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Amit Kumar
M. Tech. Student, Department of Farm Machinery and Power Engineering, Swami Vivekanand College of Agricultural Engineering and Technology & Research Station, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Dr. RK Naik
Associate Professor, Department of Farm Machinery and Power Engineering, Swami Vivekanand College of Agricultural Engineering and Technology & Research Station, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author
Amit Kumar
M. Tech. Student, Department of Farm Machinery and Power Engineering, Swami Vivekanand College of Agricultural Engineering and Technology & Research Station, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Development of back pack type butterfly sprayer

Amit Kumar and Dr. RK Naik

Abstract
Vegetable crops are grown in row with stacking method at spacing of 1.2 m to 1.8 m. The yield of vegetable crop is reduced mainly due to crops ware damaged by insects pests and diseases. The existing knapsack sprayer, foot sprayer, and portable power sprayer with single nozzle lance takes more time and effort for spraying in vegetable crop grown in rows. Therefore arrangements of spray nozzle is provided with the back pack power sprayer, which moves up and down both side of the operator to spray both fronts of rows from top to bottom of vegetable crop. In developed sprayer during spraying, spray droplets behind the operator looks like wings of butterfly. On the basis of laboratory testing of nozzles, broad cone nozzle was selected for developed sprayer with operating pressure of 6 kg/cm². Field capacity of butterfly sprayer is 0.38 ha/h. Spraying cost of developed sprayer is 723 Rs/ha. Bio-efficacy of the developed sprayer was found to be 94%.

Keywords: butterfly sprayer, sprayer, spray angle, swath width, droplet density, bio efficacy

1. Introduction
Pesticide application is a complex process. It is basically consists of target canopy characteristics, spray equipment, mode of operation and spray chemical quantities. All of these influence the amount and uniformity of spray deposition. It is also observed that for successful management of pests, uniform dispersion and deposition of chemical spray from top to bottom of the plant canopy, as well as on the undersides of the leaves, were important. The yield of vegetable crop is reduced mainly due to crops were damaged by insects, pests and diseases. Over 200 primary pests, 100 plant diseases, hundreds of weeds, and minor pests such as nematodes, birds, and rodents all this damage the crops in India. Insects, diseases, and weeds were responsible for about 18% of India's agricultural output potential loss, which comes to 30 million tonnes of food grain in terms of volume. The overall loss was expected nearly Rs 50,000 million, or nearly 18% of the country's total agricultural output (Manncsa, 2009) [4]. Small, marginal, medium, and large farmers represent the agricultural sector in India. There are two types of sprayer utilised in Indian farms: hand operated and power sprayer pumps. The main disadvantage of a hand-operated sprayer is that the operator cannot use it continuously for more than 5-6 hours and then became tired, whereas a power-operated sprayer is more convenient to use and takes less time than a hand-operated sprayer. Backpack type sprayers are mostly used by the small and marginal vegetable farmers because it is less expensive and easy to use. However, alternative types of tractor-operated boom sprayers and hydraulic sprayers (gun type) are available that have a wider spray swath width, but they cannot be utilized when the crop is mature due to the tractor's less ground clearance to take advantage of the wider spray swath. The farmer commonly utilized a back pack type power sprayer with gun nozzle to spray row type crop, but when the height of the crop exceeds 1.5m, the spray efficiency of operator is reduced and farmer could spray only one side of row at a time and surrounded by fine droplets of spray chemical which is harmful for health of farmer. Additionally, the sprayer applies the chemical to the upper surface of the plant canopy, so while the insects hide and breed beneath the leaves. The study will be carried out with spraying on vegetable crops by covering the front sides of both rows uniformly from top to bottom. The design should also consider for avoiding the surroundings of fine spray droplets to operator and for reducing the drudgery to the operator without movement each time.

2. Material and Methods
The butterfly assembly was developed to fulfill the aim to spray both fronts of rows at a time on vegetable crop while walking on row by operator. Spray can cover crop height of 1.65 to 2 m. Crop planted in row spacing of 1.2 to 1.8 meter.

Spraying uniformly on the top and underneath side of leaves and reducing the drudgery of operator without movement each time to cover both of row of vegetable crop. Uniform distribution and deposition of chemical spray from top to bottom of plant canopy and on the undersides of the leaves was most important for effective control of pests. Development consideration of butterfly assembly was that to perfectly fit in knapsack power sprayer and suitable to operate in field conditions. The development of back pack butterfly sprayer was done at Swami vivekanand college of agricultural engineering and technology and research station, IGKV, Raipur.

The development was carried out on existing knapsack power sprayer, powered with two stroke petrol engine. Two pieces of mild steel rectangular bar of length 11.5 cm was placed with end to end overlapping at center with parallel line of action. Centre of metal bar was fixed by nut bolt on frame in a manner that metal bar can move up and down easily. One MS bar fixed on left portion of frame and second was fixed on right portion of frame. The rectangular bars were connected with push pull rod at end to end overlapping. The oscillation of both sides nozzle works on the principle of equality of moment of forces. Brass pipe extension with inlet fluid pipe connection was attached with outer end of mild steel rectangular bar on both sides. Total four nozzles were connected, two nozzle each side of butterfly assembly to spray on top and underneath side of leaves at uniform manner. Butterfly assembly box was fitted on chemical tank at a height of 55 cm (centre of butterfly assembly) from base of back pack power sprayer. The angle of nozzle moves from horizontal axis to upside was 30° and horizontal axis to downside was 30°. Push pull rod connected to hand lever bar with extension plate welded on bar opposite side of hand lever. Thus the butterfly assembly works with manual operation of hand lever. The conceptual view of developed back pack type butterfly sprayer was shown in figure 1, developed back pack type butterfly sprayer was shown in figure 2 and details of parts were given in table 1. A two stroke 0.75 kW (1hp) air cooled petrol engine was used with 0.5 liter fuel tank as a main power unit for fluid pressure generation. The pressure of chemical spray was adjusted with bypass valve provided in plunger assembly and adjusting the rpm of engine.

Table 1: Part name

Part no.	Part name
1	Chemical Tank
2	BCN Nozzle
3	Brass pipe extension
4	HTP Hose pipe
5	Push pull rod
6	Hand lever
7	Two stroke petrol engine
8	Pressure assembly
9	Fuel tank
10	Mild steel rectangular bar

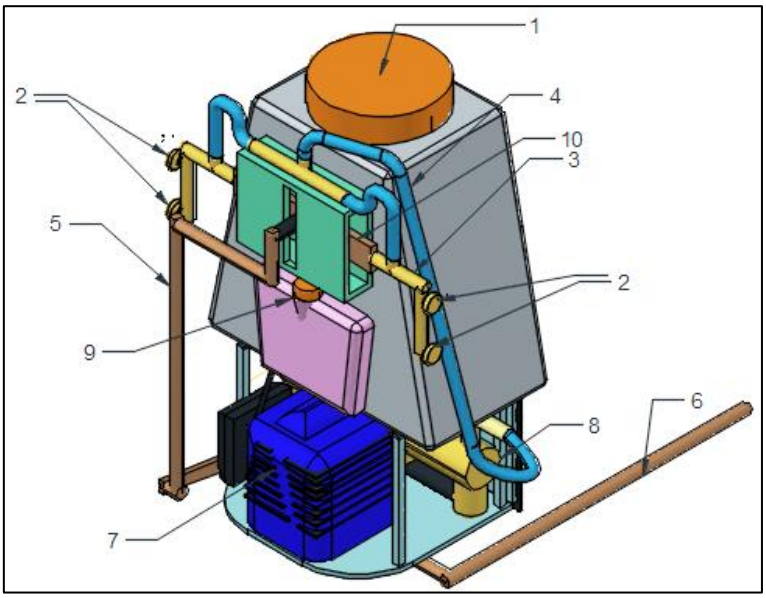

Fig 1: Isometric view of developed back pack type butterfly sprayer.

Fig 2: Developed back pack type butterfly sprayer.

3. Results and Discussion

The butterfly back pack type sprayer was successfully developed as per conceptual drawing to fulfill the aim to spray both fronts of rows at a time on vegetable crop while walking on row by operator. The laboratory evaluation of nozzle was tested in Swami Vivekananda College of Agricultural Engineering and Technology and Research Station, Raipur, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) and the field performance was evaluated in agricultural farm located at village Funda block Patan district Durg (C.G.) on crop of bitter gourd, during kharif 2021. Bitter gourd crops planted in row to row spacing of 1.8 meter and plant to plant spacing of 0.6 cm. A two stroke 0.75 kw engine was used as main source of power for pressure generation.

Four different nozzles ware tested on laboratory for selection of nozzle. On the basis of swath width spray angle discharge rate and lateral spray distribution brass broad cone nozzle was found better and selected for developed sprayer. Two nozzles were mounted each side at overlapping of 78% to increase the droplet density on crop canopy. The average droplet density was found 584 drops/ cm^2 on upper side of leaves and 388 drops/ cm^2 on undersides of leaves on bitter gourd. The discharge rate of sprayer was found 485 lit/ha, with the field capacity of 0.38 ha/h and fuel consumption was found 0.35 lit/h. the bio efficacy of developed sprayer was found 94% effective on aphids of bitter gourd crop.

4. Conclusion

Broad cone nozzle was selected due to higher swath width and spray angle. A back pack type butterfly sprayer was developed successfully. The field capacity of developed sprayer was 0.38 ha/h and Spraying cost of developed sprayer is 723 Rs/ha. The bio efficacy of the developed sprayer is 94%. The cost of developed sprayer was Rs 13570. The working of developed sprayer was found satisfactory.

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