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Design and Development of Single-Row Manual Seedling Planter

Mehul M. Kotwal[1], Mayur A. Chavan[2], Prem M. Gangurde[3], Kiran C. Ghuge[4]

[1,2,3,4]*Student, Dept. of Mechanical Engineering, Shri H.H.J.B. Polytechnic College, Chandwad, Maharashtra, India.*

Abstract - *Agriculture has been the key driver of Indian Economy over past many decades. It has empowered the aligned fields like Chemical Industry, Mechanical Industry and Research sector along with its consistent growth. The advancements in all the sectors of today's world at the peak reducing human efforts and providing more comfort to humans and increasing the per capita income of the farmers. The advancements in the agriculture sector have made it possible to lower the cost of various stages of cultivation of farm products. We have looked this journey very closely as we are backed up agricultural background in and around our surrounding. The advanced technologies available today is high cost and not affordable for small-scale farmer to invest in and to maintain it. Hence, considering it, we thought of making a low-cost planter which would be versatile in nature of all types of single-row seedling plantations. The materialized planter is completely manually operated and does not need any procuring external power source for its working. This planter works upon human push and force for its plantation and propelling. It requires two persons for its operation hence reducing manpower required, labor cost. As this planter finds replacement for conventional method using Suspensions, Gear and Chain Drives, Planter and operating levers; it reduces back pain (Spinal Cord Issues) of workers. It is low-cost, low-maintenance, less time-consuming machine meant for small-scale farmers*

***Key Words*: Agriculture, Push Force, Planter, Manually-operated, Suspensions, Gear and Chain Drives, Back pain, Low-cost.**

1. INTRODUCTION

Being from agricultural background, we were known to various problems need to be faced while practicing farming. Hence after thorough discussion, we decided to work upon the project which would help to reduce plantation cost of vegetables cultivated in our locality. Plantation of Tomato seedlings was observed which used conventional method of plantation. The side-effects and shortcomings of conventional practice was understood and decided to develop a solution for this. We decided to keep the mechanism simple and open to get modified according to user's choice. For power transmission we have used chain drive and gear drive which consist of major part of the mechanism of plantation. The machine was developed considering the ground surface, various types of soil, applied force by the operator and was declared safe for work.

1.1 CONVENTIONAL METHOD

A small hole is digged in soil for plantation of the seedling, the seedling is planted in the hole and hole and roots are again covered with soil. The distance between two seedlings is calculated by eye-seeing and rough predictions which results in irregular plantation distance. This may result in improper growth of the plant and can affect the productivity of the plant.

Figure 1 Conventional Method Of Seedling Plantation

1.2 THE PROBLEM

The conventional method used today is time consuming and require huge man power for its working. Hence increases the plantation cost and reducing profits of the farmer. Considering health of the workers, it causes major issues to back bone of our body and damages the spinal cord of the body.

1.3 THE SOLUTION

There was need to develop a productive and low-cost machine to resolve the problem. To work upon the same, we fabricated manual seedling transplanter which is operated manually and is affordable for small farmers. The machine consists of 4 wheels, out of which front 2 wheels are of small diameter. Suspension is provided to both front wheels where the transplanter is attached in order to obtain vertical linear movement of the planter. The bottom of planter is attached with a dropping cone to drop seedlings. The cone is provided with opening/closing arrangement and its control is provided to the handle from where the operator will be operating the machine functioning.

3. ACTUAL EXPERIMENTAL SETUP

Figure 2 Single-Row Manual Seedling Planter

4. CONSTRUCTION DETAILS

1. Square Rods:

These rods were used for making of the frame. The rest of the assembly is connected with these rods. The square rods used are in 2 dimensions: 4 & 2 inches.

4 inches square rod is used for the principal frame while 2 inches square rod is used for supporting planter and the hollow shaft of the conveyors.

Figure 3 Principal Frame

2. Wheels:

The machine displaces with the help of 4 wheels which are of same diameter in the front and rear side respectively. Front side (Closer to Handle) comprises of small diameter wheels and while rear wheels are comparatively larger in diameter.

Figure 4 Front Small Diameter Tyres (STANDARD)

3. Suspensions:

These are introduced between the frame and the front wheels mounted vertically.

Figure 5 Suspensions connected to Frame and Wheels.

4. Hollow Shaft:

The hollow shafts are used for mounting gears and the conveyor. 3 Hollow Shafts are used in the machine. Hollow shafts are used to reduce overall weight of the machine.

5. Pedestal Bearing:

These are used to provide support to a rotating shaft. It has been used in the machine to provide free rotation of the hollow shaft. It is also known as Pillow Block Bearing or Plummer Block. In total, 6 Pedestal Bearings were used

6. Sprockets:

Sprockets are used to transmit rotary motion between rear axle of wheel and gear drive shaft. The chain is mounted on the sprockets of different diameter.

7. Chain Drive:

It is used for power transmission between rear wheel to the gear drive shaft, mounted on the sprockets.

Figure 6 Chain Drive for Power Transmission

8. Gear Drive:

Gears are mounted on hollow shafts in the rear end which receive motion through the chain drive.

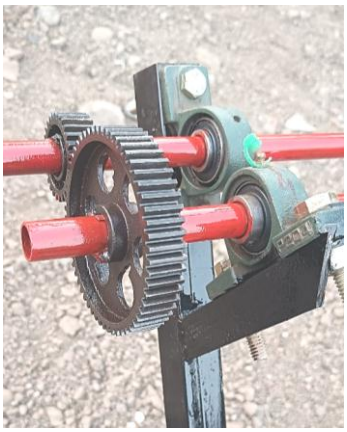

Figure 7 Gear Drive for Reverse Power Transmission

9. Conveyor:

It is a belt rotating between two hollow shafts, out of which one shaft has gear mounted on it. (Gear Drive Assembly)

10. Planter:

It is a railing pipe fitted with cone shaped orifice at its bottom (Seedling Dropper). Planter is fitted to small sized (2inches) square rod with the help of locking pin.

Figure 8 Planter with Cone

11. Spring:

It is mounted on the cone to control the opening/closing. The clutch wire operates it with the help of brake lever.

Figure 9 Tension Spring for Opening/Closing

4. WORKING:

1. The machine is powered manually using human hand efforts to drive in forward (working) motion.

2. When the machine is in forward motion or when pushed forward, the chain drive connected to the rear large wheel transmits power from the wheel to input shafts of smaller sprocket.

3. The machine comprises of gear drive unit having two gears, one half of the diameter of other's meshing with each other.

4. The input shaft having small sprocket and gear (Dia. 52 mm) mounted together transmits power to gear (Dia. 106 mm).

5. Due to the gear drive mounted parallel, opposite power transmission is possible to achieve conveyor rotation.

6. This gear (Dia. 106 mm) is mounted on the shat having the conveyor rear side mounted for movement.

7. As the operator will apply efforts, the power transmission will be done in above mentioned manner.

8. The shafts are mounted on angle cuttings with the help of Pedestal Bearings used for free rotation of the shafts.

9. Further, the conveyor is provided with seedling compartments at uniform distance to achieve uniform plantation of seedling in the field.

10. This distance is calculated in proportionate of distance between two seedlings and speed of the machine.

11. As the planting compartment comes towards the front end of the conveyor, there is planter mounted close to the conveyor end to getting accurate dropping of the seedling in the planter.

12. As seedling drops in the planter, the operator will apply push (downward force) on the handle for plantation.

13. The machine has front wheels of small diameter. Suspension system is introduced between the front wheels and the principal frame.

14. When the operator will apply downward push force, there will be change in stroke distance (length) of the suspensions.

15. This will enable the machine to get inclined, reducing height of handle (front side) from the plantation row-bed.

16. Hence, the planter cone will get inserted into the soil for final process of plantation.

17. For opening/closing of the planter cone, there are two clutch levers provided at the handle.

18. Now as the cone needs to get opened for plantation, the operator will operate clutch lever.

19. As the cone is attached with spring and tension wiring arrangement, it gets opened and drops seedling: Plantation.

20. After the plantation, the operator releases the clutch lever and due to spring tension, the spring gets compressed and the cone gets closed.

21. The second operator helping from rear side will position the seedlings in correct manner in compartments from seedling trays.

22. The operator then releases force applied on the handle and the suspension hence get to its full-length original position.

23. The operator will then repeat the same procedure for further plantation reducing cost and time required for plantation.

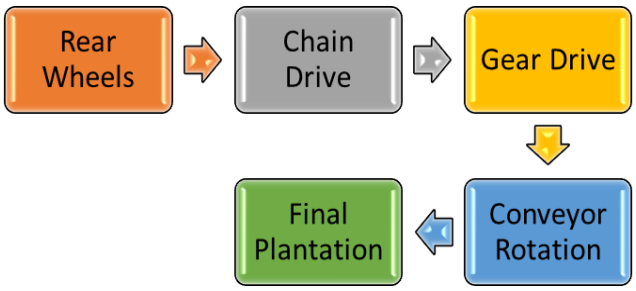

Figure 10 Power Transmission Flow Diagram

5. ADVANTAGES:

1. Reduced human efforts required.
2. Eliminates problems of back pain of operator.
3. Reduces plantation cost of seedlings.
4. Proper handling of seedlings.
5. Speedy plantation than conventional methods.
6. Low maintenance and cost effective.

6. APPLICATIONS:

1. Tomato Plantation
2. Cabbage Plantation
3. Cauli-flower Plantation
4. Chilli Plantation
5. All kinds of Row-Plantations.

7. RESULTS AND OBSERVATIONS:

The following results were obtained after the trail on a single row of 650 feet in length.

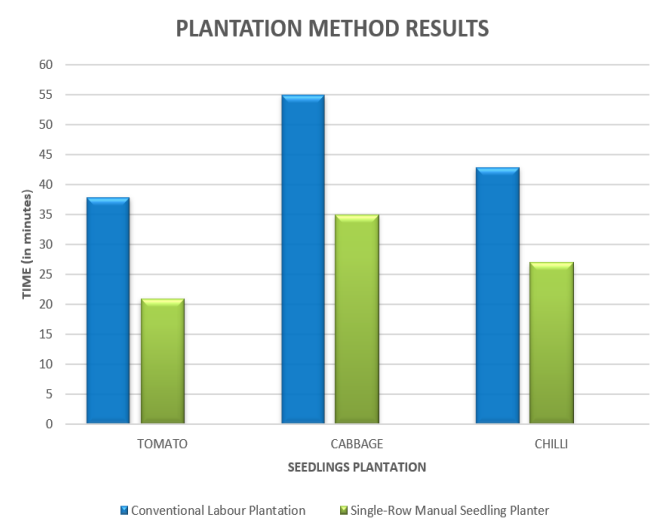

Chart 1 Time Vs Seedling Plantation by both methods for various seedlings.

The above observations hence prove the effective method of plantation and verifies its less time-consuming ability.

8. CONCLUSION:

The main aim for development of this project was to reduce the human efforts and the time required for plantations of various seedlings. After the collected data after the trails, the set aim was successfully achieved. The health issues occurring due to conventional plantations were also eliminated to great extent. The developed project was manufactured considering the farm ground surface conditions and nature of the soil. This machine was fabricated using the data collected from farmers and MORYA AGRO INDUSTRIES, CHANDWAD. All the components were designed considering the stresses and possible failures. Hence, we conclude that the design is Safe.

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FUTURE SCOPE:

This fabricated project has wide scope of improvement considering the daily increasing advancements in technology:

1. Inclusion of electric powered propelling system.
2. We also look forward to automate the plantation process by application of image sensors for scanning hole and commanded plantation.
3. This project can also be modified for variable length between the two front and rear wheels for increasing extent of rows covered.

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BIOGRAPHIES:

Mehul Manoj Kotwal
Pursuing Diploma in Mechanical Engineering at SNJB's Shri H.H.J.B. Polytechnic, Chandwad, MH, India.

Mayur Anil Chavan
Pursuing Diploma in Mechanical Engineering at SNJB's Shri H.H.J.B. Polytechnic, Chandwad, MH, India.

Prem Madhav Gangurde
Pursuing Diploma in Mechanical Engineering at SNJB's Shri H.H.J.B. Polytechnic, Chandwad, MH, India.

Kiran Chhagan Ghuge
Pursuing Diploma in Mechanical Engineering at SNJB's Shri H.H.J.B. Polytechnic, Chandwad, MH, India.