WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Design and Development of Inter Row Weeder with Fertilizer Applicator

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A B S T R A C T

Excess harmful weeds are devastating problem in most of the part of India. If it is not controlled in the beginning, it will reduce the final yield as well as deteriorate in quality of the product. For this problem weeding through manual process is generally adopted. Weeding through rotary weeder is also practiced now days for easy removal of weeds. In the present study a tractor operated multi row rotary weeder was considered for studying its performance on sugar cane field. The relation of row spacing with different components such as field efficiency, speed of operation, weeding efficiency and cost of operation was also studied.

Keywords: Weeds, yield, row spacing, field efficiency, multi row weeder

1. Introduction

Ever since man started growing crops he had come up with the problems of weeds, which are undesirable growth in a farm. Farmer's researchers are putting up a combined front to tackle the menace of weeds. Weed control in farms is a serious concern. Weeds pose major problem during warm and humid climate especially affecting crops. The problem of weed control is more acute in black soil during rainy season. Weed control is one of the most expensive operations in crop growth. A weed is essentially any plant which grows where it is unwanted. A weed can be thought of as any plant growing in the wrong place at the wrong time and doing more harm than good. Weeds waste excessive proportions of farmers' time, thereby acting as a brake for the development, Weed control is one of the most important aspects in the present agriculture. Among the control methods are mechanical, chemical, biological and cultural. The mechanical control of weeds is most widely used. It is the simplest method of weed control being followed by man since agriculture came into practice. The chemical method involves scientific knowledge on the subject and the health hazard involved that scared some of our traditional farmers coupled with the cost.

Problem statement

The Weeding and fertilizer application are most tedious and laborious field operation in crop production. At present the unavailability of timely labour and high labour wages is a serious issue in field crop cultivation So to avoid this type of problem and save labour wages and time we are going to design and develop the multipurpose machine

Common Problems

Labour not available on time.

Time consuming processes.

Big size of bag inconvenience to the operator of fertilizer .

Poor selection and quality of equipment.

Due to heavy weight during spraying, operator feels very tiredness and fatigue which reduces his efficiency.

These problems combined with a lack of awareness and technical knowledge and inadequate maintenance and poor field use of equipment has led to unacceptable risks to environment and human health.

Objectives

Aim of this project is simplify the seed sowing and the fertilizer application process.

To reduce human efforts due to the constant and load of the fertilizer carrying & continuously change the hand for application of fertilizer. This at a long run is a tiresome and cumbersome job and the farmer slowly loses interest from it.

This project focuses on the problem of health-related issues of the farmer (operator). Majority of them don't use any precaution like face masks and hand-gloves against the hazardous chemicals and working direct contact with it. Consequently, this harms the farmer as the spray in the conventional method directly hits the face.

To reduce the overall cycle time for agricultural weeding & seed sowing &fertilizer sprayer.

Multi nozzles are used and hence large area of field can be spread at a faster rate.

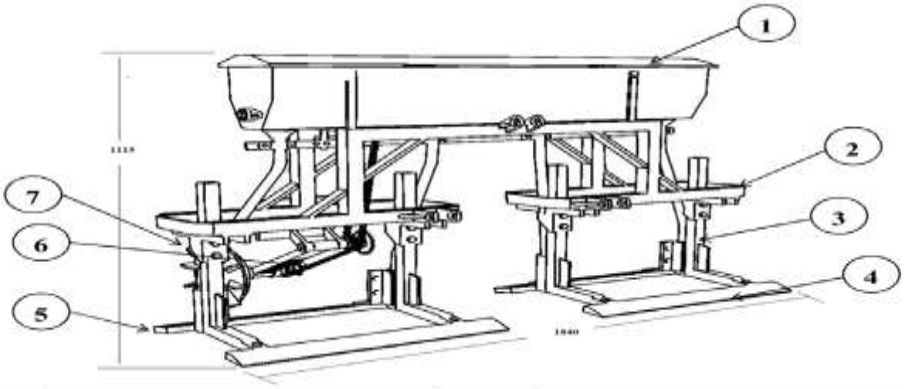
2. Methodology

The inter-row weeder cum fertilizer applicator suitable for wide row crops like cotton, chilli and red gram was developed in association with M/s Gayatri Vishwakarma Industries, Vijayapur to operate two rows at a time.

Crop, weed and, soil parameters

The agronomic parameters of crop, weed and soil parameters were studied prior to the evaluation of tractor operated inter cultivator cum fertilizer applicator. The important crop parameters which influence the mechanical weeding of field crops were identified as variety, row spacing and height of crop. The operational response of implement is influenced by type of crop since the crop types are found to differ in their growth factor and foliage, which also varies for each variety. The row to row spacing and intra row spacing also affects weed biomass which has to be handled by the implement. Weed parameters namely, type of weeds, root length and weed density were measured before evaluation. Weed removal process alone or in combination with intercultural operation is being taken up at different time intervals. Two or three such operations are preferably carried out by the farmers in the crop cycle of wide row crops. In normal conditions, weeding after 30, 60 and 90 days after sowing (DAS) is recommended practice and it varies with type and variety of crop. The soil properties relevant for inter cultivation were identified as soil type, soil moisture, bulk density and cone index. Type of soil was determined using international pipette method. Soil moisture content was determined by hot air oven method in which five soil samples of known weight were oven dried for 24 h at 105° C temperature and final weights were recorded and then the moisture content of soil was computed. Cone index of soil is a measure of resistance offered by the soil to the penetrating tool. It was determined using a standard cone penetrometer.

3. Structure



S. No.	Component	S. No.	Component
1	Fertilizer box	5	Covering device
2	Main frame	6	Power transmission system
3	Tine	7	Ground wheel
4	Weeding blade		

Tine

Two tines were attached by means of two support flats to the frame at their extremities which are made from mild steel. The tine was made of MS hollow box of size 845 × 30 × 30 mm.

Weeding blade

A carbon steel bevel edged flat was bolted at the bottom of tines as a weeding tool. It had dimensions of 760 mm length, 50 mm width and 12 mm thickness with length of bevel edge and bevel angles being 35 mm and 15 deg, respectively.

Fertilizer box

The fertilizer box was mounted over the support frame and bolted to four MS flats for additional support which are welded to support frame. It was made of MS sheet of thickness 2 mm by shaping it to the trapezoidal form. The fertilizer box had overall dimensions of 1430 × 180 mm.

Fertilizer feed cups

Four funnel type fertilizer cups were provided to collect the metered fertilizer to pass through the transparent fertilizer tube which connects fertilizer boot fitted at rear side of the tine and the funnel. A covering device is provided at the rear end of the plate to cover the soil over the dropped fertilizer which was made of hollow MS rectangular box.

Power transmission system

The power transmission to the fertilizer box was accomplished through the chain drive from the ground wheel of diameter 418 mm with 12 lugs made up of MS flats. The ground wheel was mounted on the axle of size 225 mm length and 25 mm dia. The power was transmitted from the sprocket mounted on ground wheel axle to the fertilizer feed shaft through an intermediate sprocket with the transmission ratio of 1.5:1.

Fertilizer metering mechanism

Variable orifice with rubber agitator type fertilizer metering mechanism was provided to meter the granular fertilizer at uniform rate. Four numbers of (two for each row) rubber agitators were provided. A bottom plate having eight different sized holes to match different sized fertilizer and fertilizer rate were provided for each outlet.

Performance evaluation of inter-row weeder cum fertilizer applicator

The inter-row weeder cum fertilizer applicator was calibrated in the laboratory to optimize the fertilizer application rate at three different speeds varying from 3 to 5 km h^{-1} at three different hopper levels (Full, $3/4^{th}$ and 1/2) and at minimum, medium and maximum opening holes of bottom orifice plate. The experiments were designed in Response Surface Methodology (RSM) in Design Expert software. The experiments with different coded levels are show. Optimization of operational parameters was done using numerical optimization procedure in Design Expert statistical package.

4. Cost Estimation

4.1. Total Project cost

s.r no	Part	Cost
1	Frame	7000
2	Tine	3500
3	Pipe	1620
4	Gear box	8000
5	Wiper motor	4000
6	Tank +pump	5000
7	Blades	1000
8	Other accessories	3000
9	Operational cost	7000
	Total Cost	**40120**

4.2. Cost Comparison

Sr no	Parameter	Conventional Method	Own Tractor	Rental Tractor
1	Seed Sowing	12500	4000	12000
2	Weeding And Fertilizing	15000	4000	6000
3	Weeding Spraying Pesticide	15000	4000	6000
Total Cost		**42500**	**12000**	**24000**

5. Working

5.1 Seed Sowing And Fertilizer Application At A Time

- **Drilling:**

When the machine gets pulled by using the tractor or manually, its first task is to drill the soil by setting the depth of drill. When the machine gets moved, the wheels starts rotating and drill also moves with respect to the puller. By this the drilling process gets completed.

- **Seed sowing:**

Wheels are connected to the circular plates that are situated below the hoppers. Both the wheels and plates are connected to each other by shaft and gear. The seeds are filled into the hoppers to be get sowed into the soil. When wheel starts rotating, the plate along ets rotated as they are connected to each other. The hole on the plates coincides with the hopper hole, and the seed gets dropped through this hole to be get sowed into the soil.

- **Fertilizer application:**

As like seed sowing operation the wheels are connected to the circular plates that are situated below the hoppers. When the machine gets pulled by using the tractor Both the wheels and plates are connected to each other by shaft and gear. The fertilizer are filled into the hoppers to be get sprayed into the soil. When wheel starts rotating, the plate also gets rotated as they are connected to each other. The hole on the plates coincides with the hopper hole, and the fertilizer gets dropped through this hole to be get spray into the soil.

5. 2. Inter Row Weeding And Fertilizer Applicator

While doing inter-row weeding and fertilizer application that time we have to remove hopper and hose / pipe of seeds and attached the weeding blades below to the tines.

- **Inter- row weeding**

As we attached the weeding blade below the tines and with the help hydraulic pressure of the tractor the mechanism get pushed down and when we drive the tractor it moves forward and weeding performed.

- **Fertilizer application**

When the machine gets pulled by using the tractor the wheels are connected to the circular plates that are situated below the hoppers. Both the wheels and plates are connected to each other by shaft and gear. The fertilizer are filled into the hoppers to be get sprayed into the soil. When wheel starts rotating, the plate also gets rotated as they are connected to each other. The hole on the plates coincides with the hopper hole, and the fertilizer gets dropped through this hole to be get spray into the soil.

Result And Discussion

- **Crop, weed and soil parameters**

Different crop, weed and soil parameters were measured in field prior to evaluation and average values are tabulated in Table 2.

- **Crop parameters**

The average row to row spacing of red gram was observed to be 92 cm and it varied from 85 to 98 cm. Average plant height of the red gram after 60 DAS was measured to be 52 cm. The equipment was operated in the TS3R variety of red gram crop which is dominant variety in the study area.

- **Weed parameters**

Common weeds identified in the red gram field were Eleusine indica, Echinocloa crusgalli, Ageratum conzoides, and Launaea cornuta. Length of roots of identified weeds varied from 60 to 95 mm with an average value of 88 mm. Average weed density was measured to be 36 weeds m^2.

Advantages

- This machine is adequetely designed with auto seed feeding system planting channel for optimal growing conditions.
- It is adjustable as per requirement of row spacing.
- Better Engine Performance
- Convenient feature.

Disadvantages

- Higher costs
- Will increase cost of vehicle
- Regular checking is required

Application

- Seed sowing and fertilizer application at a time.

Conclusion

- While working on the project we have conclude that the process of sowing and fertilization, fertilization and weeding, weeding, and seed sowing we have already take trial on it which is surely perfect and beneficial to the future scope .

Future Scope

- We will add pesticide sprayer to our mechanism which will helps the farmer to minimize the labour also to save cost and time and will work simultaneously and more efficiently in common mechanism.

Acknowledgment

We would like to express our gratitude to our Guide for providing support and guidance. We got to learn a lot more from this project, which will be very helpful for us, in our future endeavours.

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