AUTOMATIC PLANTING FARM EQUIPMENT

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ABSTRACT

The paper pot transplanting system is an innovative, labour saving technology. It relies on using paper poys that are connected in a chain so that they feed themselves through the transplanter. The transplanter itself is hand-pulled .with it, I can put 264 plants in the ground (one flat) in less than a minute .all while walking upright (no kneeling, crawling or stooping).the transplnter opens a narrow furrow, the paper chain goes down into the furrow, and then the plants are covered by a set of metal flanges.at the start of a row , the lead cell of a flat of a paper chain pots is pulled down into the furrow ,staked to hold it in place, and then you pull the transplanter forward .The transplanter all follow each other into the ground. Packing wheels firm the soil around the transplants as you go.

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1. INTRODUCTION

The traditional method of transplanting is labor intensive, hazardous with low per acre plantation of plants and time & cost consuming. Due to these factors the completion of paper pot cultivation suffers within the optimum transplanting period consequently farmers face the problem of low per acre production with high production cost. These obstacles can be overcome by mechanical transplanting technique. Onion transplanter isa specialized transplanter fitted to transplant onion seedlings in fields. One transplanter (2-row at a time) can transplant about 4-5 acres in a day (highly efficient as compare to traditional method). The recommended per acre plant population is 80000 plants and with the help of Transplanter farmer can transplant 80000 to 120000 plants per acre.In this project , we built a paper pot transplanter for transplanting the seedlings in the field. The following are the main objectives that were considered during designing and manufacturing of the paper pot transplanter.[1]

- Prevent back-problems in field workers
- Extremely low-cost
- Simple and rugged
- Easily transportable
- Can be repaired using local material
- Usable in a variety of terrains[1]

1.1 PROJECT-CATEGORY

This project belongs to the Innovation in agricultural category, as the labour of manual plantation is expensive in INDIA. So, this manual plantation needed to be replaced by a efficient machinery, which has been done by this project. Though the wash-root type planter were invented quite earlier but didn’t survived for a longer period as it was replaced by the Automatic Transplanter. But this automatic machine also failed to survive in market due to:

- Too Expensive
- Difficult to plant at edges and corners of the field
- Gets stuck in the field
- Difficult to repair

The paper pot transplanting system is an innovative, labor-saving technology developed in Japan. It relies on using paper pots that are connected in a chain so that they feed themselves through the transplanter. The transplanter itself is hand-pulled. With it, I can put 264 plants in the ground (one flat) in less than a minute...all while walking upright (no kneeling, crawling, or stooping).

The transplanter opens a narrow furrow, the paper chain goes down into the furrow, and then the plants are covered by a set of metal flanges. At the start of a row, thelead cell of a flat of paper chain pots is pulled down into the furrow, staked to hold it in place, and then you pull the transplanter forward. The transplants all follow each other into the ground. Packing wheels firm the soil around the transplants as you go.

2. PROBLEM DEFINATION:

The traditional method of transplanting is labor intensive, hazardous with low per acre plantation of plants and time & cost consuming. Due to these factors the completion of paper pot cultivation suffers within the optimum transplanting period consequently farmers face the problem of low per acre production with high production cost. These obstacles can be overcome by mechanical transplanting technique.A paper pot transplanter is a specialized machine used to transplant paper pot seedlings in the field

3. METHODLOGY

In a mechanical transplanter the finger follow a desired path of motion. A planar four-bar linkage with all revolute pairs is chosen, as this is very simple, a mechanism made of that may be easy to maintain and may cost less to manufacture. The input motion is applied to the crank so that the motion is continuous and rotary. The output motion follow a suitable path in order to meet the requirements of a transplanter specified below. The mechanism should have one degree of freedom and a coupler point that is capable of making a loop may be incorporated. The planting finger will be attached at the coupler point.

Materials and Method

Materials

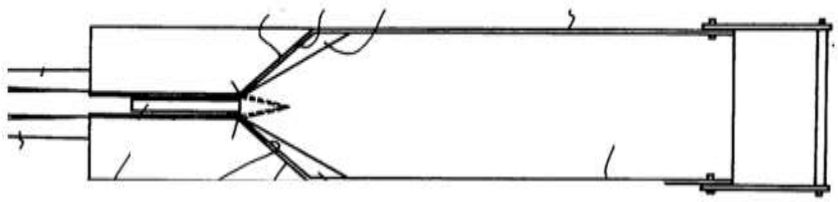
Following materials were used to manufacture the paper pot transplanting mechanism:

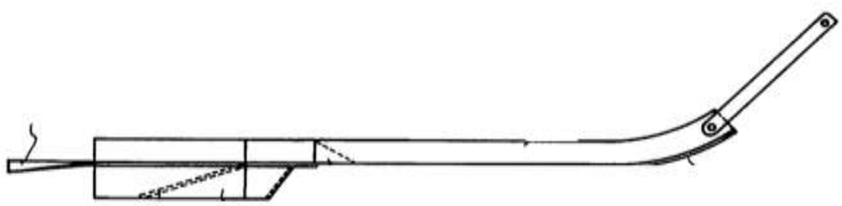
- Iron strips
- Iron rods
- Wheel
- MS pipe
- Nuts and Bolts, Rivets
- MS Sheet

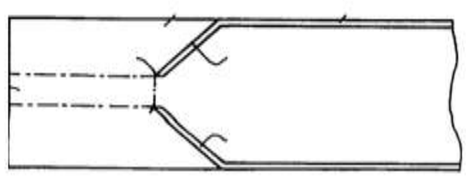
Equipments

- Toolkit and Measuring Equipments
- Welding plant (Arc and Gas welding)
- Lathe machine
- Iron cutters, Benders, Drill, Grinders
- Saws (Hacksaw)

Conceptual Design







CONVENTIONAL METHOD

A paper pot transplanter is a specialized machine used to transplant paper pot seedlings in the field. A common paper pot transplanter comprises:A seedling tray like a shed roof on which mat type paper pot nursery is set.A seedling tray shifter that shifts the seedling tray like the carriage of typewriters.Plural pickup forks that pick seedlings up from mat type nursery on the seedling tray an put the seedlings into the earth, as if the seedling were taken between human fingers.Machine transplanting using paper pot transplanters requires considerably less time andlabor than manual transplanting. It increases the approximate area that a person canplant from 700 to 10,000 m2/day (en.wikipedia.org/). Transplanting seedlings can be categorized into three groups as follows :

1. By hand (manual)
2. Manually operated machines (work by man power)
3. Mechanically operated machines (work by engine power)[2]

TRANSPLANTING BY HAND

This method is good for small fields and to fill patches. Manual transplanting does not require costly machines and is most suited for labor-surplus areas and for small paper pot fields. Manual transplanting can be done in fields with less than optimal leveling and with varying water levels. Seedlings are raised in a wet, dry or modified mat nursery. Proper nursery management will produce healthy, vigorous seedlings.

PhotographNo. 2.1Traditional Method

Limitations

- Transplanting is tedious and time-consuming (up to 30 man days /ha)
- Planting laborers can suffer from back problems(health risk)
- Difficult to get enough labor at peak periods to plant on time
- Difficult to maintain optimum spacing and uniform plant density, especially
- with random transplanting and contract labor
- Low plant density with contract transplanting on area basis lowers yields.
- Risk in rain fed areas, that seedlings (especially of modern varieties) may gettoo old before rain falls and the field is ready to be planted

4. DESIGNE PROCEDURE

Design of planting mechanisms used in power operated transplanters Most of the planting devices of power operated transplanters can be classified as crank and rocker mechanisms of four-bar linkage. A planting finger, which is a part of the coupler link of the mechanism, separates the seedlings from the seedling tray and places them in the soil. The curve traced by the planting finger may have an influence on the stability of the planted seedlings. The kinematic analysis of the planting mechanisms is considered essential for an understanding of its operation and its further improvements.

4.1 Design Of Mechanism

Most mechanism tasks require a single input to be transferred to a single output. Therefore, single-degree-of-freedom mechanisms are the forms used most frequently. Grumbler's criterion is concerned with the number of links in the mechanism and with the number and kinds of kinematic pairs. It can be used for determining the degree of freedom of mechanism analysis techniques can be used to replace costly and time consuming building and testing of physical prototypes in a trial and error design process. Analysis techniques generally form a basic part of most synthesis methods. The four-bar linkage should be among the first solutions to motion control problems to be investigated. The fewest parts that can do the job will usually give the least expensive and most reliable solution The Grash of condition can be used as a very simple relationship, which predicts the behavior of a four-bar linkage, based on the link lengths. A four-bar mechanism is physically impossible if one of the links has a length greater than the sum of the other three. In a four-bar linkage distinct types of mechanisms could be obtained by inversion. A crank-rocker mechanism is obtained by fixing one of the two links paired with the shortest link. Newton–Raphson method could used be used to solve the nonlinear equations developed for solving the four-bar linkage position problem. One basic mechanism design problem for which the four-bar chain can provide solutions is that of finding a point of the coupler of a four-bar mechanism, which describes a path closely approximating the desired one.

4.2 Designing of planting unit

When designing the planting mechanism following aspects were considered:

I. Moving pathway, speed of traveling
II. Plant catching mechanism
III. Depth of Planting

I. Moving pathway

Prototype design was build using GI sheet, nuts and bolts and evaluated to get the required measurements. The design was simple and with less number of moving parts. Free play became a problem when shafting gets long.

II. Plant Catching Mechanism

There are several parameters were considered in designing the plant catching Mechanism:

- Place of catching
- Number of plant per catching
- Distance of travel
- Releasing Point
- Tension on plants
- Angle of Planting

Plant should not be damaged while catching and releasing by the planting machine. Suitable speed, position and angle of catching and angle of planting, height of tray, width and length of figures are the factors governing the proper planting mechanism. Distance of travel was calculated according to walking speed of a normal man.

Man walking speed = 1.5 km/ hour
= (1.5 km/ hour)*(1000m/km)*(1hour/60min)
= 25m/min

III. Depth of planting

Planting depth is important for growth of roots and to stand with the submerge condition. Planting depth was controlled using height adjustable floater.

4.3 Designing of Tray

Tray is to carry the dapog mat and to direct the plants to planting arm. Basic factors (width, length, angle, speed of movement) were considered in designing the tray mechanism. As two plant rows were planted at once, the tray width was twice as plant space. Movement of the tray per one planting of arm was decided by the volume taken away from the planting finger at a time. The volume taken by finger depends on the space of the finger jaw. Tray movement decides by the speed of ground wheel rotation. To make constant feeding of dapog mat to the planting arm it should come down to the end of the tray by gravity. Higher angle reduce energy requirement to feed the dapog mat to transplanting arm while too much angle affect on falling down and compaction of nursery at end of the tray making difficult to take out the plants from the nursery by transplanting arm. Length decided by the power given to the machine. Higher the length of the mat makes higher the power requirement to carry the weight of the mat. So to reduce weight of the machine tray length was reduced to have optimum weight

DESIGN CALCULATIONS [7]

Design of paper pot transponder –Load due to weight of transponder –

1. Load due to digging of soil
2. Load to pull transponder

4.4.1Design of tray

a) Selection of material

M.S. SHEET 20 gauge – Syt = 150Mpa

Density =7861.093 Kg/m^3

20 gauge = 0.81 mm

Assume total 150 paper pond transponder contain in frame each have 500gm weight 30kg on frame = 30*9.81 = 994.3N

- Area of tray contains transponder -440*350 =154000 mm^2 =. 154 m^2
- Neglect load due to wheel (It act as a support)

Compressive Stress on Frame = F/A=64.56*10^{-3} N/m^2

Tray Design is safe

1) Force required pulling the tray.
   a. Friction Force in rolling -
      i. Force due to rolling tire in loose sand = 0.2 -0.4

         Let's radius of tier = 280 mm

         Total load = load of paper Pond +Load of tray

         Load of tray = $\rho * V$ = 0.98059274082 Kg = 9.6196147874442 N

         It distribute on two front wheel = 9.6196/2 = 4.809807

Load of paper pond transponder on each wheel =1103.625 /2 = 551.8125N

Total load W = 4.80+551.8125 = 556.6125 N

Force required to overcome the rolling friction of front wheel
= f* w/R
= 79.16 N/m

Total two front wheel required = 79.16 N/m force
Rear wheel diameter = 170 mm
Load due to tray and support on rear wheel = 1kg = 9.81 kg
Force required overcoming the rolling friction by rear wheel

= f* w/R

=22.61 N/m

Load required to digging the soil –

Design of soil anchor-

Force required to Pull the anchor = 150 N

Total force required= F = 150 +22.61 +79.16 = N

= 251.77 N

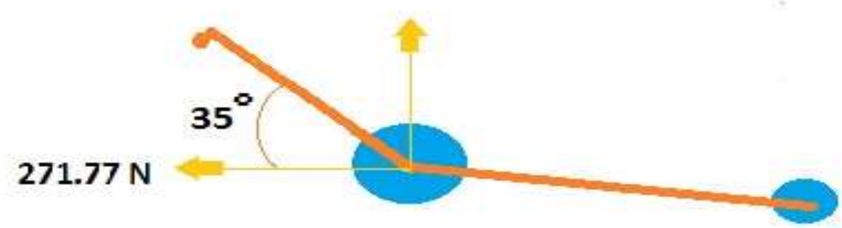


Fig. force required to drag force

Total force on Handle = F $* COS\theta$= 251.77 COS (35) =206.237 N

4.4.2.Design of Handle

Handle made up of 1 inch pipe

Handle length = 1.25 m

Handle is pull by hand therefore Pipe subjected to tensile Force.

Therefore,

$$\sigma = \frac{F}{A}$$

= 65.6475 N/m^2

(1)Material c20

S_{ut}=280 N/mm^2

$\sigma_{all}=S_{ut}/F=280/2=140$ N/mm^2

$\sigma_{all} > \sigma$

Therefore design is safe.

Weld Design Calculation [6]

Total Force = 294 . 3 N

Assume = 300 N

From PSG design data book ..

Allowable shear stress for weld joint = 75 MPa

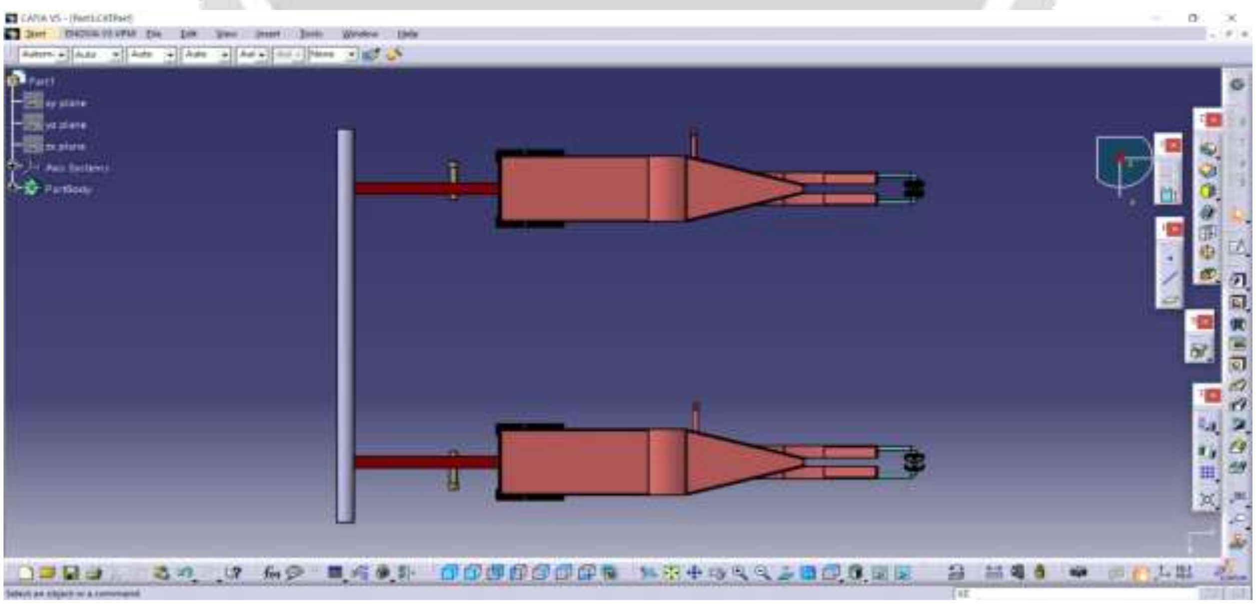
Shear stress induce in weld is,

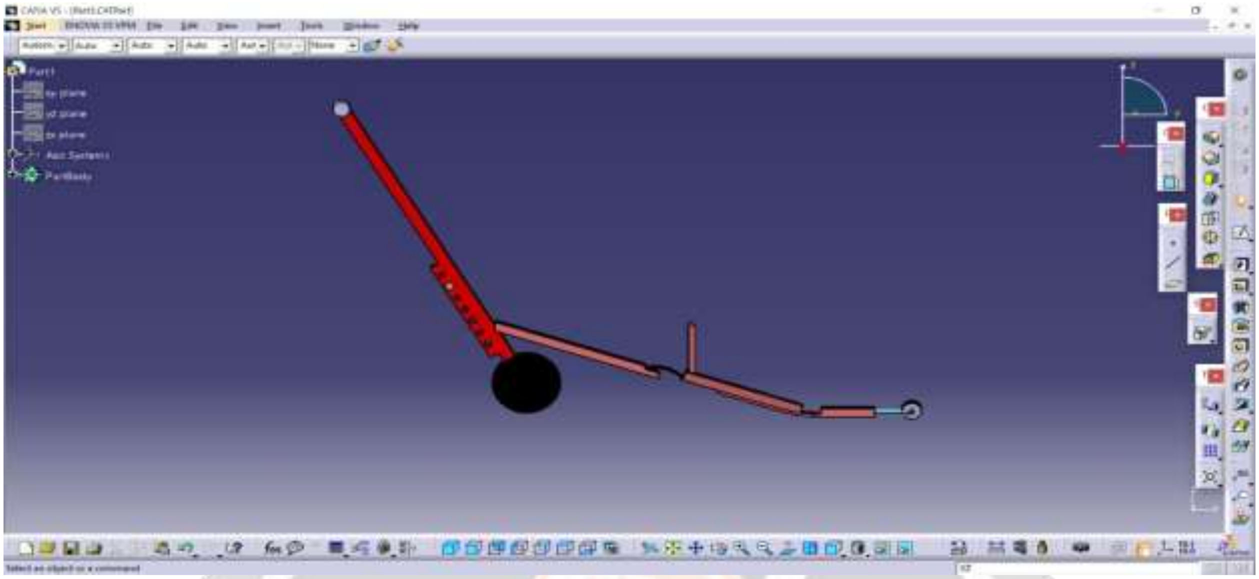
$$\tau = \frac{P}{l * t}$$

= 2.887139 Mpa

Allowable stress is greater than induced stress, therefore design is safe.

5.DESIGN:





6. CONCLUSIONS

The paper pot seedling transplanting machine worked satisfactorily. But, there were some improvements to be done before introducing to the farmers. The machine is driven by man power but engine can be coupled to enhance the performances. Machine can be developed to transplant several rows simultaneously. Weight of the machine should be reduced by removing sprocket, chains. The depot must have thin mud layer for easy removal of seedlings.

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