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Research Paper

DESIGN AND IMPLEMENTATION OF MULTI SEED SOWING MACHINE

Roshan V Marode[1]*, Gajanan P Tayade[1] and Swapnil K Agrawal[1]

*Corresponding Author: Roshan V Marode, ✉ roshan.marode@gmail.com

In the farming process, often used conventional seeding operation takes more time and more labor. The seed feed rate is more but the time required for the total operation is more and the total cost is increased due to labor, hiring of equipment. The conventional seed sowing machine is less efficient, time consuming. 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. Agriculture in India has a significant history. Today, India ranks second worldwide in farm output. Still, agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India. This paper deals with the various sowing methods used in India for seed sowing and fertilizer placement. The comparison between the traditional sowing method and the new proposed machine which can perform a number of simultaneous operations and has number of advantages. As day by day the labor availability becomes the great concern for the farmers and labor cost is more, this machine reduces the efforts and total cost of sowing the seeds and fertilizer placement.

Keywords: Seed sowing, Shovel, Sowing, Multi seeds, Fertilizer

INTRODUCTION

The major occupation of the Indian rural people is agriculture and both men and women are equally involved in the process. 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% of world population from 2.3% of world geographical area and 4.2% of world's water resources. The present cropping intensity of 137% has registered an increase of only 26% 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.

[1] MGI-COET, Shegaon, India.

Figure 1: Seed Sowing in India

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 paper is about the different types of methods of seed sowing and fertilizer placement in the soil and developing a multifunctional seed sowing machine which can perform simultaneous operations.

TYPES OF SOWING

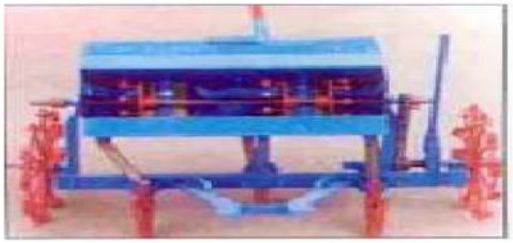
The following are the three different types of seed sowing

- Broadcasting: A field is initially prepared with a plough to a series of linear cuts known as furrows. The field is then seeded by throwing the seeds over the field, a method known as manual broadcasting. The result was a field planted roughly in rows, but having a large number of plants. When the seeds are scattered randomly with the help of hand on the soil, the method is called broadcasting.

Figure 2: Broadcast Sowing

- Dribbling: Drill sowing and dribbling (making small holes in the ground for seeds) are better method of sowing the seeds. Once the seeds are put in the holes, they are then covered with the soil. This saves time and labor and prevents the damage of seeds by birds.
- Another method of sowing the seeds is with the help of a simple device consisting of bamboo tube with a funnel on it attached to a plough. As the plough moves over the field the tube attached to it leaves the seeds kept in the funnel at proper spacing and depth. The plough keeps making furrows in the soil in which the seeds are dropped by the seed drill.

Table 1: Available Machines

Name of the Company/Institution	Diagram	Specifications	Functions
Central Institute of Agricultural Engineering, Bhopal		Driven by:-OX	1.Seed sowing
		Length:-1000	2.Fertilizer placement
		Width:-1000	3. Furrow Opening
		Height:-780	4.Seed Metering
		Weight:-50Kg	
Masters Engineering Works, Nagpur		Driven by:-OX	1. Seed sowing
		Length:-1200	2.Fertilizer placement
		Width:-1100	3. Furrow Opening
		Height:-900	4.Seed Metering
		Weight:-45Kg	
Dharti Agro Implements, Rajkot		Row to row spacing:- 9 inch	1.Seed sowing
		Length of frame:-65 inch	2.Fertilizer placement
		Weight:-60 Kg	3. Furrow Opening
			4.Seed Metering
Central Institute of Agricultural Engineering, Bhopal		Driven by:-OX	1.Seed sowing
		Length:-1080	2.Fertilizer placement
		Width:-1180	3. Furrow Opening
		Height:-925	4.Seed Metering
		Weight:-65Kg	

The above sowing methods have the some disadvantages which are as follows:

- No control over the depth of seed placement.
- No uniformity in the distribution of seed placement.
- Loss of seeds.
- No proper germination of seeds.
- During khariff sowing, Placement of seeds at uneven depth may result in poor emergence because subsequent rains bring additional soil cover over the seed and affect plant emergence.
- More labor requirement.
- Time required for sowing is more.

Functions of Seed-Drills and Planters

The functions of a well-designed seed drill or planter are as follows:

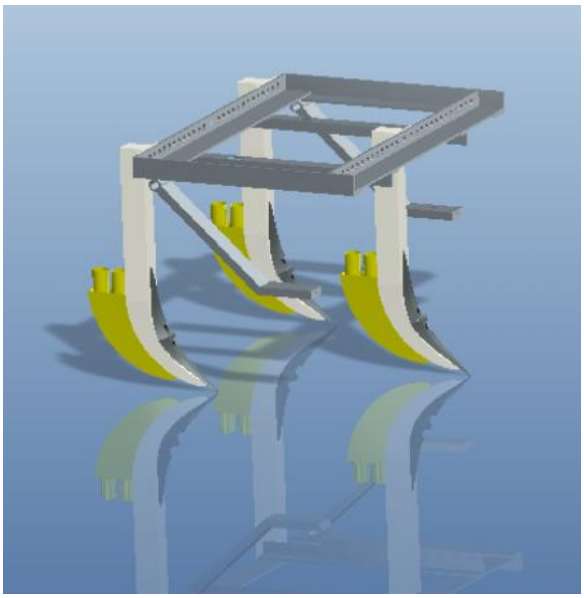
- Meter seeds of different sizes and shapes;
- Place the seed in the acceptable pattern of distribution in the field;
- Place the seed accurately and uniformly at the desired depth in the soil; and
- Cover the seed and compact soil around it to enhance the germination emergence.

FURROW ASSEMBLY

Seeds are broadcasted on the soil which results in the loss and damage of the seeds. As the cost of seeds is more and cannot be affordable for the farmers so there is the need for the proper placement of seeds in the soil. The shovel type of furrow opener is used for the furrow opening. The furrow assembly consists of:

- Shank
- Tube holder
- Tyne
- Tubes for seed and fertilizer

Figure 3: Actual Cutting Section of Machine



Types of Furrow Openers

The design of furrow openers of seed drills varies to suit the soil conditions of particular region. Most of the seed cum fertilizer drills are provided with pointed tool to form a narrow slit in the soil for seed deposition.

- Shovel type furrow opener
- Pointed bar type furrow opener
- Shoe type furrow opener

Specification of the Base Frame

Dimension: 760 x 520 mm

Material: MS Angle 50 x 50 x 6 mm

Weigh t/m: 4.5 kg/m

Total weight of base frame: 9.4 kg

Specification of Seed Box

Material: Mild steel 2 mm thick

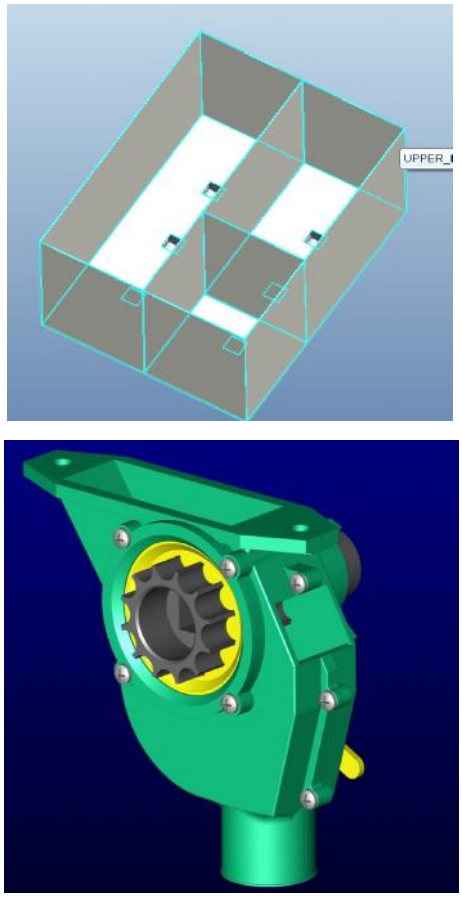
Dimension: 540 x 420 x 285 mm

Weight: 7.3 kg

Seed Box and Seed Cup

The seed box is made of HR sheet 2 mm thick. The box is designed on the basis of area of land. The box was located above the base frame supporting the furrow openers and transport cum depth control beam. A partition is provided along the length of the box to separate seed and fertilizer. The seed partition is again given one more partition so that mixed cropping can be done.

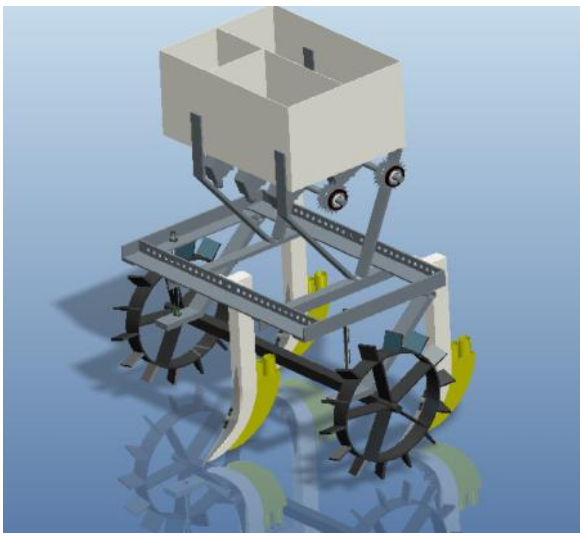
Figure 4: Seed Mixing Section and Seed Feeder



Complete Assembly

The complete seed cum fertilizer assembly is made using PRO-Engineer software with additional mixed cropping arrangement, depth control arrangement, row spacing arrangement. Two Peg wheels are given so that the wheels does not slip on the land as the seed metering device works on the rotation of the ground wheels and maintain the plant spacing and control the plant density.

Figure 5: Total Assembly of Machine



WORKING

- Put the seeds and fertilizer in the box as per its capacity.
- When a pair of bull pulls the machine, the motion Is transmitted to the fluted roller seed cup from sprocket at ground wheel through the chain.
- The fluted roller seed cup is having the arrangement of seed cut-off and controlling flap to control the amount of seeds and fertilizers.
- The Shovel type furrow openers open the furrows in the soil.

- The seeds and fertilizers will get placed in the furrows through the guide pipes.
- In this way the seeds and fertilizers are placed in the furrows at proper distance and this machine maintains the proper row spacing.

DESIGN OF SHANK FOR SHOVEL OPENER

Let,

$b \times h$ = Shank cross-section, mm^2

l = length of breast of shovel

R = Radius of curvature of bent portion of shovel (R <= 120 mm)

Figure 6: Design of Shank

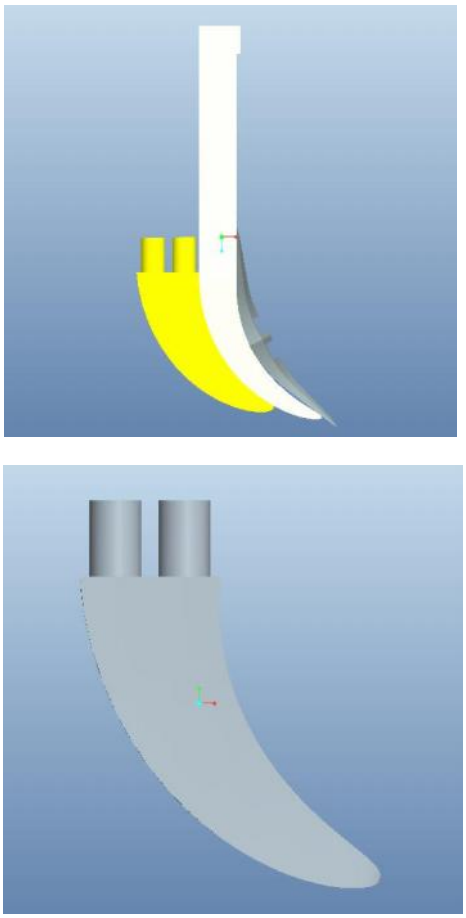
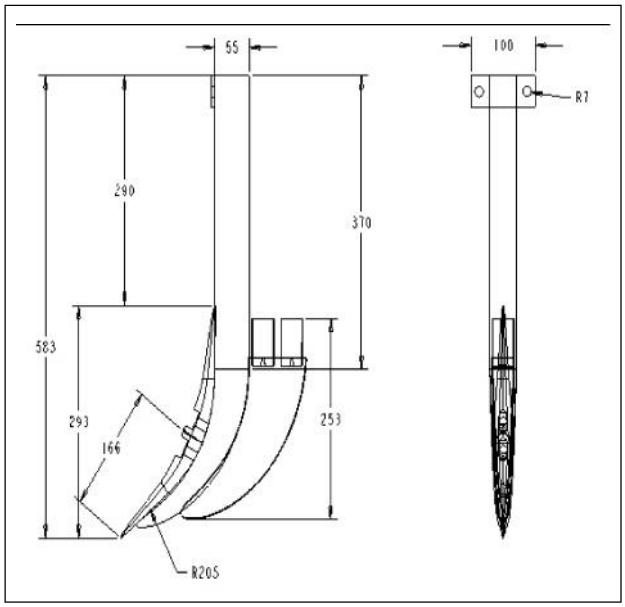


Figure 6 (Cont.)



$h1$ = Height if shank from its tip to the bent portion, mm

d = Maximum operating depth, mm

$H1$ = Shank height from the frame to the top end of the breast, mm

H = Height of shank from the tip of shovel to the frame, mm

~ = Rake angle, deg

ΔH = Length of the upper part of tine serving for fastening, cm

Ko = Soil Resistance, kg/cm^2

From the geometry, the radius of curvature 'R' of the bent portion of the shovel is given by Table 2.

Table 2: Soil Type and its Resistance Offer Values

Soil Type	Soil Resistance, kg/cm^2
Light	0.12
Medium	0.15
Heavy	0.20
Very Heavy	0.25

Force exert on the opener is

D – *Ko* x *w* x *d*

D – Draft force, Kgf

Ko – Specific Soil Resistance – 0.25 kg/ cm^2

Take *Ko* – 3 times higher as a factor of safety

w – Width of opener, cm

d – Depth of opener, cm

Take *w* – 2.5 cm—available in the market

d – 10 cm

D = *Ko* x *w* x *d*

= 3 x 0.25 x 2.5 x 10

= 18.75 Kgf

Take factor of safety – 3

D = 3 x 18.75 = 56.25 Kgf (Total draft)

Maximum bending moment for a cantilever length of 37 cm length

Bending moment (M) = draft (kgf) x Length of shank (cm)

M = 56.25 x 37 = 2081 kgf-cm

We Know that

$$\pm = \frac{MC}{I}$$

± = Bending stress, kgf/cm^2

M = Bending Moment, kgf-cm

C = Distance from the natural axis to the point at which stress is determined, cm

I = Moment of inertia of the rectangular section, mm^4

The section modulus axis was computed by using the formula

$$z = \frac{I}{C}$$

$$z = \frac{M}{¢}$$

For M.S rectangular section

± = 1000 kgf/cm^2

$$z = \frac{2081}{1000}$$

z = 2.081 cm^3

Assume ratio of thickness to width of tine, *b*:*h* = 1:2

b = 14.6 mm

Take thickness *b* = 16 mm—availability of standard size

Width = 2 x 16 = 32 mm

This section would yield a maximum fluctuation

$$Y \max = \frac{DL4}{GEI}$$

For M.S. material

E= 2 x 10^4

$$I = \frac{bh2}{12}$$

$$I = \frac{16 \times 32 \times 32}{12}$$

= 1365.3 mm^4

$$Y = \frac{56.25 \times 370^4}{3 \times 1365.33 \times 2 \times 10^4}$$

= 1.06 mm

Hence, there is a less deflection in the shank for a length of 370 mm as compared to the other lengths

CONCLUSION

Hence after comparing the different method of seed sowing and limitations of the existing machine, it is concluded that the multi-purpose seed sowing machine can

- Maintain row spacing and controls seed and fertilizer rate.
- Control the seed and fertilizer depth and proper utilization of seeds and fertilizers can be done with less loss.
- Perform the various simultaneous operations and hence saves labor requirement, labor cost, labor time, total cost of saving and can be affordable for the farmers.

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