proposed machine and considering its limitations, it is concluded that, Seed rate can be controlled. Row spacing and seed spacing process can be achieved[3].The basic objective of sowing operation is to put the seed in rows at desired depth and spacing, cover the seeds with soil[4].The size of the systems should be reduced, smaller systems has cost less than larger ones[5].To reduce the overall size of the existing metering device, allowing a more compact design with intention of mounting the metering device closer to ground, reducing the overall space travelled by a seed from the device to the ground[6].By using seed sowing equipment we can save more time required for sowing process and also it reduces lot of labourer cost. It is very helpful for small scale farmers[7].The need of a poor and small land farmer has fulfilled by the manual operated seed planter and they can easily and effectively plants their seed in the field by seed planter[8].Planter machine in which they are using cam and follower mechanism for sowing seed. This manual seed planter machine has considerable potential to greatly increase productivity. By using this machine, achievement of flexibility of distance and depth variation for different seed plantation is possible[9].The functionality of a light-weight, single-disc seed drill with a novel coulter depth control system was tested in a real field application and it was found to be capable of maintaining a more accurate and stable coulter depth across the field[10].Due to different crops have different requirement for the seed planting in the field, So the usefulness of the single crop planter is limited. Hence the requirement of the manually operated multi-crop planter is very high[8].To increase the seasonal loading of sowing units taking the duration of crop harvesting periods into account[11].A conventional walking tractor was modified by replacing its pneumatic wheels with a rubber track system to improve its tractive performance. Rubber tracks have higher motion resistance than comparable walking tractors fitted with pneumatic wheels [12].

II. RESEARCH METHODOLOGY

Principle: This seed sowing machine employs the use of scotch yoke mechanism by which seed is placed in the farm. By use of scotch yoke mechanism the seeds can be placed at constant space. Machine consists of hopper, matching plate, frame, bearing, chain-sprocket, shaft, scotch yoke mechanism and wheels.

Hopper is provided at the top of the machine in which seeds are present. The matching plate is attached below the hopper having same hole dimension as of hopper’s bottom. When the holes of both are matched the seed passes through the pipe into the soil.

As mentioned above about the use of scotch yoke mechanism, it is used to convert rotary motion into reciprocating motion.

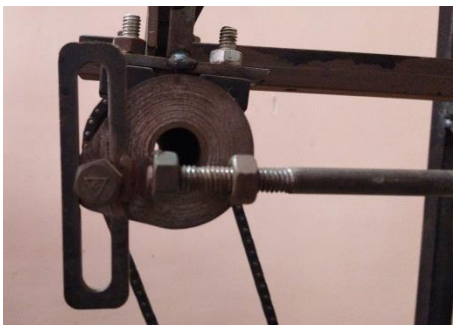

Fig.1: scotch yoke mechanism

When the machine starts, with the help of chain and sprocket mechanism, the shaft rotates. A crank which is used as scotch is attached to the shaft and hence it will also rotate. The matching plate is connected with the yoke which reciprocates with the help of scotch.

COMPARISON TABLE

Parameter	Manual	Tractor	Fluted seed sowing machine	Scotch yoke seed sowing machine
Man power	More	Moderate	Less	Less
Sowing technique	Manually	Automatically	Automatically	Automatically
Seed metering mechanism	-	Fluted feed type	Fluted feed type	Scotch yoke
Distance between seeds	Not fixed	Fixed	Fixed	Adjustable
Time required	More	Less	Less	Less
Wastage of seeds	Moderate	More	Less	Less
Cost	Less	Very High	Less	Less
Pollution	No	Yes	No	No

Table 1: Comparison of Parameter with Scotch Yoke seed sowing machine[13]

ERGONOMICS CONSIDERATION

Pushing or pulling force is applied at that time when elbow is 90^0, which is very efficient, labour can work long time.
Height of handle is should be between 800mm to 1100mm for provide better handle design, we are taking 900 mm as handle height.
For controlling the depth of the seed plantation, a check nut is provided.

OBJECTIVES

- To decrease labour cost.
- To sowing seeds at constant distance.
- To work efficiently and accurately.
- To reduce cost of current seed sowing machine.

III. DESIGN AND CALCULATION

In this study the main aim is to sowing seed after regular distance.
For the study, taking 100 mm diameter of polymer wheel which have thickness is 20 mm. So, one revolution of wheel is travel 314.15mm distance.

- The transmission ration of this machine is ½.

  1 revolution of wheel = ½ revolution of scotch
  2 revolution of wheel =1 revolution of scotch

Matching plate is mounted on reciprocating yoke. This matching plate is matched the hopper holes in two times for one revolution of scotch.

FORCE CALCULATION

- Total weight of machine(m) = 21.72 kg
- Pushing force (F_p)

  $F_p = mg = 21.72*9.81 = 213.10N$
- Transferring force (F_T)

  Coefficient of adhesion between soil and polymer wheel (μ) = 0.055

  $F_t = \mu R_N = 0.055*213.10 = 11.72N$

  Here, 3 wheels are use so $3*11.72 = 35.16N$
- Total force required in machine,

  $F_{total} = F_p + F_t$

  $= 35.16 + 213.10 = 248.26N$
- Normal man can push or carry 30 kg of mass.
- So man can carry a force(F)

  $F = mg = 30*9.81 = 294.30N$

  Here, F_{total} < F. So labour can easily work.

MODEL DESIGN

SolidWorks Design

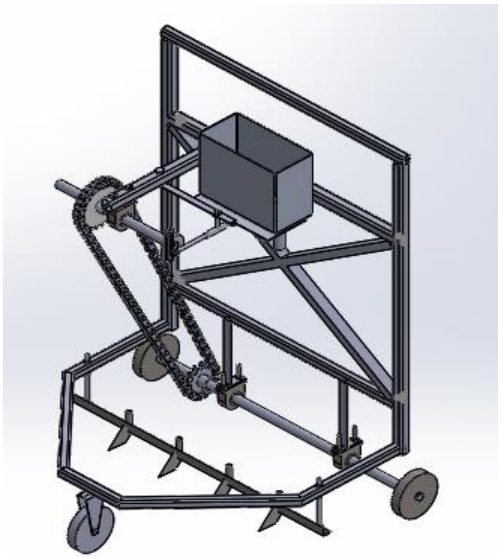

Fig.2: Isometric model of Machine

Proposed machine

Fig.3: Proposed Machine

IV. RESULT TABLE

Sr No.	Transmission Ratio	Wheel Diameter(mm)	Distance Between Two Consecutive Seeds(mm)
1	½	100	314
2	1	100	157
3	2	100	78
4	½	200	628
5	1	200	314
6	2	200	157

Table 2: Result Table

From the table above, for the given transmission ratio and wheel diameter, distance between consecutive seeds can be obtained and the values are shown in the table.

V. ADVANTAGES OF MACHINE

The advantages of proposed machine are as follow:

- Improvement in planting efficiency.
- It increased seed planting.
- Seed placement accuracies.
- It was made of durable and cheap material affordable for the small scale farmers.
- Lesser maintenance cost.
- The seed can be placed at any required depth.
- Requirement of labors are decreased.
- It consume less time for sowing.
- Seed can be placed uniformly in a row with required distance between plants.

VI. CONCLUSION

Comparing the different methods of seed sowing with proposed machine, it is concluded that,

1) The size of machine is reduced.
2) The cost of machine is low.
3) Seed spacing is maintained and seed rate is controlled.
4) As per requirement different size of punched plates should be used and it should be placed into hopper, so that the machine can be used for all kind of seeds.
5) Scotch yoke mechanism is very efficient in seed sowing operation.

VII. FUTURE SCOPE

Currently in the tractor for sowing the seed, Fluted feed type mechanism is used but in this mechanism distance between seeds is not maintained and the wastage of seed is more. So, for maintaining the distance between seeds and to reduce the seed wastage, Scotch Yoke mechanism can be used. The distance between consecutive seeds is different for various type of seeds, for that transmission ratio needs to be changed.

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