

Design and Development of Overhead Travelling Pesticides Spraying Machine by using Hybrid Energy Concept

Divesh Kumar Sharma¹, Manvar Pratikkumar¹, Patel Deep B¹, Kavan Kachoria¹, Dr. Unnati A Joshi²

¹UG Student, Dept. of Mech. Engg., A. D. Patel Institute of Technology, New Vallabh Vidyanagar, Gujarat, India

²Associate Professor, Dept. of Mech. Engg., A. D. Patel Institute of Technology, New Vallabh Vidyanagar, Gujarat, India

Abstract: - As India is a land of agriculture and ranked 2nd worldwide in farm outputs. Agriculture is required to be resonated to escalate GDP of the country by improving productivity. The productivity of the crops can be increased with the help of pest control. Spraying of pesticides with suitable technique is mandatory step in cultivation of the crops. The project deals with design and development of overhead travelling pesticides spraying machine by using hybrid energy concept. The main purpose of this concept is to cover the target with maximum efficiency and minimum efforts to keep the pest under control as well as minimum contamination of non-targets. It is beneficial for the farmers in terms of cost, time consumption, movement, effort and hazard. The machine ensures the spraying of the field in single go hence saving time of the farmers.

Keywords: Indian farming, Pesticide spraying machine, Agriculture, Hybridization

I. INTRODUCTION

This chapter contains the brief description of Indian farming, agriculture and their contribution towards economy. Further it also explains the advantages, disadvantages, various techniques and classification with applications of using pesticides in various irrigation methods.

1.1 Agriculture and Indian economy:

- In India, agriculture contributes about sixteen percent (16%) of total GDP and ten percent (10%) of total exports.
- Over 60 % of India's land area is arable making it the second largest country in terms of total arable land.
- In 2013, India exported agricultural products valuing around 39 billion dollars.
- According to 2001 census, over 56.6% of the main workers in India are engaged in agricultural and allied activities.
- India ranks 2nd worldwide in farm output.
- India ranks 2nd largest producer of wheat and rice in the world.
- India is also a major exporter of rice and wheat to countries like Nepal, Bangladesh, Africa and others.

- Its gross irrigated crop area of 82.6 million hectares (215.6 million acres) is the largest in the world.

1.2 Agriculture

- The science or practice of farming, including cultivation of the soil for the growing of crops and the rearing of animals to provide food, wool, and other products

1.3 Irrigation

- Irrigation is the method in which water is supplied to plants at regular intervals for agriculture. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and vegetation of disturbed soils in dry areas and during periods of inadequate rainfall.

1.4 Pesticides

- Pesticide is a substance or a mixture that kills a pest, or it prevents or reduces the damage a pest may cause.
- Pesticide is any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest.

1.5 Why pesticide?

- Pesticide is used to modify a plant's growth or act as a drying agent.
- Pesticides are usually chemicals, but they can also be made from natural materials such as animals, plants, bacteria, etc.
- Pesticides can prevent sickness in humans that could be caused by moldy food or diseased produce.
- Pests can be insects, mice or other animals, unwanted plants (weeds), fungi, bacteria or viruses.

1.6 The success of pest control operations by pesticide application greatly depends on the following factors

- Quality of pesticide.

- Timing of application.
- Quality of application and coverage.
- Advantages and Disadvantages of pesticides.

Table 1.1: Pesticides spraying method and working range:

S no	Method	Working range
1	High volume spraying	300-500 L/ha.
2	Low volume spraying	50 to 150 L/ha
3	Ultra low volume spraying	Less than 5 L/ha

Table 1.2: Drawbacks of various spraying techniques

S no	Spraying techniques	Drawbacks
1.	Backpack spraying	Heavy to carry and causes fatigue to labor and hence reduces the human capacity
.2.	Engine operated spraying equipment	Needs fuel which increase its operational cost.
3.	Aerial spraying	Wastage of fertilizer and some crops are not totally covered.
4.	Fuel operated vehicles	Pollutes the crops.

1.7 Benefits of overhead travelling pesticides spraying machine:

- Adjustable according to the height of plants.
- Reduces labor cost.
- Time saving.
- Boom made up of stainless steel or PVC.
- Automatic operation.
- Environment friendly.
- Ensures safety of workers

1.8 A step towards hybridization

- The machine is designed as per the concept of hybridization. The machine will work by direct electricity as well as by solar power. The concept will help farmers to save much electricity in areas where poor supply of electricity is still a big issue.

1.8.1 Solar power concept

- Solar power is the conversion of the energy from the sun to usable electricity. The most common source of solar power utilizes photovoltaic cells to convert sunlight into electricity. Photovoltaic utilizes a semi-conductor to absorb the radiation from the sun, when the semi-conductor absorbs this radiation it emits electrons, which are harnessed as electricity.

II. IMPLEMENTATION

Table 2.1 Components and specifications

S NO.	COMPONENT	SPECIFICATIONS
1.	Centrifugal pump	Pressure: 100 PSI (6.8Bar) Flow: 4.0 LPM AMPS: 3.0 A Volts: 12 V
2.	DC motor	Speed: 10 rpm AMPS: 0.5 A Volts: 12V
3.	Wheels	Diameter: 50mm Width: 20mm
4.	Switches	6 Point PDV
5.	Solar panel	SES 1270 Max power: 70Wp Voltage at max power: 17.48 V Current at max power: 4.05 A Open circuit voltage: 21.25 V Short circuit current: 4.24 A
6.	Nozzles	Spraying cone angle:80° Operating pressure: 2 bar

2.1 Creo model of overhead travelling pesticides spraying machine:

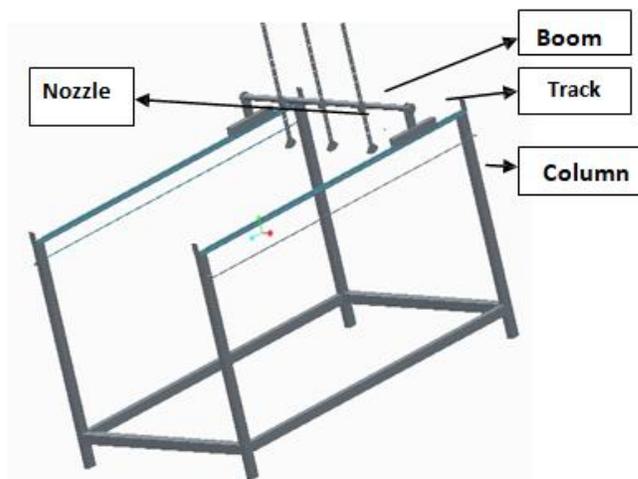


Fig: 1

2.2 Dimension of supporting structure

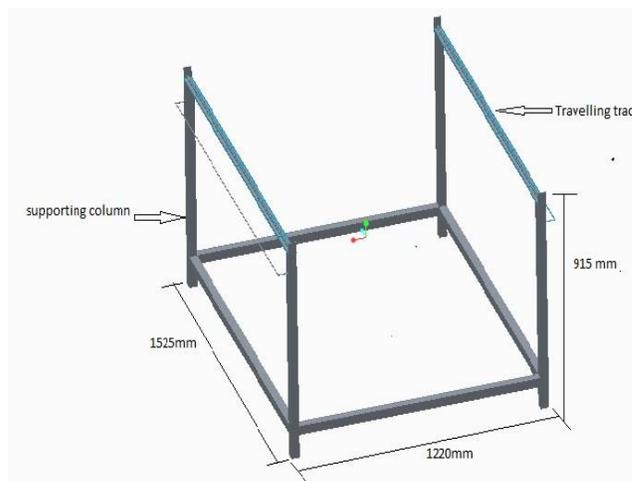


Fig: 2

2.3 Analysis of structure

2.3.1 Loading condition on structure

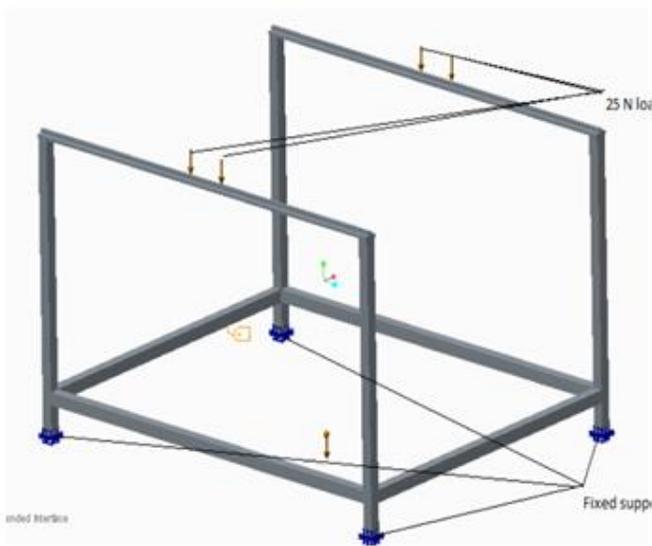


Fig: 3

3.3.2 Stress results

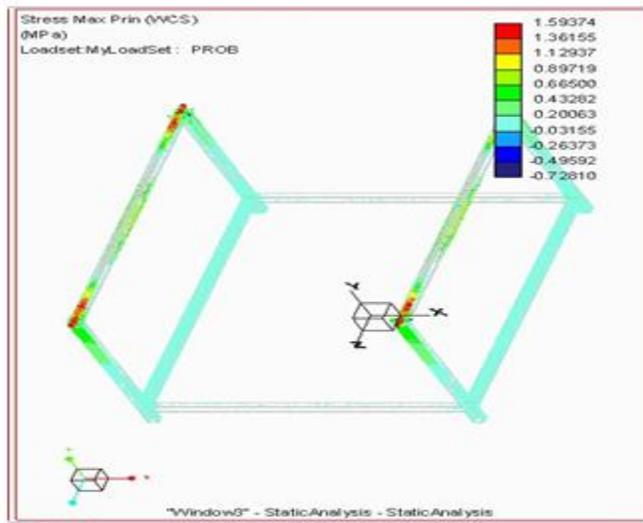


Fig: 4

Stress	Value (Mpa)
Maximum stress	1.59374
Minimum stress	-0.72810

The red part in the fig shows area under maximum stress, as we move downward from the point of contact the stress value gets reduce and goes negative at which shows the compression is induced in that part. So the material of the structure should be able to withstand the compressive stresses.

Table 2.2 Stress analysis

no	Stress (Mpa)
Maximum ess	1.59374
Minimum ess	-0.72810

2.3.3 Deflection results

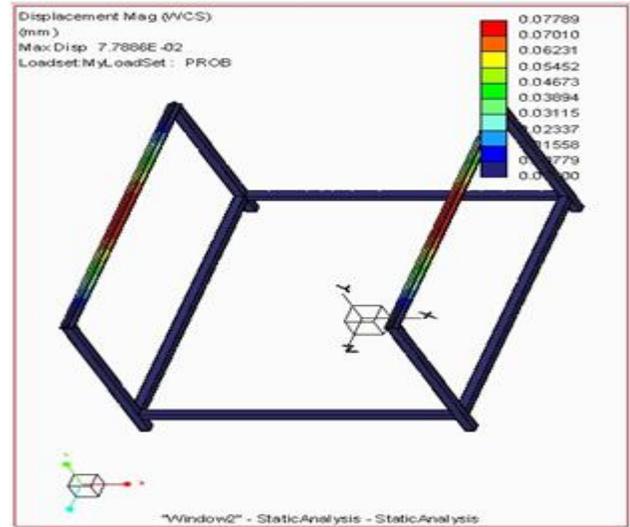


Fig: 5

This analysis shows the deflection of the track by applying the load of 25 N at each point as shown in the fig. As shown in the fig the red part shows the area under maximum deflection which is in the middle section and the value of deflection reduces with increase in distance from the mid – section.

III. FINAL FABRICATION

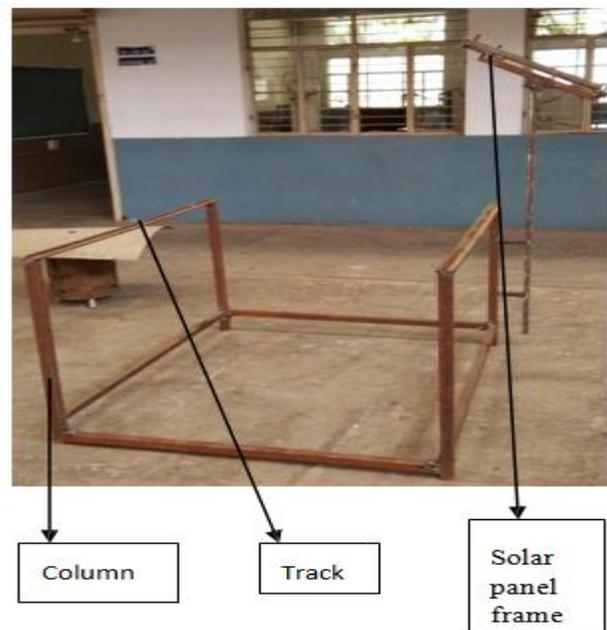


Fig: 6

IV. BOOM ASSEMBLY

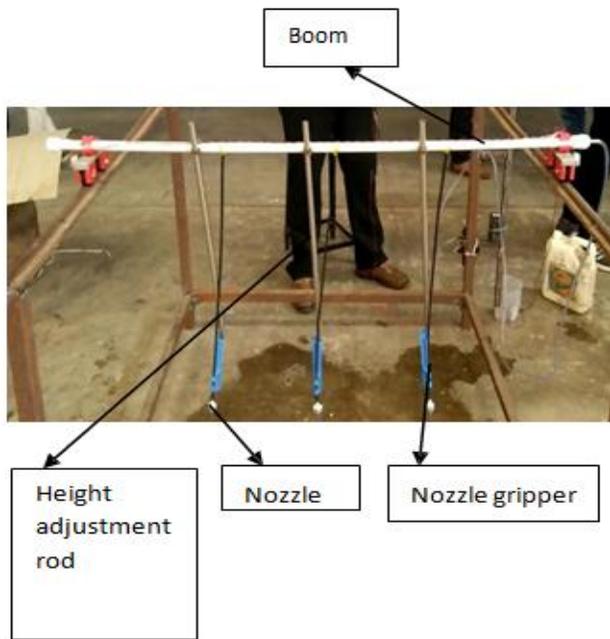


Fig: 7

The figure shows the boom assembly with height adjustment rods, nozzle gripper, nozzles and wheel with motor. Nozzle gripper provides required angle for effective spraying on field. Height adjustment rods are provided to adjust height according to the height of the plant

V. FINAL FABRICATED SETUP

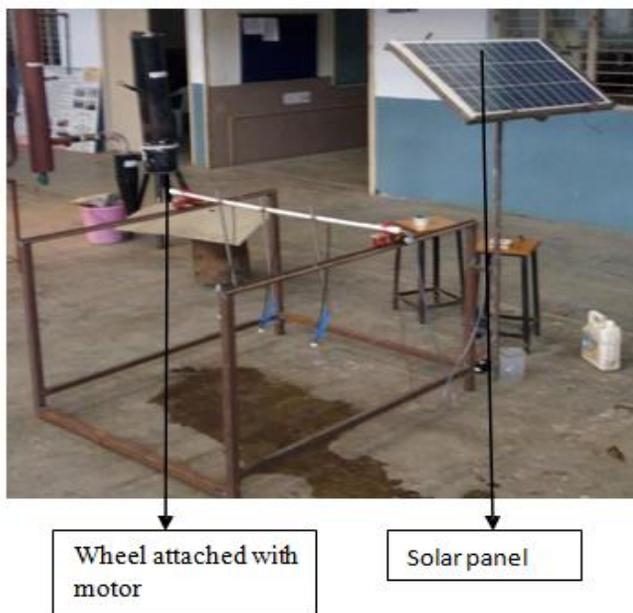


Fig: 8

VI. RESULTS

1. As per structure analysis of supporting structure, maximum stress induced on beam is 1.59374 Mpa and maximum deflection is 0.007789 mm.\
2. Voltage obtained from 70 Watt solar panel is 18.76V and 4.05 A.
3. Actual time taken by boom to travel track is 45 sec.

VII. CONCLUSION

1. Proper adjustment facility in the setup with respect to crop helps to avoid excessive use of pesticides which result into less pollution.
2. The proposed setup can spray the field in single go hence reduces time consumption and labor fatigue
3. This setup can also be used for cooling of the crops.
4. Our setup eliminates the backpack, labor cost and human efforts.
5. Actual time taken by setup to spray 5 X 4 feet sq. area is 45 sec

REFERENCES

- [1]. Shailesh Malonde, Shubham Kathwate, Pratik Kolhe, Roadney Jacob ,Nishat Ingole ,Rupesh D. Khorgade ,International Journal of Advanced Engineering and Global Technology |Gurunanak Institute of Technology, Nagpur-441501, Maharashtra, India
- [2]. Sandeep H. Poratkar, Dhanraj R. Raut , International Journal of Modern Engineering Research (IJMER) Mechanical Engineering, tulsiramjigaikwad patil College of Egg& Technology, India Department of Mechanical Engineering, Umrer Polytechnic, Umrer
- [3]. Akhilesh K.Bhatkar, P. B. Khope, P. S.Chaudhari,International Journal of Research in Engineering and Technology , Department of Mechanical Engineering, PCOE, Nagpur-440019
- [4]. Robert Grisso, Nozzles: Selection and Sizing ,Virginia cooperative extension, Virginia tech- Virginia state university, , publication 442-032, May 2009.
- [5]. Agricoop.nic.in
- [6]. International Research Journal of Engineering and Technology (IRJET), Volume: 03, Issue: 04 |
- [7]. International journal for research in emerging science and technology, volume-2, issue-8, aug-2015.
- [8]. Brent A. Pringnitz Extension Program Specialist Department of Agronomy Iowa State University.
- [9]. <http://detooproject.org/>
- [10]. www.plansee-com.azureedge.net
- [11]. <http://www.microngroup.com>
- [12]. <http://www.rapidspray.net>
- [13]. <http://www.krishijagran.com>
- [14]. <http://files.croplife.com>
- [15]. <http://efxkits.com>
- [16]. F. Richard Beard, Calibration of Boom Sprayers Using Charts to Reduce Math Calculations, Extension Journal , ISSN 1077- 5315, Utah State University Logan, Utah , 2001.
- [17]. Manak Bhavan, Dimensions for hot rolled steel beam, column, channel and angle sections IS 808 : 1989, Third edition, Bureau of indian standards, New Delhi ,2004.
- [18]. Manak Bhavan, Recommendations for structural design of fixed-wheel gates IS 4622:2003, Third edition, Bureau of indian standards, New Delhi ,2003.