

DESIGN AND DEVELOPMENT OF SOLAR OPERATED MULTIPURPOSE AGRICULTURE MACHINE

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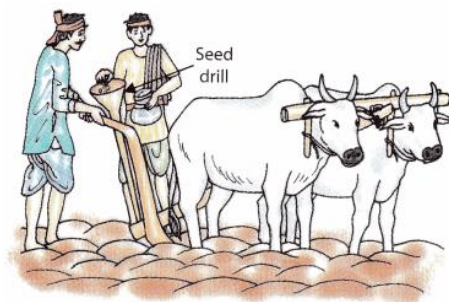
Abstract

This dissertation explores innovations in seed sowing machines and fertilizer sprayers, essential for modern agriculture. It compares traditional methods with a new machine that can perform multiple operations simultaneously, offering numerous advantages. Given the increasing labor costs and decreasing labor availability, this machine aims to reduce farmers' efforts and overall costs while enhancing crop production without harming soil texture.

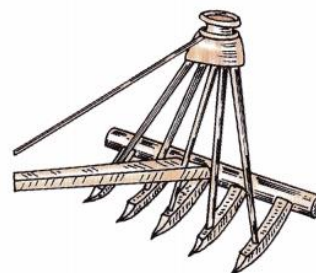
Keywords: Design, fabrication, solar operated, single row, maize & soybean & groundnut planter, mechanization, fertilizer sprayer, seed sowing, modernization, microcontroller& different sensors.

1. Introduction

Seed sowing machine is a device which helps in the sowing of seeds in a desired position hence assisting the farmers in saving time and money. The basic objective of sowing operation is to put the seed and fertilizer in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed. The paper discusses different aspects of seed sowing machine which will be helpful for the agriculture industry to move towards mechanization. The agricultural industry has always been the backbone of India's sustained growth. As the population of India continues to grow, the demand for produce grows as well. Hence, there is a greater need for multiple cropping on the farms and this in turn requires efficient and high-capacity machines. In traditional methods seed sowing is done by broadcasting manually, opening furrows by a plough and dropping seeds by hand and which requires lots of time and man power.



Sowing the seeds by using a traditional seed drill (attached to a plough).



A tractor driven modern seed drill.

Fig 1.1: Traditional Seed Sowing Equipments

2. Objectives

Objective of the project can be stated as

- Investigation of various types of seed sowing and fertilizer spraying machine.
- Development of solar powered seed sowing and fertilizer spraying machine.
- Testing of development of solar powered seed sowing and fertilizer spraying machine in actual agricultural farm



Fig 2.1: Traditional Seed Sowing methods

3. Scope of study

Seed sowing machine is a device which helps in the sowing of seeds in a desired position hence assisting the farmers in saving time and money. So considering these points related to spraying and seed sowing an attempt is made to design and fabricate such equipment which will be able to perform both the operations more efficiently and also will result in low cost. Decrease the operational cost by using new mechanism.

- Work reliably under different working conditions.
- Decrease the cost of machine.
- Decrease labor cost by advancing the spraying method.
- Machine can be operated in small farming land (1 acre).
- Making such a machine which can be able to perform both the operation

4. Material and methodology

Spraying and seed sowing an attempt is made to design and fabricate such equipment which will be able to perform both the operations more efficiently and also will result in low

Now the project mainly concentrates on designing a suitable operating system. To maintain simplicity and economy in the design the locally fabricated unit has been used.

Our project achieves higher safety, reduces human effort, increases the efficiency, reduces the work load, reduces the fatigue of workers and reduces maintenance cost.

1. Battery

An electric battery is a device consisting of one or more electrochemical cells with external

connections provided to power electrical devices such as flashlights, smartphones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The capacity of battery is 12V

2. DC Motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have same internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

Table 4.1: Specification of DC Motor

Specification	
Speed	30 cycles/min
Voltage	12 DC
Rotation Approximately	165 degree arc
Amperage	0.5 Amps

3. Spray Pump With Pipe Nozzle Trigger

A sprayer is a device used to spray a liquid, where sprayers are commonly used for projection of water, weed killers, crop performance materials, pest maintenance chemicals, as well as manufacturing and production line ingredients. In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides, and fertilizers on agricultural crops. Sprayers range in size from man-portable units (typically backpacks with spray guns) to trailed sprayers that are connected to a tractor, to self-propelled units similar to tractors, with boom

Table 4.2: Specification of Spray Pump

Specification	
Speed	200
Voltage	12 DC
Rated Torque	1.5 kg/cm
Load Current	0.3amp

4. Seed Drilling Mechanism and Tank

The equipment consists of a seed box attached to the main frame of a hand wheel hoe. A fluted roller assembly is provided at the bottom of the seed box. Fluted roller is rotated with the help of chain and sprockets from the ground wheel. The seed rate can be adjusted with the help of a lever provided on the seed box. The fluted roller used for sowing rape seed and mustard has 8 flutes. Each flute is 3 mm wide and 2 mm deep. The diameter of the fluted roller is 50 mm and its length, 32mm. For operation, the machine is pulled by rope attached to the hook of machine by one man and other person steers the machine by holding it by the handle.

Table 4.3: Dimensions of Seed Box

Length(mm)	12 inches
Width(mm)	5 inches
Height(mm)	5 inches
Weight (kg)	5.0
Power Transmission	Through chain and sprocket
Seeding mechanism	Fluted roller with narrow flutes
Hooper capacity(kg)	2
No. of roller	3

The tank should be made of a corrosion resistant material. Suitable materials used in sprayer tanks include stainless steel, polyethylene plastic and fiberglass. Pesticides may be corrosive to certain materials. Care should be taken to avoid using incompatible materials. Aluminum, galvanized or steel tanks should not be used. Some chemicals react with these materials, which may result in reduced effectiveness of the pesticide, or rust or corrosion inside the tank.

5. Solar Panel and Sensors

Table 4.4: Specification of Solar Panel

Pmax (Wp)	Vmax (V)	Imax (A)	Voc (V)	Isc (A)	Module Size(mm)	Weight(kg)	Efficiency
40	17.60	2.14	21.50	1.23	555x340x22	2.1	10.5

We can interface sensors to this Machine so that it can monitor some parameters.

IR sensor, Thermistor NTC Sensor, Voltage Sensor, Moisture sensor, LDR Sensor, I2C 20x4 LCD, BMP180 Atmospheric Temp, Buck Boost Converter, pesticide sensor, Microcontroller ESP32 etc.

5. Result and discussion

Our project is successfully implemented for seed sowing and fertilizer spraying. The equipment is purposely design for the farmers having small farming land say 5-6 acre. The performance of the equipment will increase when it is operates on the smooth surface or less uneven surface and also it will be more effective when it is used on the crops having nearly similar height and having the less space between two crops.

Table 5.1 actual Results & Testing in farm

By Traditional Methods	By Proposal Machine
Labour cost = For seed sowing = Rs 800 For pesticides spraying = Rs 2000 per day (for two persons)	Labour cost = For seed sowing & pesticides sprayer = Rs 400 per day (for one person)
Cost of pump = 1 acre of land 200 lit (20 tank) A labour can spray 3.5 acre of land per day(for two persons), Total cost = pesticides cost + labour cost = $3.5 * 1750 + 2000$ = Rs 8125	Discharge through Sprayer = 1.5 lit per min. Our equipment can spray 3 acre of land per day (for one person), Total cost = pesticide cost + labour cost = $3 * 1750 + 400$ = Rs 5650
1 acre of land 8kg of corn seeds, 8kg = Rs 1200 One labour can sowing seeds 1 acre of land in one day Total cost = seeds cost + labour cost = $1200 + 3000$ = Rs 4200	1 acre of land 8 kg of corn seeds, 8kg=Rs 1200 One labour can sowing seeds of 1 acre of land in one day Total cost = seeds cost + labour cost = $1200 + 400$ = Rs 1600

As shown in result, it reduces the labor cost by resolving the two days' work in a single day. So the proposed machine not only saves the money but also the time. The proposed machine takes Rs.5650/- for 3 acre for spraying & for seed sowing Rs.1600/- for 1 acre of land in one day whereas traditional method takes Rs. 8125/- for 3.5 acre in one day for spraying & for seed sowing Rs.4200/- for 1 acre of land in one day.

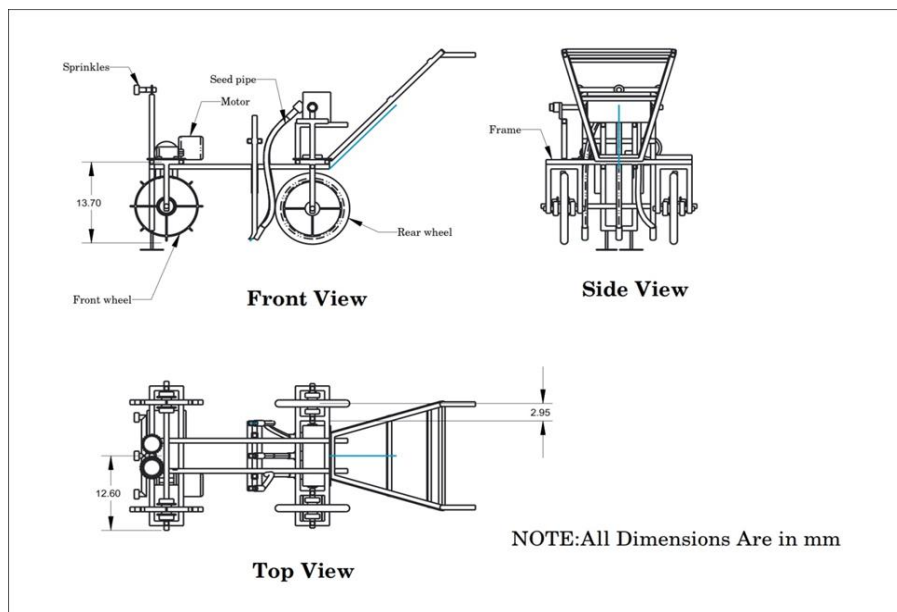


Fig 5.1. Design consideration of the project in Creo

6. Acknowledgement

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7. Conclusion

Our project is successfully implemented for seed sowing and fertilizer spraying. The equipment is purposely design for the farmers having small farming land say 5-6 acre. It is suitable for spraying as well as seed sowing at minimum cost for the farmer so that he can afford it. The performance of the equipment will increase when it operates on the smooth surface or less uneven surface and also it will be more effective when it is used on the crops having nearly similar height and having the less space between two crops.



Fig 7.1: project setup

References

1. Ibukun B. Ikechukwu, Agidi Gbabo and Ikechukwu C. Ugwuoke, "Design and Fabrication of a Single Row Maize Planter for Garden Use" (IJET) | Volume :01 Issue: 02| (2014)
2. Laukik P. Raut, Smit B. Jaiswal and Nitin Y. Mohite, "Design, development and fabrication of agricultural pesticides sprayer with weeder (IJARS) | Volume: 02 Issue: 11 | (2013)
3. R. Joshua, V. Vasu and P. Vincent, "Solar Sprayer - An Agriculture Implement" (IJSA) | Vol:02 Issue:01 | (2010)
4. Ayesha Akhtar, Ankit Munshi and Mohammad Fuzail Qaiser, "Automatic Seed Planter Punching Type" (IJETR) | Volume: 01 Issue:0 3 | (2014)
5. Varikuti Vasantha Rao, Sharanakumar Mathapati and Dr. Basavaraj Amarapur, "Multiple Power Supplied Fertilizer Sprayer" (IJSRP) | Volume: 3 Issue: 8 | (2013)
6. Mahesh. R. Pundkar and A. K. Mahalle, "A Seed-Sowing Machine: A Review" (IJESS) | Volume:3 Issue:3 | (2014)
7. R.S. Khurmi and Gupta, "Machine Design" 14th edition, S. Chand
8. V.B. Bhandari, "Machine Design" 3rd edition, Tata McGraw Hill
9. K. Sawney, "Electrical and Electronic Measuring Instruments", Dhanpat Rai and sons.
10. Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design" 9th edition, Tata McGraw Hill.