Design and Fabrication of Pneumatic Transplanter

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***Abstrat* -Developing countries contribute to about 72% of the total production of vegetables in the world. India, which is one among them, is the second largest producer of vegetables in the world and accounts for about 15% of the production of vegetables in the world. Its production level is over 90Mtons from around 6.2 million hectares. However, the whole cultivation process is done mainly by hand or manually except for the preparation of soil. This manual cultivation involves huge investments in cost, time and labor. In addition to this, hand held transplanters are also used for cultivation purposes.**

It consists of components like handle, lever, hollow pipe, jaw and jaw operating wire. This implement penetrates into the soil by its self-weight hold with handle, seedling is dropped into the hollow pipe and then the jaw is opened with the lever. The main drawback of the hand held transplanter is that it does not reduce the manpower completely. This gives rise to a need for a transplanter which further reduces manpower. Therefore, this project was focused on the Design, Fabrication, Testing and Evaluation of a Pneumatic Transplanter. This project demonstrates the application of engineering techniques to reduce the labor efforts and time required for transplanting. The designed pneumatic transplanter consists of 2 Pneumatic Cylinders, a compressor, a battery, 2 solenoid valves, a plant feeding pipe, a base plate, a switch board, 3 switches- one for the forward motion, one for the cylinder extension and retraction and one for the opening and closing of valves, tubes- to carry the compressed air, tube fittings, 2 pair of wheels and 4 DC motors. By using pneumatic components, the production process is made more economical since these components are cheap, durable and the cost of repair is significantly lower than other systems.

Keywords - Cylinder, Transplanter, Hollow Pipe, Pneumatic,Fabrication.

I. INTRODUCTION

A. Background

An automated transplanter is an agricultural machine used for transplanting seedlings to the soil field. This is very important as it reduces the time taken to transplant seedlings (when compared to manual transplanting), thus allowing more time for harvesting. It also reduces the use of manual energy.

Transplanting and planting vegetables in traditional way, is of hard job and inefficient activity. In addition, harvesting of prior crop and preparation of the substrate and transplantation should be done in a period of short time in doubled planting which by doing conventional way of transplantation, it would be hard. These factors show the need for mechanization of transplantation even more than before. Labour costs, solicitude in transplanting and the difference in depth of planting seedlings are of other factors that make the mechanical transplanting of vegetables seeding necessary. Mechanization of transplanting means the reduction demand for labour in cultivating operation in which the minimum damage to seedling and the maximum efficiency of cultivating is being provided.

B. Brief Description of Project

A transplanter is an agricultural machine used for transplanting seedlings to the field. This is very important as it reduces the time taken to transplant seedlings (when compared to manual transplanting), thus allowing more time for harvesting. It also reduces the use of manual energy. So here in this project there are mainly three parts which consists of base platform, vertical plunger and a horizontal opener.

Base platform is made up of mild steel sheet metal base having 4 wheels arrangement, 4 individual 60 rpm geared motor will be used to forward and reverse as well as to stirring the Vehicle to desired direction. On the platform vertical plunger is placed and it will be

connected to diameter 20mm x 100mm stroke pneumatic cylinder and guiding mechanism is attached. Operating cylinder will be placed vertically and through pneumatic fittings its connected to 5/2 solenoid Direction control valve.

On the platform vertical plunger is placed and it will be connected to diameter 20mm x 100mm stroke pneumatic cylinder and guiding mechanism is attached. Operating cylinder will be placed vertically and through pneumatic fittings its connected to 5/2 solenoid Direction control valve. 12V DC supply activates the valve and cylinder will move up and down, it leads to plunging action. The plant feeding pipe is transformed as plunger we can feed 40mm x 40mm size plant in to it.

Finally the third assembly mounted on second assembly and consist of opening of hinge door to drop the plant and close for stop and hold the next plant to feed. It also connected with pneumatic cylinder of size 20dia x 50mm stroke. 5/2 solenoid direction control valve will be connected to small cylinder. Controlling of 4 motors and 2 cylinder will be done by manual push bottom switch control connected through wires.

C. Concept Selection

Transplanting is the setting of young plants into fields rather than seeds, has been used for centuries. It is in a variety of crops, such as vegetables, rice, grasses, and sugar beets. Transplanting and planting vegetables in traditional way, is of hard job and inefficient activity. In addition, harvesting of prior crop and preparation of the substrate and transplantation should be done in a period of short time in doubled planting which by doing conventional way of transplantation, it would be hard. These factors show the need for mechanization of transplantation even more than before. Labour costs, solicitude in transplanting and the difference in depth of planting seedlings are of other factors that make the mechanical transplanting of vegetables seeding, necessary.

Transplanting accomplishes many things. It can overcome problems of establishing stands directly from seed, such as soil crusting [1], maintaining an environment conducive to seed germination, and the non emergence tray used extensively in the united states. Many others exist, but they are variations on the same theme the cells in which individual seedlings are grown unchangeably attached to one another in two dimensional arrays.

D. Objectives

The idea behind fabrication of low cost Automated vegetable transplanter machine is to fulfill the demand of labour problem in agricultural field. The development of a automated vegetable transplanter prototype is presented with following specifications

- Low cost
- Easily operable
- Easy interface
- Low power consumption
- High production rate
- To develop a low cost automated vegetable transplanter.
- To test the developed automated vegetable transplanter.
- To carry out costing.

II. LITERATURE REVIEW

A. Ernest S et.al (1943)

This invention relates to planters and more particularly potato seed planters. One of the important objects of this invention resides in the provision of a potato seed planter adapted to permit planting of the potato seed quickly and while the planter remains in a walking position.

B. Subo Tian et.al (2005)

They designed an automatic transplanter for lettuce in China.Transplanting is one of the most important operations during vegetable and flower production.

C. Rozan Manzoor et.al (2016)

They designed manual cultivation involving less investments in cost, time and labor. In addition to this, hand held transplanters are also used for cultivation purposes.

D. Yi- Chich Chiu et.al (2006)

The objective of this study was to develop an automatic pallet loading and unloading system for rice seeded trays, that receives three seeded trays in a stack from an automatic sowing line and arranges them orderly on a pallet.

E. P. Dissanayake et.al (2 0 0 8)

Guayule (Parthenium argentatum Gray) is a source of high quality rubber and low-allergenic latex. Commercial potential of guayule to produce high value latex products has increased due to the increased incidence of deadly diseases in humans.

III. COMPONENTS

A. Air Compressor

Air compressor is a device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air (i.e., compressed air). By one of several methods, an air compressor

forces more and more air into a storage tank, increasing the pressure.

Fig. 1: Air Compressor

B. Base Plate

A Solid Piece of Material that has enough Strength and Sturdiness to serve as the Surface to which other things are attached to be Supported.

Fig. 2: Base Plate

C. Pneumatic Cylinder

Pneumatic cylinders are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion.

Fig. 3: Double Acting Pneumatic Cylinder

D. DTDP Switch

A Double Pole Double Throw (DPDT) switch is a switch that has 2 inputs and 4 outputs; each input has 2 corresponding outputs that it can connect to.

Fig. 4: DTDP switch

E. Feeding Pipe

For the purpose of feeding plants between the wire walls, the planting machine comprises feeding pipe positioned vertically or substantially vertically. The top portion of the pipe may be provided with funnel and the bottom portion is open towards the rear.

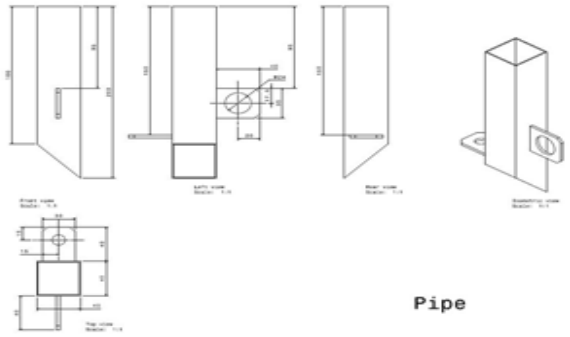


Fig. 5: Feeding Pipe

F. 5/2 Solenoid Valve

A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid.

Fig. : 5/2 solenoid valve

G. Wheel

A wheel is a circular component that is intended to rotate on an axial bearing. The wheel is one of the main components of the wheel and axle which is one of the six simple machines.

Fig. 7: Rubber wheel

H. DC Motor

A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most

common types rely on the forces produced by magnetic fields.

Fig. 8: DC Motor

I. Silencer

Pneumatic Silencers can effectively reduce pneumatic equipment noise. The mufflers are engineered to provide an optimal balance between noise reduction and acceptable backpressure in the pneumatic system.

Code	Screw Thread Size	S mm
SET-7	1/8"	8
SET-9.5	1/4"	10
SET-12.5	3/8"	13
SET-16.5	1/2"	15
SET-22	3/4"	19
SET-28	1"	24

SET Type Series Muffler
Steel Copper Plating Feet

Fig. 9: pneumatic silencer

J. Battery

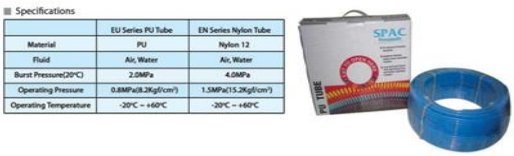
A VRLA battery (valve-regulated lead-acid battery), more commonly known as a sealed battery (SLA) or maintenance free battery, is a type of lead-acid rechargeable battery.

Fig. 10; Battery

K. Tube

Characteristics

- Good resistance to high pressure, vibration, abrasion, flection [2].
- Light ,easily fixed, convenient for fitting.
- With high precision in dimension control applying for all kinds of connector.
- Many colors for choosing.

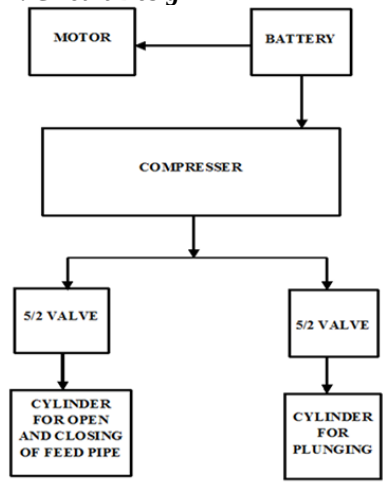


	EU Series PU Tube	EN Series Nylon Tube
Material	PU	Nylon 12
Fluid	Air, Water	Air, Water
Burst Pressure(20°C)	2.0MPa	4.0MPa
Operating Pressure	0.8MPa(8.2Kgf/cm²)	1.5MPa(15.2Kgf/cm²)
Operating Temperature	-20°C ~ +60°C	-20°C ~ +60°C

Fig. 11: Tube

IV. DETAIL DESIGN

A. Circuit Design



V. CALCULATION

1) Cylinder force calculation when cylinder extend
Cylinders used,
Diameter 20x100mm,
Pressure in Bar,
P=4 bar
=4 Kgf⁄〖cm〗^2 ,
D1, Diameter in mm
= 20mm,
A1, Area of cylinder (bore area) 〖cm〗^2
=3.14159 〖cm〗^2,
F, Force in Kgf,
=P×A1
=4×3.1415
=12.5663 Kgf,

2) Cylinder force calculation when cylinder Retracts,
Cylinders used
Diameter 20x100mm,
Pressure in Bar,
P=4 bar
=4 Kgf⁄〖cm〗^2
D1, Diameter in mm
=20mm
=2cm,
D2, Rod Area-8mm-0.8cm,
A1 bore-Area of cylinder (bore area) 〖cm〗^2
=3.14159〖 cm〗^2,
A r = rod area -0.50265〖 cm〗^2 ,
A1-A r =A2-2.638 〖cm〗^2,
F, Force in Kgf,
= P×A2,
=4 x 2.638,
=10.55 Kgf,

VI. OBSERVATION

Final development of product

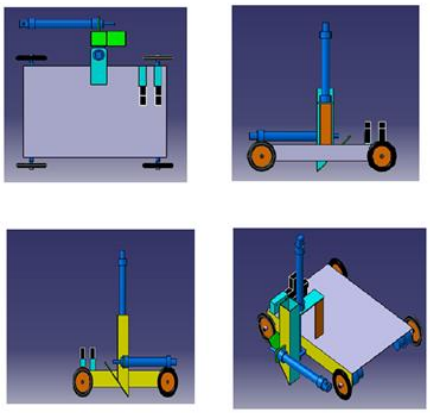


Fig. 12: 3D Modeling Design

Main Assembly of transplanter is consisting of three sub assemblies

1. Base platform assembly
2. vertical plunger assembly
3. horizontal opener assembly.

Base platform is made up of mild steel sheet metal base having 4 wheels arrangement, 4 individual 60 rpm geared motor will be used to forward and reverse as well as to stirring the Vehicle to desired direction.

On the platform vertical plunger is placed and it will be connected to diameter 20mm x 100mm stroke pneumatic cylinder and guiding mechanism is attached. Operating cylinder will be placed vertically and through pneumatic fittings its connected to 5/2 solenoid Direction control valve. 12V DC supply activates the valve and cylinder will move up and down, it leads to plunging action. The plant feeding pipe is transformed as plunger we can feed 40mm x 40mm size plant in to it.

Finally the third assembly mounted on second assembly and consist of opening of hinge door to drop the plant and close for stop and hold the next plant to feed. It also connected with pneumatic cylinder [3] of size 20dia x 50mm stroke. 5/2 solenoid direction control valve will be connected to small cylinder. Controlling of 4 motors and 2 cylinder will be done by manual push bottom switch control connected through wires.

All wires Both 5/2 valves will get air supply from on board pneumatic portable Compressor of capacity 12V DC, 10 bar pressure and 35 liters supply, placed on base platform. For whole machine power source is 12V DC 7Ah battery. prototype assembly will be moved to desired location and by manually we can plunge the cylinder and it leads to dig hole in cultivated land, placed plant in it and releasing the plant to ground. Then plunger will be raise up. This Cycle will be repeated for each single plant to be placed.

Fig. 13: Final Pneumatic Transplanter

VII. CONCLUSION

Manual transplanting of plant seedling in dry field is slow, inaccurate, costly and tedious task. Also cannot be achieved efficient production within short period of time. With concerns of seedling planting, this prototype is designed so that it helps to maintain seedling quality, labour cost reduction and cost of crop production. In this thesis, a small prototype of automated vegetable transplanter is designed and analyzed under very limited budget. In this project we developed a low cost automated transplanter prototype and tested for planting the seedling [4].

It has become more important to achieve automation of plug seedling transplanting with the rapid development of Chinese horticulture industry. This paper dealt with a simple, practical and automatic transplanter for plug seedling. Prototype was manufactured and performance tests were conducted. Experimental results showed that the precision positioning of mechanical arm and different positions of plug and flower pot could be achieved, and the automatic transplanter had reliable transplanting performance. The main purpose of this model pneumatic transplanter is to serve the small scale farmers, for them to farm easily and cost effectively for a long period of time. Using the appropriate design calculation pneumatic transplanter force is calculated for both the extend and retract positions. This system can improve the degree of automation of the seedling transportation processes of rice nursery operations. Labour saving and cost cutting with the help of this system is expected. Two in-field demonstrations of the system have been conducted in the past. Farmers seemed to be satisfied with the performance of the system.

VIII. SCOPE FOR FUTURE

Developing countries contribute to about 72% of the total production of vegetables in the world. India, which is one among them, is the second largest producer of vegetables in the

world and accounts for about 15% of the production of vegetables in the world. Its production level is over 90Mtons from around 6.2 million hectares. However, the whole cultivation process is done mainly by hand or manually except for the preparation of soil. This manual cultivation involves huge investments in cost, time and labor. In addition to this, hand held transplanter s are also used for cultivation [5] purposes. It consists of components like handle, lever, hollow pipe, jaw and jaw operating wire. This implement penetrates into the soil by its self-weight hold with handle, seedling is dropped into the hollow pipe and then the jaw is opened with the lever. The main drawback of the hand held transplanter is that it does not reduce the manpower completely. This gives rise to a need for a transplanter which further reduces manpower. Therefore, this project was focused on the Design, Fabrication, Testing and Evaluation of a Pneumatic Transplanter. This project demonstrates the application of engineering techniques to reduce the labor efforts and time required for transplanting.

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