



DESIGN AND DEVELOPMENT OF ECONOMICAL PLOUGHING AND SOWING MACHINE

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Abstract:

The agriculture is a vital role which plays a role of economy development of a nation through in large manner. Agriculture technology means the technological developments in the field of different crops that are being produced. The basic objective of sowing operation is to put the seed in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed. The present review provides brief information about the various types of innovations done in seed sowing equipment. 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. The comparison between the traditional sowing method and the new proposed machine which can perform a number of simultaneous operations with excess flexibility and with added advantages. In current scenario, availability of labors becomes a critical problem which leads to labour cost more also, totally the design of this seed sowing device plays a lead role in reducing cost, labor problems by giving more productivity with little manufacturing cost.

1. INTRODUCTION

The Indian economy is based on agriculture. Development in agriculture leads to rise in economic status of country. In India farmers are facing problems due to unavailability of skilled labours, traditional way of farming using non efficient farming equipment which takes lot of time and also increases labour cost. In this work describes enhancement in

seed sowing and farming operations by using multifunctional seed sowing machine. The main objective of sowing operation is to place seed at proper position respective of other placed seeds in every row at particular depth and provide a cover of soil on it. As per change in shape and size of different seeds the parameters like distance between two seed, depth of seed, planting rate changes. This project is attempt to produce multifunctional and highly efficient seed sowing machine which will reduce time of plantation, cost of labour, and enhances production. Traditional method of seed sowing based on assumptions of seed to seed spacing and depth of placement which is not at all efficient and beside this it requires lot of time and efforts too. The agricultural has always been the backbone of India's sustained growth. As the population of India continues to grow, the demand for producing grows as well. Hence, there is a greater need for multiple cropping in the farms and this in turn requires efficient and time saving machines. Primarily this system works manually, but with lesser input energy requirement. The present review provides brief information about the various types of innovations done in seed sowing equipment. The basic objective of sowing operation is to put the seed in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed. 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. The comparison between the traditional sowing method and the new proposed machine which can perform a number of simultaneous operations and has a number of advantages is done in this project.

As day by day the labour availability becomes the great concern for the farmers and labour cost is more, this machine reduces the efforts and total cost of sowing the seeds. Seed sowing devices plays a wide role in agriculture field.

1.1 Methods of Sowing

The different methods of sowing are given in brief manner as

- Broadcasting
- Dibbling
- Sowing behind the country plough (manual and mechanical drilling)
- Seed drilling

a) Broadcasting

Broadcasting is otherwise called as random sowing. Literally means 'scattering the seeds'. Broadcasting is done for many crops. Broadcasting is mostly followed for small sized to medium sized crops. This is the largest method of sowing followed in India, since; it is the easiest and cheapest and requires minimum labours. To have optimum plant population in unit area certain rules should be followed.

- Only a skilled person should broadcast the seeds for uniform scattering.
- The ploughed field should be in a perfect condition to trigger germination.

The seeds are broadcasted in a narrow strip and the sowing is completed strip by strip. To ensure a good and uniform population, it is better to broadcast on either direction. This is called criss-cross sowing. If the seed is too small, it is mixed with sand to make a bulky one and for easy handling. Ex. Sesame seeds are mixed with sand at 1:15 or 1:10 ratio sown. In other cases the person sowing will be beating the seeds against the basket for uniform scattering. Ex. Sorghum, pearl millet. After broadcasting, the seeds are covered gently either using a country plough with a very shallow ploughing. In some cases, tree twigs or shrub branches are used. If the seeds are large, levelers collect the seeds and leave in the other side. Comb harrow is the best used one.

b) Dibbling

This is actually line sowing. Inserting a seed through a hole at a desired depth and covering the hole. Dibbling is practiced on plain

surface and ridges and furrows or beds and channels. This type of sowing is practiced only under suitable soil condition. Rice fallow cotton is dibbled on a 2 plain surface. The seeds are dibbled at 2/3rd from top or 1/3rd at bottom of the ridge. Before sowing, furrows are opened and fertilizers are applied above which seeds are sown. The seeds do not have contact with the fertilizers. This is done for wider spaced crops and medium to large sized seeds. Ex. Sorghum, maize, sunflower, cotton are dibbled on ridges and furrows. Both beds and channels; and ridges and furrows come under line sowing. While earthing up, the plant occupies middle of the ridge. Earthing up is essential for proper anchorage of the root system. Advantages of line sowing are

- (i) Uniform population,
- (ii) Better germination

And also Sowing behind the plough is done by manual or mechanical means. Seeds are dropped in the furrows opened by the plough and the same is closed or covered when the next furrow is opened. The seeds are sown at uniform distance. Manual method is a laborious and time consuming process. Seeds like red gram, cowpea and groundnut are sown behind the country plough. Major sown crop is groundnut. Seeds are sown by mechanical means by Gorus – seed drill. A seed drill has a plough share and hopper. Seeds are placed on hopper. Different types of seed drill are available, e.g., simple Gorus-Guntakas. And some of the advantages are The seeds are placed at desired depth covered by iron planks. Except very small, very large seeds most of the seeds can be sown, e.g. maize, sorghum, millets, sunflower, etc.

c) Drill sowing (or) Drilling

Drilling is the practice of dropping seeds in a definite depth covered with soil and compacted. In this method, sowing implements are used for placing the seeds into the soil. Both animal drawn Gorus and power operated (seed drills) implements are available. Seeds are drilled continuously or at regular intervals in rows. In this method, depth of sowing can be maintained and fertilizer can also be applied simultaneously. It is possible to take up sowing of inter crops also. It requires more time, energy and cost, but maintains uniform population per unit area. Seeds are placed at uniform depth, covered and compacted.

2. PROBLEM DEFINITION

- Usually seed sowing using manual method demands skilled labors as maintaining perfect

row and column spacing requires lot of experience.

- Even though there are seed sowing equipments in the market, they cost a lot and farmers owning small farms can't afford it.

- The present day manual seed sowing machine have too complex mechanism and require frequent maintenance.

3. LITERATURE REVIEW

Laukik P. Raut and et. al.[1] studied to meet the food requirements of the growing population and rapid industrialization, modernization of agriculture is inescapable. Mechanization enables the conservation of inputs through precision in metering ensuring better distribution, reducing quantity needed for better response and prevention of losses or wastage of inputs applied. Mahesh R. Pundkar and A. K. Mahalle .[2] is presented review provides brief information about the various types of innovations done in seed sowing machine available for plantation. The seed sowing machine is a key component of agriculture field. The performance of seed sowing device has a remarkable influence on the cost and yield of agriculture products. Presently there are many approaches to detect the performance of seed-sowing device. Mechanization reduces the unit cost of production through higher productivity and input conservation. D. Ramesh and H. P. Girish Kumar [3] presented review provide brief information about the various types of innovations done in seed sowing equipment. The basic objective of sowing operation is to put the seed and seed in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed. 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 sowing devices play a wide role in the agriculture field. Gupta V.K and et. al .[4] are investigated the today's era is marching towards the rapid growth of all sectors including the agricultural sector. To meet the future food demands, the farmers

have to implement the new techniques which will not affect the soil texture but will increase the overall crop production. This Paper deals with the various sowing methods used in India for seed sowing and seed placement. Pranil V et al.[5] This research paper presents design and development of manually operated seed planter machine. In this they present objective of seed planter machine design, factors affecting seed emergence, some mechanisms.

seed germination like uniformity of depth of placement of seed, uniformity of distribution of seed along rows. In this power transmission mechanism, seed meter mechanisms, plunger mechanism etc. mechanisms" are used. The working as machine is pushed; power wheel is rotating which transmit power to plunger through chain and sprocket mechanism. Now cam is mounted on sprocket shaft which push plunger towards downward direction. Once plunger is penetrate in soil and during backward stroke flapper is opened so seed get separated from plunger and inserted in dig. From this we get idea that if we use the belt having small holes with defined thickness then it is beneficial for our project. As our automatic seed feeder is only for small seeds then using of conveyor belt with motor is useful. Harish Patil et. Al [6] This research paper present "Agriculture Seed Sowing Equipment: A Review". The present review provides brief information about the various types of innovations done in seed sowing equipment. 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. In this multipurpose seeding machine equipment consists of cylindrical shape container in which the seeds can fill. The container is attached on the four wheeled carrier assembly. It consists of metering plate bevel gear mechanism and two holes at the bottom depending on seed size. The working as plate will rotate in container when the bottom holes of container and meter plate hole coincide seeds will flow through pipe to soil. Here the metering plate gets rotating motion by bevel gear assembly and the bevel gears get the motion by rear wheels with the help chain and sprocket assembly. Kannan A et al. This research paper presents design modification in multipurpose sowing machine. In this they

present that for sowing purpose we import the machinery which are bulk in size having more cost. To prevent this they design multipurpose sowing machine which consists of hopper, seed metering mechanism, ground wheel, power transmission system, seed distributor, and tiller. In this they design model on PRO-E software. Actually the working is very simple as the tiller rotates it directly transmit motion to ground wheel which directly connected through main shaft. A main shaft has a disc with scoops inside the hopper. When the ground wheel rotates the main shaft also rotates with the help of power transmission system. The scoops collect the seed from hopper and leave it inside the seed distributor. The tiller is having very good contact with ground. Uttam. S. K. [7] et al, This research paper represents “Design & Implementation of Multi Seed Sowing Machine”. In this paper gives types sowing machine. The following are the three different types of seed sowing are broadcasting: A field is initially prepared with a plough to a series of linear cuts known as furrows. The field is then seeded by throwing the seeds over the field, a method known as manual broadcasting. The result was a field planted roughly in rows, but having a large number of plants. When the seeds are scattered randomly with the help of hand on the soil, the method is called broadcasting. Dribbling: Drill sowing and dribbling (making small holes in the ground for seeds) are better method of sowing the seeds. Once the seeds are put in the holes, they are then covered with the soil. This saves time and labour and prevents the damage of seeds by birds. Another method of sowing the seeds is with the help of a simple device consisting of bamboo tube with a funnel on it attached to a plough. As the plough moves over the field the tube attached to it leaves the seeds kept in the funnel at proper spacing and depth. The plough keeps making furrows in the soil in which the seeds are dropped by the seed drill. Vaibhav A. et al. [8]. Agriculture is demographically the broadest economic sector and plays a significant role in the overall economy of India. For the growth of Indian economy, mechanization is necessary. The main purpose of mechanization in the agriculture is to improve the overall productivity and production. Planning is conventionally done manually which involves

humans and draught animals, this result in higher cost of cultivation and delay in planting. The purpose of this paper is to compare conventional sowing methods and modern methods. The required row to row spacing, seed rate, seed to seed spacing can be achieved by proposed machine. The machine reduces the human efforts. The progressive invention in agricultural system is becoming an important task especial because of rising demand on quality of agriculture products and declining labours availability in rural farming areas. The designed system is seeding and fertilizing agriculture robot using micro controller. The aim of designed system is to seeding fertilizing and soil ph, temperature, moisture, humidity checking. The robot is controlled by remote. The designed system involves navigation of robot is controlled via remote. The robot and remote system are connected through internet system. DC motors are used for navigation of the robot. The speed of DC motor is controlled using controller. The solenoid is used to control seeding fertilizing. This paper gives idea about the automation and use of motor for movement of belt conveyor.

4. OBJECTIVES AND SCOPE OF WORK

- To achieve the desired type of sowing machine the following objectives are set
 - To study the present day seed sowing methods and design a system that can sow seeds of different varieties.
 - To build a chassis which helps to accommodate plough, seed dispensing wheel and soil covering bar.
 - To make the seed dispensing wheel interchangeable for sowing multiple variety of seeds. And its scope is briefly as follows
- To study the concept and design features of seed sowing and ploughing machine, analyze the effects of various parameters in the seed sowing and ploughing machine which suggests to made design and fabricate the seed sowing and ploughing machine according to the design specification, the same is being fabricated and can be used to plough and sow the seeds in the agricultural field .which leads to reduce the human effort and labour cost.

5. METHODOLOGY

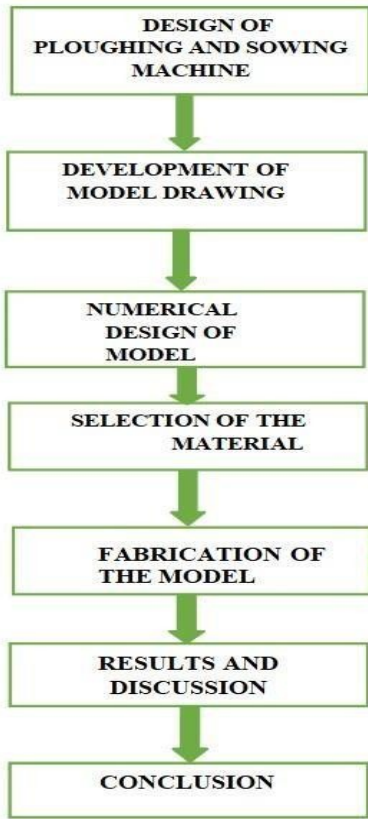


Fig.4.1 Flow chart of Methodology

The methodology adopted for the fabrication of seed sowing and ploughing machine is explained step by step in the flow diagram As per the methodology flow, The machine is designed to plough the soil and sow the seeds in the agricultural land therefore the parameters chosen for design considerations are overall dimensions of machine, ploughing and seed sowing mechanism of the machine. According to the usage condition, of the machine overall dimensions. As respect to the expectation of machine operation, ploughing and seed sowing in the Agricultural land. And also according to the tasks of machine, seed sowing from the hooper With the help of seed dispensing wheel. In the primary stage the ploughing teeth plough the soil and then the seed sowing process will take place. In the Figure 4.1 2d representation of the main frame in the fig all the dimension of the frame is shown. In Figure 4.2 2d representation of seed dispenser is show. In the seed dispenser seeds will be stored.

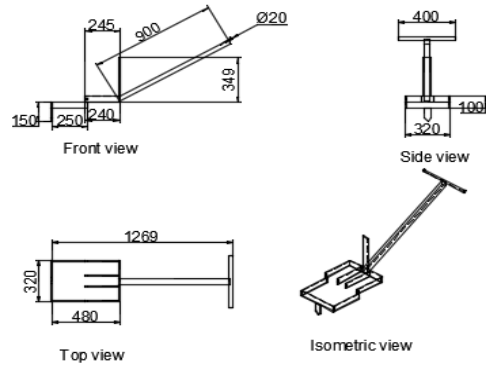


Fig. 4.2 Main Frame Fig

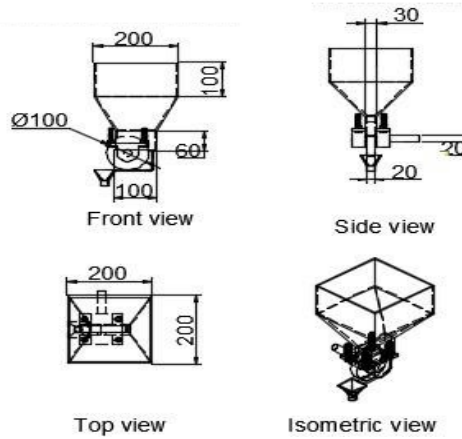


Fig. 4.3 Seed dispenser

6. DESIGN ANG FABRICATION OF SEED SOWING AND PLOUGHING MACHINE

6.1 Components used

1. Mild steel sheet metal: Specifications:- Thickness:-2 mm



Fig.6.1 Mild steel sheet metal



Fig. 6.2 Flat bar



Fig.6.3 Steel pipe



Fig.6.4 Wheel

6.1.a Bearings(UC 204):-

Ball bearings are used to provide smooth, low friction motion in rotary applications. Ball bearings are able to provide high performance and long lifetime in order to transfer the load from the balls to the inner races. The balls have minimal contact with the inner and outer races due to their spherical shape and this allows them to spin smoothly. Bearing is selected on standard size of the shaft diameter.



6.1.b Chain drive

This is a combination of sprockets and chain used to transmit power between the two shafts .Here the direction of rotation of both driving and driven shafts having chain drive will be the same. There will be no slippage during transmission in this type of mechanisms and the maintenance is also very easy and reliable

compared to other mechanisms.

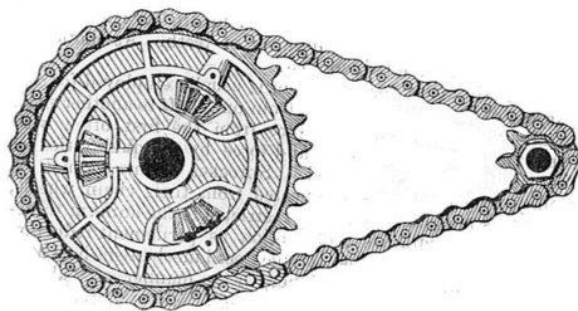


Fig 6.6 Chain drive
6.1.c. Main frame

The main frame is constructed using 2 inch flat bar and 20*40 mm mild steel square pipe. And for the handle 20 mm diameter pipe is used . The main frame has all provisions to install wheels , plough and seed dispenser. First the 2 inch flat bars are cut and a basic frame is welded. To install the wheels groove is made and for guiding the machine handle is welded. A frame to install the seed dispenser is also provided.

6.1.4 Fabrication



Fig. 6.7 Fabrication

6.1.d SEED DISPENSING MECHANISM:-

The seed dispensing mechanism consists of a hopper which is made up of 14 gauge sheet metal. The sheet metal is cut according the the required dimension and is welded sanding operation is carried out to give it a good finish. Now the bearing mountings are made using 2 inch flat bar. The holes for installing bearings are drilled and bearings are installed. The seed dispensing wheel is installed later and a sprocket is mounted in the shaft of the seed dispenser. Now chain drive is installed between the sprockets of wheel and seed

dispenser. To place the dispensed seeds properly on the ground a funnel and pipe combination are used.



6.2 Calculations of seed sowing machine

- Sprocket ratio of wheel and dispensing wheel is 1:1
- When wheel completes 1 rotation the dispensing wheel also completes 1 rotation.
- For demonstration purpose we are using dispensing wheel of ground nut seeds.

6.3 Circumference of the wheel

$$2\pi r = 2 * 3.14 * 177.5 = 1114.7\text{mm}$$

When the wheel completes 1 rotation 1114.7mm is covered on the ground. The seed spacing for ground nut is 250mm

Number of grooves in the wheel (dispensing wheel)

$$\begin{aligned} &= \frac{5 \text{ circumference}}{\text{seed spacing}} \\ &= \frac{1114.7}{250} \\ &= 4.4 \cong \end{aligned}$$

5 grooves are required for ground nut

Seed spacing for Jower -200mm

Number of grooves in the dispensing wheel = circumference / Seed spacing

$$= \frac{1114.7}{200} = 5.5 \cong 6$$

6.4 Volume of the hopper

- The hopper is made up of a square prism and truncated square prism
- Volume of square prism

$$\begin{aligned} V &= a^2 * h \\ &= 19.6 * 19.6 * 10 \end{aligned}$$

$$V = 3841.6\text{cm}^3$$

6.5 Volume of truncated square pyramid

$$\begin{aligned} V &= \frac{1}{3} (a^2 + b^2 + ab) * h \\ &= \frac{1}{3} ((19.6)^2 + (5)^2 + 19.6 * 5) * 10 \\ V &= 1690.5 \text{ cm}^3 \end{aligned}$$

Total volume of hopper = Volume of square prism + Volume of truncated square pyramid
Total Volume = 5532.1 cm³

6.5.6 Amount of peanut that hopper can hold

- Total volume of hopper = 5532.1 cm³
- Total volume of 100grams of peanut (shelled) = 156 cm³

$$\begin{aligned} \text{Volume} &= \frac{5532.1 \text{ cm}^3}{156} \\ &= 3546 \text{ grams} \end{aligned}$$

The hopper can hold 3546 grams \cong 3kilogram of ground nut

6.7 Working principle

Fig a shows manual seed sowing machine. It has a frame constructed from 2 inch flat bar and 20*40 mm rectangular mild steel pipe. It has provisions for installation of wheels and seed dispensing mechanism. To guide the machine a handle made up of 20*40 mm and 20 mm diameter mild steel pipe is used. A plough made up of 2 inch flat bar is used in the front to make a small trench in the ground to sow the seeds. A hopper made up of 14 gauge sheet metal is used to store the seeds. The seed dispensing wheel is fitted inside the hopper using bearings. The seed dispensing shaft is fitted with a sprocket. Another sprocket is fitted to the wheel. This sprockets are linked through chain drive. When the machine is give a push the wheels start to rotate hence the seed dispensing wheel also rotates this make s the seed to come one by one through the groove provided in the dispensing wheel. The number of groves provided on the wheel determines the number of seed to be dispensed and seed spacing. Now to drop the seed exactly in the small trench a funnel and pipe combination is used. after the seeds are dispensed they fall inside the funnel and go through the pipe to fall in the trench. The seed dispensing wheel can be change according to the seed used and seed spacing required. The number of seed dispensing wheels can also be increased to cover multiple rows now once the sowing is done the seeds should be covered. in order to do it a metallic bar is attached behind the machine and it is simply dragged over the small trench. This covers the trench with soil

and finishes the process.



FIG.6.9 Seed sowing and Ploughing machine

6.8 Expected outcome:

- The hopper will have enough space to hold many seeds and constant refilling of seeds shall be avoided.
- The machine shall be light weight and can be easily carried from one place to another
- The machine can be pushed with much less effort and the seeds can be sown easily.
- The machine shall require less maintainance.
- The seeds after sowing shall be effectively covered by the metallic bar attached to the end of the machine

7. RESULTS AND DISCUSSIONS

7.1 Time consumption

The manual seed sowing machine was tested on a well prepared land. The machine was operated by different members and the time take for the machine to groove the land , dispense the seed and cover the ground after sowing the seed was measured using stop watch. The length of the land which was worked on was 20meters. Different members operated the machine completing one lane at a time. The time recorded is for 20 meter single lane .

Trails	Time consumption in seconds
Trail 1	38.8
Trail 2	42.1
Trail 3	44
Trail 4	39.8
Trail 5	40
Trail 6	35.6
Trail 7	
Trail 8	
Trail 9	38.5
Trail 10	37
Average	39.6 seconds

Table 7.1: The time recorded is for 20 meter single lane

The above experiment shows that the average time taken to complete one lane (20 meters) is 39.6 seconds.

- In a plot area of 20 meter*20 meter 66 lanes of spacing 30 cm apart can be created . The time taken for the machine to complete the plot of 20*20 meter shall be 43 minutes(we are supposed to get this value in actual use when a 20*20 meter land is sown with seeds

- .when sowing seed for 20meter*20 meter plot the time taken was around 47 minutes. The additional time is due to the time taken while changing the lane and also in the field the porosity of the soil in different areas also effects the speed of operation.

- 1 acre is 4046 square meters . 400 square meters is covered in 47 minutes and 1 acre of land shall be covered roughly within 8 hours.

7.2 Seed spacing errors

The seed spacing errors of the machine was measured randomly in 10 trails after the seed landed in the groove. After the seed was dispensed from the hopper and the seed landed in the groove which is created by the plough , the seed distance from another seed was measured and the data was recorded.

Table 7.2 Seed spacing and errors

Trails	Seed spacing in cm	Error in cm(theoretical distance –seed spacing)
Trail 1	23	2
Trail 2	24.2	0.8
Trail 3	25	0
Trail 4	24.4	0.6
Trail 5	25	0
Trail 6	25	0
Trail 7	24.3	0.7
Trail 8	24	1
Trail 9	24.9	0.1
Trail 10	24.5	0.5

Average error value=0.57cm

Percentage error of the machine=(average error value*100)/theoretical distance
Percentage error of the machine=(0.57*100)/25

Percentage error of the machine =2.28 %

The above percentage error value is very very small and it does not effect the entire agriculture process.

7.3 SEED REFILLING

- While sowing seed for a plot are of 20 meter * 20 meter the hopper consumed 3168 gms of ground nut seeds.

- We can roughly say that for covering a 400 square meter land the hopper should be refilled once.

7.4 PERFORMANCE

- The machine can be considered as a prototype since future upgrade of the machine is possible.

- The machine when tested for time consumption provides assuring result to furthur upgrade it for multiple lane use .

- The errors in the machine are due to shakes and resistance force applied by the soil while making groove.

- The plough can be further upgrade with high carbon steel to avoid wear/scratches. The problem is with the paint , it goes when in use . So plough with high carbon steel without paint is preferable.

- The minimum time required to change the dispensing wheel is around 10 minutes.

Since the machine was built with limited manufacturing process and sources , only the concept could be developed roughly. The wheel changing time can be reduced if custom parts are manufactured.

- The machine uses a sprocket with ratchet mechanism , the seed is only dispensed only if the machine is pushed in forward direction. To carry it to a different place without dispensing seed it needs to be dragged in reverse direction.

8. CONCLUSIONS

At the end of the results obtained by the analysis made on this work the following conclusions were made as follows

- The attachments available for tractors and tiller cost around 50000-90000 rupees. These attachments can be used to sow seeds. The time taken to cover 1 acre is around 2-2.5 hours

- But manual seed sowing machine focuses on reducing the cost so that poor farmers can use better modern equipments rather than traditional methods.

- The manual seed sowing machine consumes almost triple the time compared to these methods. This is due to single lane concept done in the prototype. The prototype can be upgraded for completion of double lane and can be made to almost match with these sophisticated and costly machines.

- Above all these points it eliminates the need of tractor / tiller. The framer need not think about huge investments and can easily go for these machines.

- In terms of budget , maintenance and operation the user can get satisfied results from manual seed sowing machine.
- Since the mechanism is less complex the machine requires less maintenance and is also pocket friendly.

Fabrication of Seed Sowing Machine”
International Journal of Mechanical and
Production Engineering Research”Vol-6
Issue-3 2020 IJARIII-ISSN(O)-2395-2412.

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