Design and Manufacture of Machine for Seed Sowing and Planting Operation

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Abstract— Need of rice trans-planter machine is growing nowadays because it unique features seeding in well sequence and in well manner. Seeding by rice trans-planter saves too much efforts of human being. Class of people who uses this kind of machines is farmers and they are having poor economic background. Use of rice Trans planter machines is new trend but current machines having high cost of purchase. So the main focus of this project is to minimize the cost of that machine.

Key words: Rice trans-planter, seed sowing, Minimization of cost, Reduction in labor cost, Automation in agriculture

I. INTRODUCTION

Agriculture has been the backbone of the Indian economy and it will continue to remain so for a long time. The main purpose of mechanization in agriculture is to improve the overall productivity and production. As our population continues to increase, it is necessary that we must produce more food, but this can only be achieved through some level of mechanization. It is therefore necessary to develop a low cost planter that will reduce tedium and drudgery and enable small holder farmer to produce more foods and also environmental friendly.

II. DESCRIPTION OF MODEL

Fig. 1: Actual Model of Sowing and Planting Machine

A. Frame

Frame is a basic component of rice planting device. It is made up of M.S angle bar on which other components like supporting links, ground wheel, hopper, tray, disk, shaft etc are mounted. Frame provides base structure for mounting the other components.

B. Plant Carrying Tray

Plant carrying tray is made up of Mild Steel Sheet which contains seedling. On this frame, seedlings are mounted by keeping their roots on other side by using flat bar.

C. Shaft

Shaft is important component in this mechanism as it used to transfer the torque from handle to ground wheel and thus to the whole assembly. It is made of M.S bar on which ground wheel and chain sprocket is mounted. Both end of shaft are supported on the bearing.

D. Ground Wheel

Ground wheel is a component which transfer motion to the ground from chain. It provides forward motion to the mechanism. It is made up of mild steel.

E. Chain & Sprocket

The chain is made up of no. of rigid links which are hinges together by pin joints in order to provide the necessary flexibility for wrapping round the driving & driven wheels. These wheels have projecting teeth of special profile a fact into the corresponding recess. The toothed wheel is known as sprocket wheel.

F. Plough

It is made of rectangular C. I. material which is used for picking seedlings from the support tray and put them into the muddy ground. It is last link of machine used for plant the seedlings.

G. Ball Bearing

The basic function of bearing is to support the shaft into the bearing mounter which is welded to the frame. It provides less friction and ensures free rotation of shaft. As load acting on bearing consist of two components Radial & Thrust. So we have used single row deep groove bearing. This bearing has high load carrying capacity & suitable for high running speed.

H. Crank Plate

It is used to provide the oscillating motion to the plough. The power coming from the handle is first given to ground wheel and then to the crank plate through chain and sprocket mechanism. This power is in the form of rotary motion which is converted into oscillatory motion by crank plate.

I. Hopper

The hopper contains seed and planting. The metering unit is attached to the hopper. There may be individual hopper for seed or a common hopper may have compartments for seed. In same seed hoppers are provided for each row.

J. Furrow Opener

It is the soil working component of a seed drill that penetrates the soil and a furrow is opened in which the seeds are placed. They help in proper placement of seed in the soil. The role of the furrow openers is very important in a

seed planting drill so far as placement of seed in the soil is concerned. The seed should be placed in moist soil and covered for proper germinations.\

K. Metering Unit

It is the functional unit in a machine which determines and drops the desired amount of seed in the field.

III. WORKING

The planting machine is used to provide combination of operations, one is planting and another is seed sowing. Hence we can use same machine in Rabbi and Kharip season. The working of machine is simple and requires less effort. When the handle is rotated by using man power in anticlockwise direction, the motion is transmitted to the chain drive through sprocket. Then another combination of chain and sprocket forwards this motion to ground wheel. The ground wheel contents 12 teeth which provides forward motion to machine. Also same motion is transferred to the crank plate. Crank plate is connected to the link which converts rotary motion into oscillatory motion of plough. The plough takes the seedlings from the support tray and put them into muddy ground. The seedlings filled in the tray come down due to vibrations and tilted shape of tray. In this way planting operation takes place.

While for seed sowing operation there is an arrangement of hopper and seed metering device. There are two hoppers; one contains the seeds and another to take the seeds from seed metering device. The rotary motion is transmitted by using chain and sprocket drive to the shaft which contains Seed metering device. Seed metering device is mounted in between two hoppers which contains small holes drilled according to the diameter of the seed.

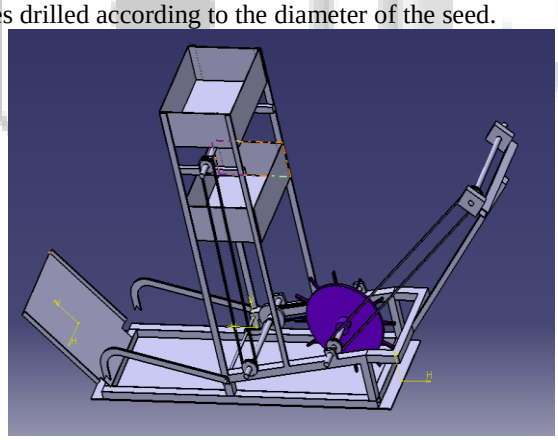

Fig. 2: CAD Model of Seed Sowing and Planting Machine

The seed from bottom hopper comes down through a pipe into furrow opener. Furrow opener is the last element in sowing operation which puts the seeds into soil. The spacing in between seeds is kept constant by using ground wheel. In this way seed sowing and planting operation is achieved with the same machine.

IV. MATERIAL SELECTION

A. Mild Steel

Carbon = 0.15% to 0.35%. Tensile strength is between 1200 to 1420 MPA and Yield strength is 750 to 1170 MPA. Frame and structure of the model is made up of Mild Steel.

(2)**C30** material is generally used for cold formed levers, hardened and tempered tie rods, Cables, Sprockets, Hubs and Bushes –Steel Tubes. Having Properties as follow:

Carbon = 0.25% to 0.35%, Manganese = 0.60% to 0.90%, Tensile strength = 620 MPA, Yield strength = 400 MPA.

V. DESIGN CALCULATION

A. Ground Wheel

Diameter of ground wheel=300mm
Angle of teeth= 30 degree

B. Shaft

Total Force acting on frame = 981N.
$R_A = R_B = 981/2$
= 490.5 N
R_N= Normal Reaction.
$F_1 = \mu \times R_N$
= 0.33 x 490.5
= 161.865 N
For 2 rear wheels Resultant force,
$F_R = 2 \times F_1$
= 2 x 161.865
= 323.73 N
Torque transmitted (T),
$T = F_R \times r$
= 323 x (300/2000)
T = 48.45 N-m
So, for C45
S_{yt}= Yield strength of shaft material= 330 N/mm^2,
S_{ut}= Tensile strength of shaft material= 600 N/mm^2,
According to A.S.M.E. code,
$(\tau_{max}) = 0.18\ S_{ut} = 0.18 \times 600 = 108$ N/mm^2
OR
$= 0.3\ S_{yt} = 0.3 \times 330 = 99$ N/mm^2
$\tau_{max} = 99$ N/mm^2 (Selecting minimum value),
so,
$\tau_{max} = 99 \times 0.75$
= 74.25 N/mm^2
Now,
$(\tau_{max} / R) = (T / J)$
Where,
τ_{max} = maximum torsional shear stress, N/mm^2
R= Radius of shaft, mm
T = Torque transmitted, N/mm^2
J = Polar moment of Inertia, mm^4
So, substituting values we get,
$(74.25 / [d/2]) = ([48.45 \times 10^3] / [\pi d^4/32])$
$d^3 = 3330.1430$
d= 14.933mm
So, for safety we are selecting the shaft diameter d=20mm

C. Metering Device

For the design of the seed metering device the most important thing is that how many cells would be developed for desired crop; so that the requirement of the plant to plant spacing is achieved.
Number of cell on the seed metering device is,

$$Ns = \frac{\pi \times \text{diameter of drive wheel } (d_w)}{\text{drive ratio}(N) \times \text{plant spacing } (X)}$$

$$Ns = \frac{\pi \times 300}{.\ 100 \times 157}$$

So Ns = 6
Now the second thing is that what would be the diameter of the seed metering device. So the diameter of the seed metering device is:
D cm = $V_r / \pi N_r$
Where
N_r = rpm of seed metering device in m/min
V_r = Peripheral velocity of seed metering device

VI. EXPERIMENTATION

There are several parameters that act as input and output parameters.

A. Input Parameters

A – Level of Mud 1: Soft Mud 2: Medium Mud 3: Hard Mud B- Time Span (1:3M 2: 5M 3:10 M) M- Minutes
C- Age Group (1: below 25 yr., 2: 25-30, 3: Above 30yr)

B. Output Parameters

OP1- Distance travelled in meters (cm)
OP2- Number of seeds planted (n)
OP3- Depth planting (cm)

Exp. No	A	B	C	OP 1 (cm)	OP 2 (n)	OP 3 (cm)
1	1	1	1	200	80-100	4.2
2	1	2	1	480	192-250	4.2
3	1	1	2	200	80-100	4.2
4	1	2	3	480	192-250	4.2
5	1	2	2	980	392-450	4.2
6	1	2	3	980	392-450	4.2
7	1	1	3	200	80-100	4.2
8	2	1	1	200	80-100	4.1
9	2	2	1	480	192-250	4.1
10	2	1	2	200	80-100	4.1

Table 1: Experimentation

VII. CONCLUSION

The economy is the most highlighting feature of this machine as it does not require any electric power & is independent of tractor or bullocks which are unaffordable to poor farmers. Farmers face the problem of non-availability of bullocks as well as tractors during the peak period of sowing. Hence, they are tempted to hire them at an increased cost. By making use of manually operated seed cum planting drill, the yield loss can be substantially decreased. The most important advantage of manually operated seed cum planting drill is that - it can be easily driven by a single person. There is hardly any problem of manpower in rural areas where the average size of the family is large. Thus, if 2 to 3 people are employed for the sowing operations, the area coverage can be increased.

The low cost of the machine as well as its ability to carry out planting, is certainly a boon to the farmers thereby saving much of their time. It results in almost 60 % saving in operational cost and 15% saving in plant requirements. If the machine is commercially exploited, it can be proved to be beneficial to poor farmers.

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