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A REVIEW PAPER ON MULTIPURPOSE AGRICULTURE CULTIVATOR

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Abstract- In this modern era research in the agricultural field is going on. Plant nursery is important part of agriculture field and facing many problems. The problems are availability of low productivity rate and more manual efforts required for seed feeding. In plant nursery more time is required for plantation which is due to seed feeding process. For reducing these problems of plant nursery research of multipurpose agriculture cultivator mechanism is used. MAC is a semi-automatic operated machine used for agricultural land operation to give better productivity of crops and to ease the work of farmers. MAC is used for cultivation of land comprising of three major agricultural operation in a single prototype machine which in case would reduce the work load and the use of draft animals. In this report various parameter of the design and the manufacturing of the MAC is studied. The machine would be developed considering the difficulties faced by the farmers.

1.INTRODUCTION

As we all know that India is a developing country it continues to rely on hands tools for the foreseeable future for cultivation. The use of hand tools for land cultivation is still predominant in India because draft animals and tractors require resources that many Indian farmers do not have easy access to. The need for agricultural mechanization in India must therefore be assessed with a deeper understanding of the small holder farmer's activities and what values farm power generated for them. As per seeing the current scenario in our country, we all know that our population is increasing day by day. So as to fulfil the requirement of the food for the increasing population, which can only be achieved through some level of mechanization. Manual method of seed planting, results in low seed placement, spacing efficiencies and serious back ache for the farmer which limits the size of field that can be planted. However, planting machine or planter that is normally required to produce more food is beyond the buying capacity of small holder farmers.

These small holder farmers still continue to plant manually, the result of which is low productivity of the crops. 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 environmentally friendly. So here we have come with an idea of multipurpose agriculture machine (MAC).

1.1 Scope and objective

Reason for selecting problem:

1. Lack of mechanization in farming.
2. Excess time consumption for performing individual process and also excess efforts are required for different operations.
3. Cost of individual equipments for performing different farming operations is very high.

Scope:

Multifunctional agricultural vehicle mainly focuses on the basic problems faced by fellow farmers i.e. seed sowing, fertilizers spraying, cultivation and digging. We are looking this project as revolution in small farms in India, which is most uncovered area in this sector. The Multipurpose agriculture machine is a device which helps in the sowing of seeds in the desired position hence assisting the farmers in saving time and money. The main objectives are:

1. To decrease the overall cost.
2. Decreasing labour cost by advancing spaying, cultivating and seed sowing mechanisms.
3. To design a machine in small operable land.
4. To design such a machine that can perform all the 3 major functions at a low cost.

1.2 What is MAC?

MAC is a multipurpose agriculture machine. It is a semi-automatic machine which would be driven with the help of motor and with minimal human efforts. The MAC would be performing the three major operations on the agricultural land. It would be having a sprinkler which would soften the soil and after that it would be have a cultivator which would useful in plugging the soil which in case would make some sort of opening in the soil and after that with the hopper the seeds would be dropped in an orderly manner with the help of the seed metering device provided on the MAC.

2. LITERATURE REVIEWS

Dr. C.N. Sakhale et al. (2016): According to the author multifunctional agricultural vehicle mainly focuses on basic problems faced by our fellow farmers i.e., seed sowing, water spraying, cultivation and digging. Cultivation tool is removable. This operation is done by manual force. For spraying motor, battery and switch is given. When switch is on fertilizer pump from motor, enter to the spray nozzle then it sprays with high velocity to the crops. In our machine the cultivation tool i.e., the tiller will be removable for the ease of transportation purpose and also the operation can be carried out by manual force. [1]

Mr. Thange R.B, Mr. Ugale A.G et al. (2016): The author studied and developed agricultural needs to find new ways to improve efficiency. One approach is to utilize available information technologies in the form of more intelligent machines to reduce and target energy inputs in more effective ways than in the past. Here author is trying to make such an equipment that will perform no. of operations like sowing, weeding, grass cutting, tillage, spraying, etc. So, we will be making the sprayer drum of plastic and will have capacity of 15 litres which will be used for spraying purpose. Existing old machines had the individual storage place and separate individual mechanism which leads to more cost. The drawbacks in the existing machine are rectified successfully in our machine. [2]

Amol Nalawade, Akash L. Kundu et al. (2019): The author presented the information about the different innovations done in seeding machines available for farming and plantation purpose. In this the main aim of seed sowing operation is to put the seed in rows and at desired depth and having a particular spacing between seed to seed with soil and provides a proper exertion of a force over the seed. So, it shows proper row spacing within the seeds, their seed rate and their depth associated with different agro-climatic conditions to achieve optimum yields. Our equipment consists of a low maintenance cost which does not consist of a fine texture which can be easily broken or damaged. [3]

Nagesh Adalinge, Rahul Mane et al. (2017): Here the author has proposed that seed sowing machine is a device which helps in sowing of seeds in the desired position hence assisting the farmers in saving time. When the equipment is pushed forward by using handles, the front wheel rotates and the gear is mounted on the axle of the wheel start to rotate and its rotation is then transferred to the pinion through chain drive. The rotary motion of pinion is converted into reciprocating motion by simple slider crank mechanism. Improved seed drills are provided using seed and seed boxes and by seed metering mechanism for variation of seed and seed dropping rates. [4]

Pradip Gunawat, Vinayak Yadav et al. (2017): The author proposed that the objectives of seed planter machine are to put seeds at desired depth with constant seed spacing and covering the seed with soil. Our machine is suitable for planting seed in

ridge and furrow method, flat arrow method, flat bed method as well as multi cropping. The main objective of our machine is to reduce human effort and back ache of farmers. Tooth Bevel gear is used to convert rotational motion into Linear. Dibber is used to stir the soil to various depths. [5]

3. BASIC CONCEPT OF DESIGN

Concept to design a project for small scale farmers. And in one machine multi functions can be performed with cheap cost as compared to other agriculture machine. For this concept not essential to skilled person. Mechanism of the machine should be very simple. so, that for gardening and small scale farming ,design this concept.

4. COMPONENT DETAILS

MAC consists of the following components:

1. 24 volts BLDC motor
2. Controller
3. Throttle
4. Battery
5. Wheel
6. Handpump
7. Water tank
8. Hopper
9. Seed metering device
10. Tiller
11. Metallic or chassis frame

4.1 Brief description of some major components:

1. Bldc motor:

Fig. 4.1 BLDC motor

A brushless DC electric is a synchronous motor which has a high power to weight ratio and makes low noise during operation and it has many advantages over normal motors.

- We would be using a 24v 250w bldc motor .
- Which would be used to drive the front wheel .
- It would be operated with the help of battery and a controller .
- It's speed will be controlled with the help of a throttle.

2. Battery:

Fig. 4.2 Battery

The battery will be used to supply current to the motor and the battery will be of lithium ion as it has no acids and is convenient for charging.

3. Handpump:

Fig.4.3 PVC Handpump

The handpump's lever will be connected to a crankshaft mechanism which will convert rotary motion into reciprocating motion and then the hand pump will suck water from the water tank and afterwards water will flow through the pipes and will get sprinkled out through the nozzle.

4. Water tank:

Fig. 4.4 Water Tank

5. Hopper:

Fig. 4.5 Hopper

Hopper is a large pyramidal or cone shaped container used in industrial processes to hold particular matter such as seeds, nuts etc. Mostly hoppers are made up of steel.

- Hopper is used for the seed sowing purpose on the area that is already tilled.
- The hopper mechanism is mounted on the cultivator frame and seeds are dropped in furrows behind the cultivator shovels. a square bar is provided at the rear of the unit to cover the seeds in the furrows. Row to row spacing is adjusted by changing the position of the cultivator tires.

6. Tiller:

Fig. 4.7 Tiller

- The tiller is used for plugging the field.
- So after the field is successfully plugged then the seed sowing operations can be performed .

7. Metallic frame:

Fig 4.8 Metallic frame

The chassis is considered to be one of the significant structures of a machine. It is a frame which holds both the body of machine and the power train. Various parts are bolted on to the chassis.

4.2 Dimensions:

- Total Height – 825 mm
- Total Breadth – 954 mm
- Total Length – 1955 mm
- Motor – 13 X 11 cm
- Battery – 110 X 55 X 66 mm
- Wheel – 160X 35 mm
- Handpump – 32mm diameter ,176mm height and 180ml volume
- Water tank – 70 X 25 X 10 cm
- Hopper – Total height 497mm
- Seed metering device – outer radius 30mm
- Tiller – Total length 1305mm, no. of teeth 29

4.3 Material used:

- Frame - mild steel
- Wheel – centre plate mild steel & outer grip rubber
- Handpump – polycarbonate
- Water tank – polycarbonate
- Hopper – sheet metal
- Tiller – metal
- Metering gear – Alloy steel
- Small sprocket – Alloy steel
- Sprinkler system - pvc

5. Design study and working

The function of a well-designed Multipurpose Agriculture Cultivator is to sprinkle the water on the agricultural land, further creating some sort of opening in the soil with the help of tiller and to meter the seeds of different sizes and shapes, place the seed in the acceptable pattern of distribution in the field, place the seed accurately and uniformly at the desired depth in the soil and cover the seed and compact the soil around it to enhance germination and emergence. The recommended row to row spacing, seed rate, seed to seed spacing and depth of seed placement vary from crop to crop and for different agro-climatic conditions to achieve optimum yields. Seed flow through a planter is dependent on size, shape, true density and angle of repose of seeds. In addition, the impact of seeds on the internal components of the planter is influenced by the coefficient of restitution of seeds on various impinging surfaces. The main frame is the skeletal structure of the Multipurpose Agriculture Cultivator on which all other components are mounted. The two design factors considered in

the determination of the material required for the frame are the weight and strength. In this section we are going to discuss about the design and fabricate a semi-automatic or manually operated multi crop planter machine for different agricultural operation. Since most of our farmers especially in the rural areas and the small scale farmers use dibbler or sticks to sow different seeds. This dibbler, or sticks is used to open the soil as the farmer drops the required numbers of seed (often times more than they require numbers of seeds to be dropped) and then covers them up.

Fig 5.1 2D view of model

In the above 2D figure as we can see the motor which has power rating of 250 watt is used to drive the front wheel, the crank shaft is attached to the lever of the handpump which will then sprinkle the water out of the nozzles and the tiller and the hopper mechanism at the left hand side of image are used for the ploughing and seed sowing operation.

Fig 5.2 Isometric view of solidworks model

The design is done on solidworks and all the major 3 mechanisms such as tilling ,seed sowing and sprinkling of water is shown by the machine in above figures.

6. CALCULATIONS

6.1 Design Consideration:

The design of semi-automatic operated Multipurpose Agriculture Cultivator for different agricultural operation is based on the Following considerations:

1. The ease of fabrication of component parts.
2. The safety of the operator
3. The operation of the machine should be simple for small scale or rural farmers.

6.2 Calculation of chain drive:

The requirement of the chain drive mechanism is to move the prototype in forward direction. Hence the necessary calculations are shown down below:

1. By trade off w.r.t space and breaking load select rolon chain DR957
2. Diameter of the driven sprocket , D2 = 424.50 mm
3. Velocity of chain, V= 8.44 m/s
4. Gear ratio= 1.236 %

6.3 Water spray calculation of spray nozzle:

As the water gushes out through the hand pump with the help of slider crank mechanism then the water flows out from it

Water sprayed/discharged per stroke will be equal to volume of pump.

So, Volume sprayed = 0.1768 Litres/stroke or 176.8ml/stroke

6.4 Seed dropping calculation.

As we know the output rpm of the prototype with the application of chain drive mechanism gives us an rpm of 380.

And in terms of speed = 13 km/hr

Our Seed metering device is having 6 holes for dropping of seeds.

So, for calculating number of seeds dropped in one rotation of seed metering device,

Suppose, for 4 rotations the seed dropped will be calculated as follows.

$$= 4(\text{rotations}) * 6(\text{holes})$$

$$= \underline{24}$$

So, 24 seeds will be dropped in 4 number of rotations and so on.

6.5 Design of hopper:

Hopper is the place where the seed are placed in the trapezoidal container having a huge opening in the top and minimal opening in the bottom and the calculation for it is shown below.

$$\text{Volume} = \underline{22740\text{cm}^3}$$

6.6 Battery life calculation

Running rate of motor = 2.2A

Battery capacity = 14AH

Battery life (at full motor output) = 6.4 hours.

So the minimum battery life is 6.4 hours.

6.7 Power developed by the operator

Assuming mass as 100 kg

Power developed = 25 Watt

7. CONCLUSION

After the design and trail on the “Multipurpose Agricultural Cultivator” conclusion which made are as follows:

Based on the overall performance of the cultivator we can definitely say that the project will satisfy the need of small scale farmer, because they are not able to purchase costly agricultural equipment. The simultaneous working of seed plantation and watering of field makes farming more efficient and easy . The cultivator requires less man power and less time compared to other cultivators , so if we use it on a large scale the agricultural costs will be reduced and we hope this will satisfy the partial thrust of Indian agriculture. So in this way we make farming more efficient and economical thereby reducing the farming expenditures in India.

7.1 Future scope:

1. We can interface sensors to this Machine so that it can monitor some parameters.
2. We can add Wireless Technology to Control Machine.
3. We can add More Drill for different crop
4. There are to be proper provisions are needed to couple the machine with the tractor.
5. We can add solar panel for spraying system or for powering the battery and motor.

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