

Design and Development of Fertilizer Spraying and Weed Removal Machine

M.R.Rawal¹, OmkarPowar², Pratiksha Pawar², Shwetakshirsagar² and KamleshMulik²

¹Assistant Professor, ²Student, Dept. of Mechanical Engineering, DKTE Textile & Engineering Institute Ichalkaranji, Kolhapur, Maharashtra, India
E-mail:manjunathrrawal61@gmail.com

Abstract - In order to meet the food requirements of the growing population and rapid industrialization, modernization of agriculture practices is need of today and crucial one. Mechanization enables the conservation of inputs through precision in metering, ensuring the better distribution and reduces the quantity required for better response. In addition to that it prevents the losses or wastage of inputs applied. Mechanization reduces unit cost of production through higher productivity and optimized input. Though modernization is done in agriculture field, many farmers are using the traditional methods and equipment for weeding and fertilizer spraying. The spraying is traditionally done by labor carrying backpack type sprayer which requires more human effort or it is done by fertilizer spraying unit tractor, which is not affordable and suitable for many agricultural fields as per the cultivation. Weeding is usually done with the help of bulls, which is very costly for farmers with small arable land. To overcome these above two problems a machine is developed on which both the tasks are performed simultaneously and beneficial to the farmer for the spraying and weeding operations.

Keywords: Sprayer, Weed Removal, Equipment, Fertilizer.

I. INTRODUCTION

India is a country where nearly 70% of people lives in rural area and main source of their income is farming, directly or indirectly. Though majority of people doing farming, we are not able to produce the crops to the full capacity. The main concern is, farmers are not using technology/mechanization very effectively. To overcome some lacuna, the concept of combined weed removal and spraying machine come into mind which will help to save time, money and increase the productivity. It's a need to make economic machinery/equipment, so farmers can purchase it.

Present scenario of agricultural field in India for fertilizer spraying is, hand operated sprayer or motorized sprayer is used. Here a small four wheel kart or vehicle is designed and developed, which is operated by a wireless remote runs on power source as a DC battery. One vertical arm is attached at center of vehicle on which a horizontal arm is fixed. Nozzle is fitted to these arms so that it can spray pesticides on both the sides. As nozzle are fitted either side of frame spraying is done rapidly due to which both time and money are saved. As a developing country, farmers also need to change the way of agriculture practice from traditional to more "Sophisticated" and "Advanced

mechanization". Which will decrease overall time for the task to be performed. Now the world realizes that in order to meet the food requirements of the growing population, modernization of agriculture practices is must. Mechanization enables the conservation of inputs through precision in metering and ensures better distribution along with reduction in quantity requirement. Mechanization reduces unit production costs by increasing productivity and saving investment.



Fig.1 Tradition method of weed removal by Bullocks



Fig.2 Fertilizer spraying using tractor

In India, two types of agricultural equipment are used, manual (conventional method) and mechanized type.

Mechanization involves the use of hybrid devices between the power source and the field work. This hybrid devices usually transfers motion or provides ample of mechanical advantages such as increase/decrease or leverage of velocity. Agricultural machinery is used in farming or other agriculture related sectors. Mechanized agriculture machinery is used to mechanize the work of agriculture which leads to increase farm worker productivity greatly. In modern times, powered machinery has replaced many farm jobs formerly carried out by labour or by animals such as oxen, horses, and mules. The entire history of agriculture contains many examples of the use of tools such as the head and plough.

However, since the industrial revolution, the continuous integration of machines has greatly reduced the labor intensity of agriculture. The biggest profit of automation is that it saves the labour efforts and time. However, it also saves energy and input materials required leads to improve the quality, accuracy, and precision. Spraying of pesticides is done to control pest and diseases for that purpose sprayer are used as shown in figure 2. Sprayers breaks liquid fertilizer into droplets of effective size, also distribute them uniformly over the plants and regulate the amount of fertilizer to avoid excessive application, helps to avoid serious problem faced by the farmers. Considering the advantages of these technique, field performance evaluation trials of self-propelled boom sprayer were carried out in cotton and chilly field [1-3].

In India, most of the farming sectors relies on spraying by traditional technique. Mostly backpack type sprayer is used by farmers as its cheaper, handy, easily available and main thing about it is cost efficient. With the help of this machine farmer spray pesticides in their farm, but it will take lots of time and thus it is low efficient, many health related problems are arising due to direct contact and mainly not economical. As it is harmful, farmers are affected by lumbar pain and shoulder disorder due to weight of equipment. Seed feeding, pesticides sprinkling, weed removing and crop cutting are the important stages in the agriculture field. The design of multipurpose agriculture equipment machine will help Indian farmers. It will reduce the cost of pesticides sprinkling and crop cutting [4-6].

II. LITERATURE REVIEW

In India farmers are using backpack type sprayer for small agriculture field. which has to carry on back of the person with 15 lit maximum capacities, connected to hand single hand operated nozzle. Farmer has to carry it in one hand while other hand is used to pump the machine to create pressure. Another machine which was developed in England, manufactured and patented by Holme Farm Supplies Ltd. This machine consists of water tank on tractor, contains liquid pesticides. To the backside of it a long rod is connected on which nozzles are mounted for spraying. such kinds of machinery were manufactured by this company for large scale farming and big size crops.

meanwhile another machine was designed and developed in India by "MansukhbhaiJagani", attached spraying and cultivating equipment to his bike. that bike was able to furrow opening, sowing, cultivate and spray pesticides on plants. That was a revolutionary step in farming practices which leads to cost efficient for small size farms. The weeds were removed by using bullocks from ancient times as shown in fig.1. Now a days tractors are used to remove the weeds which is costly and consume more amount of fuel.

Laukik P. Raut, Smit B. Jaiswal, Nitin Y. Mohite et. al. 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. Mechanization reduces unit cost of production through higher productivity and input conservation. Farmers are using the same methods and equipment for the ages. In our country farming is done by traditional way, besides that there is large development of industrial and service sector as compared to that of agriculture.

D.Ramesh and H. P. Girish Kumar presented review on information about the various types of innovations done in weeder equipment's. The basic objective of throwing of fertilizer operation is to sow the seed and fertilizer in rows at desired depth and seed to seed spacing, cover the throwing of fertilizer 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. Weeder devices plays a wide role in agriculture field.

S. Sridhar H, studied report of agriculture every year in INDIA, an average of 1980 Cr rupees were wasted due to weeds. The mechanical weeder was made up of two attachments i.e. the primary cutting edge which is in front to loose soil at top surface and the secondary cutting edge at back which leads to do cutting and lifting of weeds. The blade is thin but very sturdy and tough besides, it is very safe to use and offers zero threat of hurting to the user. Other than wheel, there is nothing mechanization in this single wheel weeder but it works wonderfully under the condition where it is put into. This hassle free equipment requires no special maintenance. It is necessary to design the weeder which minimize the human effort and provide efficient work output.

D.Ramesh and H.P. Girish Kumar discussed the information about the various types of innovations done in weeder machine available for plantation. The weeder machine is a key component of agriculture field. The performance of weeder device has a remarkable influence on the cost and yield of agriculture products. Presently there are many approaches to detect the performance of seed-throwing of

fertilizer device. Depth of seeding has shown to be an important factor affecting seeding vigor and crop yield.

III. OBJECTIVES

Based on the literature review, the current demand is to Design and development a fertilizer spraying and weed removal mechanism for small size farming sectors which will leads to save labour efforts, time and mainly economically beneficial one. Keeping that view of point in mind a combined setup of weed removal and spraying machine is to be developed which will be electronically controlled and save amount of fertilizer and fuel consumption as compared to general practice done by tractor equipped attachments.

IV. DESIGN AND DEVELOPMENT OF MODEL

After several visits and trial on farm, one CATIA model is prepared which has electronic control unit and combined fertilizer spraying & weed removal mechanism in it as shown in figure 3. Design calculation are shown in annexure for reference. As the main moto is to develop a model which can be used in small agriculture fields by keeping cost efficient in mind. The movement/travel of is achieved by using 125cc single cylinder four stroke petrol engine. From engine crankshaft output motion is transferred to base wheels by gear box assembly. Which will help to get required output speed during weeding and spraying on field. Electronic control units are used to control the developed equipement with Bluetooth control device.

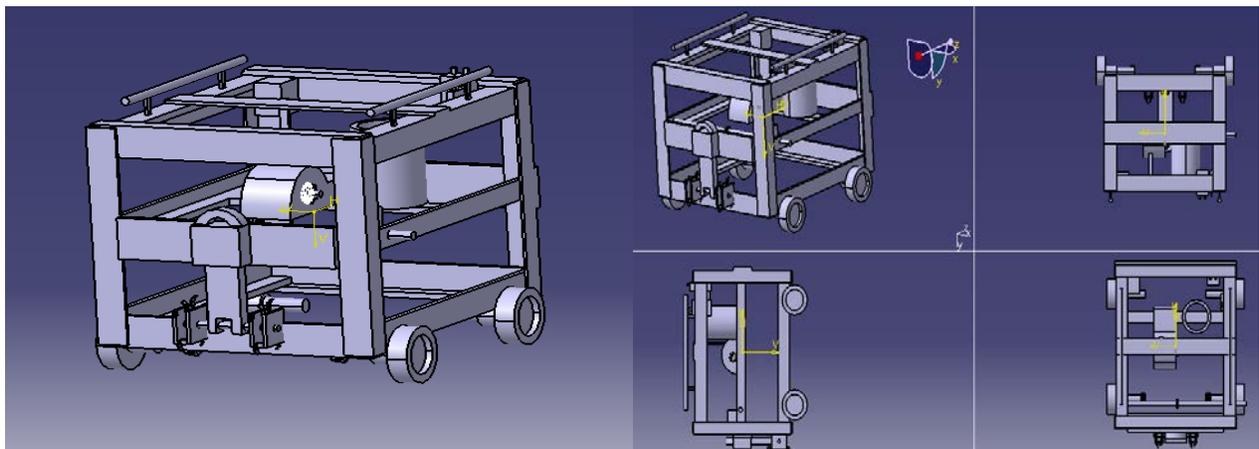


Fig. 3 Basic Catia Model

V. CONSTRUCTION

The machine consists of various parts and components which are used for transmission, Spraying and weed removal mechanism. Each of the mechanism has specific work to perform. The details of component and its functionality revealed below.

A. Transmission Mechanism

Transmission mechanism consists of four stroke single cylinder petrol engine (Activa 125cc), which is installed on the upper platform of the chassis. fuel tank is mounted on left hand side corner of the structure. It is a button start engine. The output of the engine shaft is transmitted through the sprocket wheel mounted on the it to the intermediate shaft on chain wheel.

Two sets of worm and worm wheel mechanism is used to reduce the speed of the transmission shafts. The output from the worm and worm wheel is transmitted to the wheels through Sprocket and Chain wheel Mechanism as shown in figure 4.



Fig. 4 Transmission Mechanism

B. Weed Removal Mechanism

Weed removal mechanism consist of blades which are bent in a curved shape. A single weeder consist of four blades mounted at right angle to each other. Two weeders are used to carry out the weeding function. Output power from engine is transmitted directly to the weeder through sprocket and chain wheel mechanism. The weeder can be disconnected when not in work by using screw jack mechanism as shown in figure 5.



Fig. 5 Weed Removal Mechanism

C. Spraying Mechanism

Spraying mechanism consist of a single supply two output DC motor. A 20 Litre tank is used to store fertilizer from which it is pumped with help of motor. A thin flexible pipe is between tank and DC motor through which fertilizer is supplied to motor and then to nozzles. It also consists of a two steel pipes on which the nozzles are mounted each pipe consists of three nozzles as shown in figure 6. The Motor is powered by a D.C. Battery.



Fig.6 Spraying Mechanism

Chassis-Chasis is made up of EN8 material having L section. Its dimensions are 3.5*3.5*5 ft. as shown in figure 7.



Fig. 7 Chassis

The actual photographs of designed and developed model is as shown in below figure 8.



Fig. 8 Photographs of Designed and Developed Model

VI. TRIAL AND TESTING

The fertilizer spraying and weed removal machine has wide range of working. It is a very useful and efficient in work field. It is a multitasking machine which performs two functions at a time i.e. weed removal and spraying of fertilizer. It can be used for both, for spraying fertilizer on Grapevine as well as on ground crops.

The weeder mechanism is used to remove the weeds from the soil itself. It is a adjustable type of mechanism which can be adjusted as per the height of the grown crops. It can be uplifted and move down with the help of the screw jack mechanism. The weeder rotate at a very high speed and removes the weeds from the soil by the centrifugal action. It is very useful as the weeds are removed from its roots itself and helps to enrich oxygen content require for growth of the crop.

Spraying mechanism consist of a D.C pump, steel piped nozzles and a fertilizer tank. The pump has one input and two outputs. Pump supplies the fertilizer at very high pressure to the nozzle and fertilizer is sprinkled at a high velocity on the plants.

VII. RESULTS AND DISCUSSION

The design and developed model has much better results as compared to conventional weeder and spraying machine. The results are shown in bar charts for better understanding in below figure number 9 & 10.

Figure no. 9 shows comparison for fertilizer used in litre per acre area. Whereas figure no. 10 shows results for average fuel consumption in km per litre.

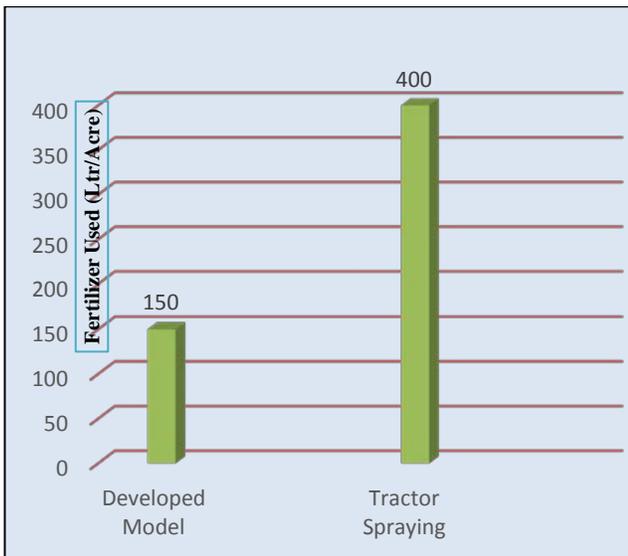


Fig 9 Fertilizer consumption per AcreFig

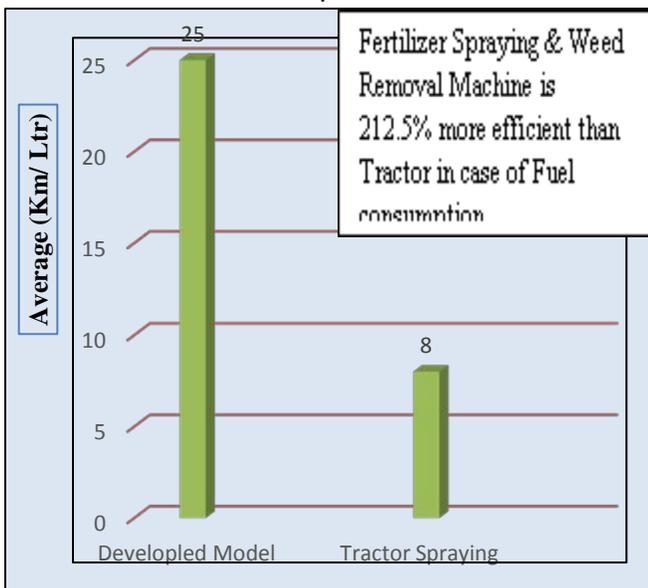


Fig.10 Average (Km/Ltr) of Fuel

Table I Shows Comparison between Developed Model and Conventional Weed Cutter with certain field work parameters.

TABLE I COMPARISON BETWEEN DEVELOPED MODEL AND CONVENTIONAL WEED CUTTER

SL.No.	Parameters	Developed Model	Conventional weed cutter
1	Weed Removal	Removeweeds completely from root	Remove weeds from surfaceonly
2	Soil Moisture Content	As the weeds are removed from the root, no water is absorbed by the weeds, so it improves the soil moisture content and makes the soil free to absorb oxygen from atmosphere.	As weeds are not removed from theroots, some water is absorbed by the weeds, thus reducing the soil moisture content.
3	Efficiency	More efficient	Less efficient

VIII. CONCLUSION

The equipment is purposely design for the farmers having small farming fields(5-6 acre). It is suitable for spraying as well as weed removal at minimum cost. When the device is operated on a smooth surface or an uneven surface, the performance of the device will be improved, and it will be more effective when it is used on crops with almost similar heights and a small space between two crops.

1. It is upgraded design of manually operated sprayer which will be helpful for small land farmers. It consumes less time and saves money as compared with conventional spraying and weed removing process.
2. Coverage area is twice that of manual spraying
3. As spraying and weed removing process is done simultaneously, leads to saving of labour cost, efforts and time.
4. Fertilizer consumption is much less as compared to conventional and tractor equipped spraying equipment. It saves near about 250 litres per acre approximately.
5. Fuel consumption is less as compared to tractor as it is operated on SI engine. leads to cost saving.

REFERENCES

[1] SayaliSalkade, Varun Salian, Gaurav Sakalgaonkar and Aashna Pawar , “Design Considerations of a Cycle Mounted Agricultural Sprayer.” *International Journal of Engineering Research & Technology (IJERT)* ISSN: 2278-0181 IJERTV3IS110566 Vol. 3, No.11, Nov.2014.

- [2] M.G.Jadhav and Prof.J.K.Sawale, "Design and Fabrication of Manually Operated Weeder with Pesticides Sprayer." *International Research Journal of Engineering and Technology (IRJET)* ISSN: 2395-0072, Vol .3, No. 12, Dec .2016.
- [3] Sandeep H. Poratkar and Dhanraj R. Raut "Development of multi nozzle pesticides sprayer pump", *International journal of Modern Engineering Researc*", ISSN: 2249-6645, Vol.3, No.2, pp.864- 868, April-2013.
- [4] Laukik P. Raut, Smit B. Jaiswal and Nitin Y. Mohite, "Design, development and fabrication of agricultural pesticides sprayer with weeder", *International Journal of Applied Research and Studies*, Vol.2, No. 11, pp.1-8, 2013
- [5] D. Ramesh and H. P. Girishkumar, "Agriculture Weeder Equipments: A Review," *International Journal of Science, Engineering and Technology Research*, Vol. 3, No.7, pp.1987-1992, 2014
- [6] Dhiraj N. Kumbhare, Vishal Singh, Prashik Waghmare, Altaf Ansari, Vikas Tiwari and Prof. R.D. Gorle,"Fabrication of Automatic Pesticides Spraying Machine", *International Research Journal of Engineering and Technology (IRJET)*, ISSN: 2395-0072, Vol. 3, No.4, Apr.2016.
- [7] T.K.Das, Ramanjit Kaur, Rishi Raj, KapilaShekhawat, Raj Singh and Anil K. Choudhary "Weed management in pigeonpea-based cropping systems", *Indian Journal of Weed Science*, Vol.47, No.3 , pp. 267–276, 2015.