

# Automatic Seed Drill for Finger Millet Based Intercropping System

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**Abstract** - Presently, small land holding farmers mostly use bulls for land preparation. Manual method of seed planting, results in low seed placement, low crop yield and serious back ache for the farmer which limits the size of field that can be planted. The cost price of imported planters has gone beyond the purchasing power of our farmers. Automatic seed drill for finger millet based intercropping system is focused on the design and fabrication of seed drill equipment which is used for sowing, leveling and weed removal process. The seed drill has the capability of delivering the finger millet and pigeon pea seeds precisely with uniform depth in the furrow, and also with uniform spacing between the seeds. The seed drill equipment is very simple to use, the various adjustments are made with ease, and it is of less maintenance.

**Key Words:** Seed box, Furrow openers, Finger millet gear, Pigeon pea gear, Ground wheel, Engine assembly, etc

## 1. INTRODUCTION

Agriculture has been the backbone of the Indian economy and it will continue to remain so for a long time. Agriculture is a branch of applied science. Agriculture is the science and art of farming, which includes cultivating the soil, producing crops and raising livestock. It is the most important enterprise in the world.

Modern agricultural techniques and equipments are not used by small land holders because these equipments are too expensive and difficult to own. The use of hand tools for land cultivation is still predominant in India because tractors require resources that many of the Indian farmers don't have.

Automatic seed drill for finger millet based intercropping system is a equipment which helps to sow the finger millet and pigeon pea seeds in an order by providing proper spacing between them.

### 1.1 Advantage of automatic seed drill over other tractor drawn equipment

The tractor drawn equipments cannot be owned by most of the Indian farmers, as the cost is very high and the maintenance cost incurred is also more. But the automatic seed drill is of low price. The seed drill is not only used for the seed sowing process, it can also be used for the seed removal and leveling of the land. The tractor drawn equipments can only used by skilled person, whereas the

seed drill can be operated by the farmer easily and he can make use of the machine whenever there is requirement.

### 1.2 Problem identification

On surveying, some of the problems that we identified in the agricultural method used in India are :

- Traditional seed sowing process are followed, which requires more labour.
- Seeds are not sowed in proper manner which leads to poor production of crops.
- Weed removal. Because of not giving the proper distance between the seeds the weed removal process is difficult.

### 1.3 Solution for above problems

The automatic seed drill is designed and developed to assist the small farmers in the seed sowing process. One person can handle the entire equipment which reduces the number of workers required. The seeds are sowed in an order by providing the necessary space between them, which increases the productivity. The furrow openers are used to remove the soil during the sowing process. Due to the space provided the weed removal becomes easy. The furrow openers can also be used as the weed remover by varying the height. The equipment is provided with an engine to pull the entire equipment and the speed can be varied with the manual accelerator.

## 2. MAIN COMPONENTS USED IN THE PROJECT

1. Frame
2. Seed box assembly
3. Furrow openers
4. Finger millet gear
5. Pigeon pea gear
6. Ground wheel
7. Guided pipes
8. Engine

### 2.1 Component details

#### 2.1.1 Frame

The frame is the main part in the equipment on which all the other parts are mounted. Handle, hopper assembly, furrow openers, engine, ground wheel, back wheel and front wheels are mounted to frame. The frame is made of one inch square mild steel material. The frame bears entire load which is

acting on the equipment and transfer that to ground through the front wheels and the back wheel.



Fig 1 : Frame

### 2.1.2 Seed box assembly

The seed box assembly is consisting of the seed box, shaft, seed gears, funnel and plate to cover the seed box. The seed box is placed with the help of stand which is made of mild steel. The seed box will be having five compartments i.e. one is for pigeon pea and other four for finger millet. Each compartment will be having seed gear which picks the seed from the seed box and drops that into the funnel. When the ground is wheel is rotated it transforms the rotation to the shaft through the chain and sprocket mechanism. The gears are mounted on the shaft, which are rotated when the ground wheel is rotated. The seed box assembly is attached to the frame through the nut and bolt system, which makes the assembly to remove whenever it is not required.

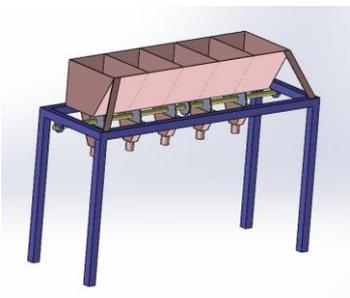


Fig 2 : Seed box assembly

### 2.1.3 Furrow openers

The furrow openers are attached to the frame through the nut and bolt system. The depth of soil removal can be varied by shifting the nuts to other slots provided on frame. The openers are made little bent in order to remove the soil easily. Five furrow openers are provided in the equipment which can plough the soil in five rows at a time.

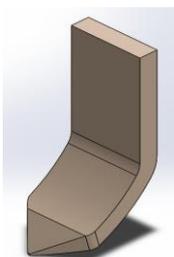


Fig 3 : Furrow opener

### 2.1.4 Finger millet gear

The finger millet gear is the one which is present in the seed box. This gear will be having 14 teeth on it. The seeds are picked when the space over the gear comes into the box and it drops the seeds into the funnel. The gear helps to pick the right amount of seeds and avoid more dropping of the seeds. Four finger millet gears are used in the equipment.

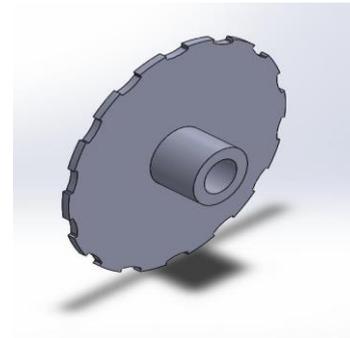


Fig 4 : Finger millet gear

### 2.1.5 Pigeon pea gear

The pigeon pea gear is also present in the seed box. The pigeon pea gear will be having 10 teeth on it. Here only two or three seeds are picked when one teeth comes inside the box. Only one pigeon pea gear is used in the equipment. The pigeon pea gear will be having more thickness than the finger millet gear.

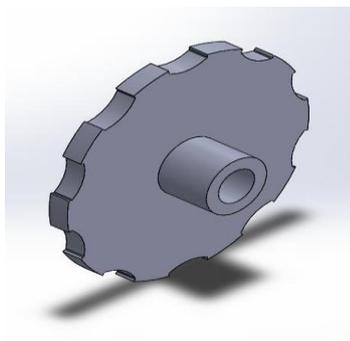


Fig 5 : Pigeon pea gear

### 2.1.6 Ground wheel

The ground wheel is constantly in contact with the ground. During the forward movement of the equipment, the ground wheel rotates with grip from the soil. When the ground wheel is rotated, it makes the shaft of the seed box to rotate as it is in contact with it through the chain and sprocket mechanism. The shaft rotation makes the seed gears to pick the seed from the box and makes the seeds to fall into the funnel.

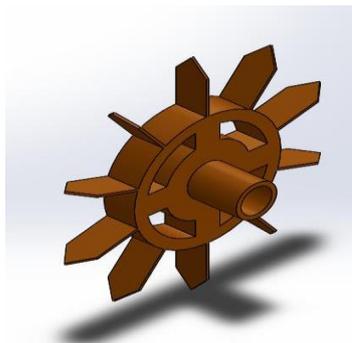


Fig 6 : Ground wheel

### 2.1.7 Guided pipes

Guided pipes used here are made of plastic material. The pipes are connected from funnel to the metallic pipes fixed to the main frame. The pipe helps the seed to flow from funnel to the ground through a fixed pipe which is present on the frame.

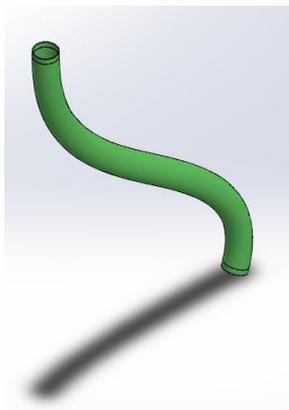


Fig 7 : Guided pipe

### 2.1.8 Engine

Honda activa four stroke petrol engine is used to drive the machine. The engine can be started with battery as well as by kick start method. The engine is fixed to the main frame with nut and bolt. The engine is capable of developing a maximum power of 8.16 PS @ 7500 rpm and it is air cooled engine. The engine has a compression ratio of 9.5:1



Fig 8 : Engine

## 3. DESIGN AND CALCULATIONS

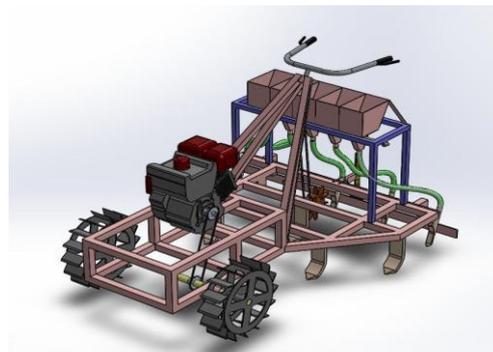


Fig 9 : Assembled view of the automatic seed drill

### Design of chain and sprocket

$P=3.6\text{kw}$  Power transmission

$n_1 = 3000$  rpm

$n_2 = 3000$  rpm

### Pitch of chain

$$P=25 (900/n_1)^{2/3}$$

$$P=25 (900/3000)^{2/3}$$

$$P=11\text{mm}$$

### Number of teeth on sprocket

$Z_1 = 18$  (used two sprockets of same number of teeth and specification)

$$Z_2 = 18$$

### Pitch diameter

$$d_1 = P / (\sin (180/Z_1))$$

$$d_1 = 11 / (\sin (180/18))$$

$$d_1 = 63.3\text{mm}$$

Another sprocket is also same diameter

$$d_2 = 63.3 \text{ mm}$$

### Velocity

$$v = PZn_1/60000$$

$$v = 11*18*3000/60000$$

$$v = 9.9 \text{ m/s}$$

### Required pull

$$\text{Power} = N=F_0v/1000 k_s k_l$$

$$N = F_0v/1000 k_s k_l$$

$$K_L = \text{load factor} = 1.1-1.5 \text{ (Assume 1.3)}$$

$$K_S = \text{Service factor} = 1.2$$

$$3.6 = F_0*9.9/(1000*1.3*1.2)$$

$$F_0 = 3.6*1000*1.3*1.2/9.9$$

$$F_0 = 567.27 \text{ N}$$

**Allowable pull**

$$F_a = F_u / n_0 \quad (n_0 = \text{factor of safety})$$

$$\text{Factor of safety} = 14.8$$

$$F_u = 4900 \text{ standard}$$

$$F_a = 4900 / 14.08 = 331.209 \text{ N}$$

**Number of strands**

$$i = F_\theta / F_a$$

$$i = 567.270 / 331.2 = 1.712$$

$$i = 2$$

**Check for the actual factor of safety**

$$n_a = \{F_u / (F_\theta + F_{cs})\} * i$$

$$F_\theta = 1000N/v = 1000 * 3.6/9$$

$$F_\theta = 363.6 \text{ N}$$

$$F_{cs} = \omega v^2 / g$$

$$F_{cs} = 1273.8 \text{ N}$$

$$F_s = K_{sg} * \omega * C$$

$$\text{For horizontal drive } K_{sg} = 6$$

$$C_{min} = C = 30p \text{ to } 50p$$

$$C_{min} = 30 * 11 = 330 \text{ mm}$$

$$C_{max} = 50 * 11 = 550 \text{ mm}$$

$$\text{Take } C = 450$$

$$F_s = 6 * 127.5 * 450 / 1000 = 344.25$$

$$\eta = [4900 / (363.6 + 1273.8 + 344.25)] * 2$$

$$\eta = 16.231$$

$$\eta_a > \eta_o$$

$$13.23 > 14.8$$

Since selection of chain is safe.

$$L_p = 2C_p \cos \alpha + (Z_1 + Z_2) / 2 + \alpha (Z_1 - Z_2) / 180$$

$$\alpha = \sin^{-1} [(d_2 - d_1) / 2C]$$

$$\alpha = 0$$

$$L_p = 2 * 40 \cos (0) + 18$$

$$L_p = 98 \text{ Pitches}$$

**Length of chain**

$$L = L_p * P$$

$$L = 98 * 11 = 1078 \text{ mm}$$

**Correct Center distance**

$$L_p = 2C_p \cos \alpha + (Z_1 + Z_2) / 2 + \alpha (Z_1 - Z_2) / 180$$

$$98 = 2C / 11 + 18$$

$$C = 80 / 0.18$$

$$C = 444$$

**4. WORKING OF THE SEED DRILL**

The seed drill is operated with the help of engine driven system. When the engine is accelerated, it drives the front wheels, which drags the entire machine. Furrow openers present in the equipment removes the soil when the machine moves forward. The furrow openers remove the soil up to a depth of 2-3 inch. The furrow openers height can be varied with the help of nut and bolts. The seed box can be dismantled when there is no need of it. The forward movement of the equipment makes the ground wheel to rotate. The rotation of the ground wheel makes the shaft of the seed box to rotate with the chain and sprocket mechanism. The rotation of the shaft makes the seed gears to rotate which picks the seeds from the box and drops them into the funnel.

There will be five compartments in the seed box out of which one is for pigeon pea and other four are for finger millet. There will be five furrow openers which removes the soil in five rows at a time. The pigeon pea and finger millet are sowed in the lane ratio of 2:8. i.e. for every 10 rows there will be 2 rows of pigeon pea and 8 rows of finger millet. The guided pipes are connected to the funnel through which the seed flows to the ground. The equipment can be also used for ploughing by removing the seed box assembly.



Fig 10 : Fabricated automatic seed drill image

**5. ADVANTAGES**

1. Reduces the cost involved in the seed sowing process.
2. The machine can be easily handled by a single person and doesn't require any skilled operator.
3. Consumes less time when compared to traditional methods.
4. The machine helps to place the seeds properly by providing necessary space between them, which also increases the productivity.

5. The weed removal also becomes easy due to the space provided between the seeds during the sowing process.

## CONCLUSION

The project reduces the number of labour required during the seed sowing process, which also reduces the cost incurred in this process. The maintenance and machinery cost is less compared to other tractor drawn equipments. The project helps to do the agriculture using the scientific method of providing proper spacing between the seeds. The equipment performs the seed sowing fastly which reduces the time required. As the engine is used to drive the machine, the effort required by the human to push the equipment is reduced and the speed can be varied through the accelerator.

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