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Study of Performance Parameters and Evaluation of Tractor Operated Aero-Blast Sprayer for Horticultural Crop

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ABSTRACT: Aero-blast sprayers are a viable alternative to hydraulic sprayers especially when the sprayer has to deposit chemicals on target which are very far from the sprayer. The performance of tractor operated aero-blast sprayer was evaluated under lab and field conditions. The sprayer was operated in the guava orchard at three forward speeds *i.e.* 2.0, 2.5, and 3.0 km/h and three fluid flow pressures *i.e.* 3.0, 3.5, and 4.0 kg/cm^2. The droplet density on the upper side of the top leaves, middle leaves, and bottom leaves varied from 57 to 112 drops/cm^2, 52 to 72 drops/cm^2, and 40 to 57 drops/cm^2 respectively. Area covered by droplet spots on the upper side of the top leaves, middle leaves, and bottom leaves varied from 15.64 to 24.18mm^2/cm^2, 14.12 to 21.10mm^2/cm^2, and 8.11 to 15.34mm^2/cm^2 respectively. The volume of spray deposition on the upper side of the top leaves, middle leaves and bottom leaves varied from 443.51 to 683.65 × 10-6 cc/cm^2, 356.31 to 631.28 × 10^{-6} cc/cm^2 and 266.90 to 670.86 × 10-6 cc/cm^2 respectively. The actual field capacity of the sprayer was found in the range of 1.60-2.03 ha/h at selected forward speeds with field efficiency of 80 to 80.87 %. The average fuel consumption was obtained to be 5.30 to 5.60 l/h.

Keywords: Aero-blast sprayer, horticulture sprayer, tractor operated sprayer, sprayer testing, plant protection, performance evaluation of sprayer.

INTRODUCTION

There is rapid growth in horticulture production in India and presently India ranks second with the overall production of 96.75 million tonnes of fruits in 6.53 million hectares. To control the pest and diseases, spraying is necessary to avoid damage to the crop. Different types of sprayers are available and used by farmers. Aero-blast sprayers are gaining popularity because of the advantages of uniform and fast spraying operation on tall trees like Mango, guava, agroforestry, etc. It is spraying the pesticide uniformly and efficiently throughout the tree.

The conventional methods of spraying in orchards and tree crops involve low initial cost but cause serious drawbacks and limitations in spraying orchards like a great amount of time and labour is required, a large volume of water required per tree, More than 50 percent of spray fluid is lost by drift, environmental hazards occur due to high application rate and spray cannot properly penetrate through the foliage and trees as enumerated below. However, tractor operated aero-blast sprayers having advantages of less amount of water per tree/vine with saving in labour and time, saving of chemical with reduction or elimination of runoff, quick and easy pest control is possible keeping economic losses to a minimum level, little chance of missing areas of foliage due to blanket type of spray application, and coverage of whole tree canopy front as well as backsides of leaves facilitating deep penetration into the tree canopy.

In an aero-blast sprayer, blowers and pumps are powered by the PTO shaft of the tractor. Pumps are used to deliver the spray fluid under liquid pressure to nozzles. The degree of atomization depends primarily on liquid pressure, nozzle characteristics, and air velocity. Air atomization is sometimes employed on airblast sprayers but hydraulic nozzles are commonly used. To obtain uniform coverage it is necessary to install more nozzles in the portion of air steam that is directed to the tree. The turbulence of air stream causes though mixing of air and liquid, this spray laden air proceeds from the sprayer to displace original air, inside the tree canopy. The mist produced by this sprayer contains few droplets of size more than 250 μm. To overcome the human factor in spraying and increase field capacity, Aero blast sprayer sprayer may be the best option. The tractor operated aero blast sprayer was found to produce smallest droplet size (254 μ) with better penetration of spray droplets into the canopy, highest field capacity (1.54 ha/h) with lowest man-power requirement (1.95 man-h/ha) (Saha *et al.,* 2004). An air carrier sprayer equipped with an axial flow blower-RK was tested at three levels of pressure (5, 10, 15 bar) and three levels of travel speed (2, 3 and 4 kmph) to determine its distribution pattern for effective spraying in the orange orchard. They reported that for effective spraying tractor travel speed of 2 kmph and system pressure of 15 bars (Tekale *et al.*, 2007). A tractor mounted air-assisted sprayer was developed and evaluated in a field of cotton at three different forward speeds (0.5, 2.5 and 4.0 km/h). At a forward speed of 4.0 km/h, better uniformity coefficient (1.69) and the area covered by droplets on the underside of top, middle and bottom leaves were 1.11, 0.93 and 0.44 % was obtained for the air assisted sprayer (Singh *et al.*, 2010). Sufficient velocity and pressure are needed to cause movement of leaves for under leaf deposition and allow droplets to penetrate in the inner part of the canopy (Bode and Bretthauerb 2007; Salyani *et al.*, 2013; Jadav *et al.*, 2019).

In orchards, pesticide spraying is frequently used as an efficient plant-protection strategy to generate a higher yield and better-quality produce (Li *et al.*, 2013). Different growing cycles and variable geographical locations result in very different tree shapes, sizes, and canopy densities (Chen *et al.*, 2011). Spraying is one of the most efficient methods for pest and disease control. The effective control of diseases and insect pests inorchards can recover nearly 10% of economic losses (Zhou *et al.,* 2017). Currently, chemical pesticides that are applied 8–15 times annually to apple trees during their growth cycle are the main methods used to manage diseases and insect pests. This workload makes up around 30% of the total workload associated with managing fruit trees (Zhang and Xu 2014). The majority of orchard spraying operations, however, employ frame-mounted and backpack sprayers, both of which have ineffective spraying capabilities (Ding *et al*., 2016). Spraying also affects the environment and reduces the value and viability of agricultural products. The dense fruit tree canopy can be penetrated by air-blast sprayers' strong flow, which ensures that the pesticide can reach most of the leaves and has a 30–40% utilization rate (Cross *et al.,* 2001).

The need for accurate detection and on-demand spraying, which is a widespread issue in the modern world, is not met by the currently available orchard spraying equipment (Zhai *et al.,* 2018). In practice, excessive spraying-which leaves behind a significant amount of chemical pesticide residues-is frequently used to accomplish the desired impact of pest control, jeopardizing the safety of fruit production and seriously polluting the environment (Solanelles *et al*., 2006). In order to achieve the target variable spraying and the variable wind control method to achieve the on-demand air supply, it will be beneficial for the development of orchard spraying machinery to develop the intelligent control technology for spraying amount. As insecticides and herbicides are expensive, machines which spray unevenly or drift can waste a significant amount of liquid. Thus, in order to improve spraying, this resulted in the introduction of the necessary changes to the current equipment. Effective pest management depends highly on the uniform application and deposition of chemicals on the undersides of leaves and throughout the plant canopy (Jadav *et al*., 2019).

Looking to the above problems in spraying by using different sprayers and aerob last sprayer, there is need to evaluate the performance of aero blast sprayer thoroughly and know the adjustments required for its future use in plant protection. Therefore, in this study an aero-blast sprayer was selected to evaluate its performance in the field.

MATERIAL AND METHODS

An Aero blast sprayer was developed to spray in the orchard based on the functional requirements. The working principal, aero blasts prayer PTO power transmitted to the gearbox of the sprayer and then it transferred to a blower. Blower operation produces high velocity air which transferred to the sprayer. Power was taken from PTO through belt to rotate diaphragm pump for sucking pesticide/herbicide from chemical tank and pass to nozzle which is connected by a delivery pipe. The components of the aero blast sprayer were a blower, a centrifugal pump, a line filter, two nozzles, a by-pass assembly, an operator's seat, two adjustable discs, a pressure gauge, and a regulated valve. The spray was carried to the target by an airstream produced by the centrifugal kind of blower. Between the nozzles and by pass assembly, a line filter is placed. The discharge rate was managed via a regulated valve. On the sprayer’s duct were two movable discs, one of which was horizontal and the other vertical. Ahorizontal disc altered the location's horizontal position angle. The height of the sprayer duct could be adjusted vertically. The specifications of aero blast sprayers are given in Table 1.

Table 1: Specifications of aero blast sprayers.

Sr. No.	Particulars	Specifications
1.	Source of power	35-50 HP Tractor
2.	Power transmission mode	PTO of tractor
3.	Type of blower	High capacity centrifugal
4.	Tank capacity (Litre)	425
5.	Total power (Hp)	21
6.	Length of sprayer (m)	2.0
7.	Width of sprayer (m)	1.8
8.	Height of sprayer (m)	2.2
9.	Gross weight of sprayer (Kg)	190
10.	Approximate cost of sprayer (Rs)	180000

Labarotary test: Labaoratory studies were conducted to determine the effect of the selected parameters on the performance of the aero-blast sprayer. The performance of the aero-blast sprayer was evaluated by determining the performance parameters VMD, NMD, and uniformity coefficient.

Field test: The aero-blast sprayer was evaluated in the field of guava orchard. The suitable parameters obtained from the laboratory studies were used in field experiments and the forward speed of the sprayer was kept 2, 2.5 and 3.0 km/h.

Plate 1: Tractor operated Aero-blast sprayer during operation in field.

Determining the performance parameters of aero-blasts prayer: The following measurements and calculations were made for performance parameters such effective working width, speed of operation, blower speed, pressure, VMD, and NMD.

Swath width : The working width covered by the sprayer during operation.

Forward speed (m/s) : Tractor forward speed was calculated using the formula: 100 m plot length divided by field coverage time.

Speed = {Distance (m) }/ {Time required to cover distance (s)} × 3.6

Blower speed, rpm : An electronic tachometer can be used to quickly determine the blower speed.

Spraying capacity : Experimentation of air trajectories and spray deposition on a test stand in the lab.

Droplet size : The size and density of the droplets were measured using a digital droplet size analyzer.

Volume Median Diameter (VMD): Volume median diameter is a diameter of a spray of droplets, which divides into two equal parts by volume so that one half of the volume contains droplets smaller than a droplet whose diameter is the VMD and the other half of the volume contains large droplets.

Number Median Diameter (NMD): Number median diameter, NMD is the average diameter of droplets without any reference to volume. The diameter corresponding to the size that divides the droplet into two parts by number only is known as the number median diameter.

Uniformity coefficient (UC): The ratio of volume median diameter to the number median diameter is known as the uniformity coefficient (U.C). A more uniform size indicates the ratio is earlier to unity.

$$UC(\%) = VMD/NMD$$

Droplet density : The number of droplets per unit area of the leaf surface is called droplet density. By using a droplet analyzer, the number of drops in one square centimeter area of glossy paper was obtained. The number of droplets per square centimeter area was termed as droplet density

Droplet size: The size of the spray droplet is represented as the number median diameter (NMD) and volume median diameter (VMD). For the determination of NMD and VMD the dye (Methylene Blue MS dye), its concentration in water, and the spread factor used were the same as used by

$$V = \frac{\pi}{6} \times (\text{Droplet diameter})^3 \times (\text{Number of droplets})$$

Area covered by droplets: Each range of droplet size on the glossy paper was assigned a mean droplet diameter. With the number of droplets of each size in one square centimeter area and spotted diameter of those droplets.

$$\text{Actual field capacity (ha/h)} = \frac{\text{Area covered by the sprayer (m}^2\text{)}}{\text{The average time is taken (h)} \times 10000}$$

The volume of spray deposition:

With the number of droplets in one square centimeter area and the actual droplet diameter, the volume of spray deposition contributed by drops of a particular size was calculated as follows:

The volume of spray deposition contributed by the drops of a particular size

$$= \frac{\pi}{6} \times (\text{Diameter of drop})^3 \times (\text{Number of drops of a particular size})$$

RESULT AND DISCUSSION

Droplet size and uniformity coefficient in lab test: The cumulative percentage of the number of droplets and the cumulative percentage of the volume of droplets contributed by each range of droplet diameter were calculated. Using plots of cumulative percentage of a number of droplets and actual droplet diameter, Number

Median Diameter (NMD) was determined. Similarly, Volume Median Diameter (VMD) was determined using the plot of cumulative percentage of the volume of droplets and actual droplet diameter. Graph of effect of forward speed and pressure on NMD was plotted (Fig. 1). It was observed that with an increase in pressure NMD decreases.

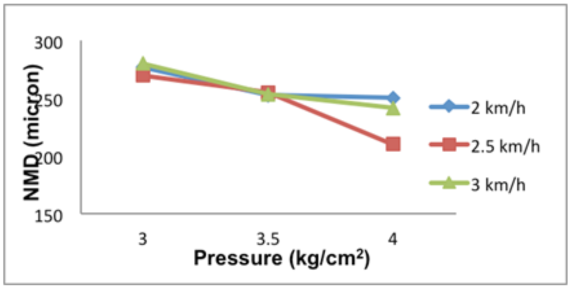

Fig. 1. Effect of forwarding speed and pressure on NMD.

Similarly, the volume median diameter (VMD) varied from 395.76 to 535.90 µm (Fig. 2). The minimum VMD was found to be at pressure 4.0 kg/cm^2 and the maximum VMD was at 3.0 kg/cm^2 (Fig. 2).

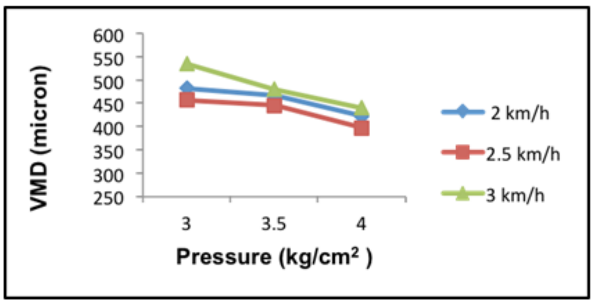

Fig. 2. Effect of forwarding speed and pressure on VMD.

The volume median diameter (VMD) and number median diameter (NMD) was used to calculate uniformity and combine effect of speed and pressure on uniformity coefficient was studied and plotted (Fig. 3).

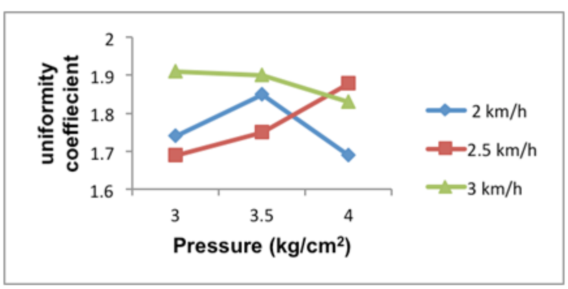

Fig. 3. Effect of forwarding speed and pressure on uniformity coefficient.

Droplet density: Droplet density in laboratory conditions for different forward speed and pressure were obtained. It was observed that for all pressures with the increase in the forward speed of the sprayer the droplet density decreased. It was due to a reduction in the retaining time of the sprayer above the plant with the increase in the speed of the sprayer. The droplet density on the upper side of the top leaves was having a large variation with the variation of pressure and forward speed of the sprayer.

More droplet density was at pressure 4.0 kg/cm^2 and minimum droplet density was at pressure 3.0 kg/cm^2. The droplet density for forward speed 2.0 km/h varied from 72 to 86 drops/cm^2 with variation of pressure from 3.0 to 4.0 kg/cm^2. At forward speed of 2.5 km/h droplet density varied from 59 to 89 drops/cm^2 with variation of pressure from 3.0 to 4.0 kg/cm^2. However droplet density varied from 52 to 106 drops/cm^2 for forward speed of 3.0 km/h with variation of pressure from 3.0 to 4.0 kg/cm^2**.**

The droplet density on the upper side of the bottom leaves varied from 40 to 63 droplets per square centimeter. The droplet density varied from 56 to 63 drops/cm^2 at pressure 4.0 kg/cm^2 was maximum and at 3.5 kg/cm^2 droplet density varied from 40 to 58 drops/cm^2 was minimum. The droplet density for forwarding speed 2.0 km/h varied from 46 to 58 drops/cm^2 as the pressure increased from 3.0 to 4.0 kg/cm^2. At forward speed of 2.5 km/h droplet density varied from 42 to 62 drops/cm^2 as the pressure increased from 3.0 to 4.0 kg/cm^2. However ,droplet density varied from 40 to 63 drops/cm^2 for forward speed of 3.0 km/h as the pressure increased from 3.0 to 4.0 kg/cm^2. It was observed that the droplet density increased with an increase in pressure and decreased with an increase in forward speed.

Area covered by droplets: The area covered on the upper side of the top leaves varied from 32.04 mm^2/cm^2 to 51.31 mm^2/cm^2. The maximum area covered was at 3.0 kg/cm^2 and the minimum area covered was at 4.0 kg/cm^2. The area covered at forward speed 2.0 km/h varied from 33.78 to 46.58 mm^2/cm^2. At forward speed of 2.5 km/h area covered varied from 32.04 to 51.31 mm^2/cm^2. However, the area covered varied from 35.40 to 44.14 mm^2/cm^2 at forward speed of 3.0 km/h.

Area covered by droplets on upper side of the bottom leaves varied from 15.92 mm^2/cm^2 to 24.30 mm^2/cm^2. The area covered for forward speed 2.0 km/h was varied from 16.22 to 20.74 mm^2/cm^2. At forward speed of 2.5 km/h area covered varied from 15.92 to 20.37 mm^2/cm^2. However, the area covered varied from 16.02 to 24.30 mm^2/cm^2 for forward speed of 3.0 km/h. It was observed that there was no set trend of the area covered by droplet spots due to a change in working pressure.

The volume of spray deposition: The volume of spray deposition on the upper side of the top leaves varied from 489.43 to 660.71 $\times 10^{-6}$ cc/cm^2. The volume of spray deposition on the upper side of the bottom leaves varied from 352.28 to 695.65 $\times$ 10^{-6} cc/cm^2. The maximum average volume of spray deposition (695.65 $\times$ 10^{-6} cc/cm^2) was at 3.0 kg/cm^2 and minimum average volume of spray deposition (194.11 $\times$ 10^{-6} cc/cm^2) was at 3.0 kg/cm^2. At all combinations of forward speed and pressure, the volume of spray deposition showed uneven results due to which no certain trend was found.

The droplet density, area covered and volume of spray deposition were more on the upper side of top leaves of the plant than those on the upper side of the bottom leaves. But, there was no droplet deposition on the underside of the leaves on any part of the plant at any forward speed.

Field experiments: The aero-blast sprayer was evaluated in the field of the orchard. The suitable parameters obtained from the laboratory studies were used in field experiments and the forward speed of the sprayer was kept 2, 2.5 and 3.0 km/h.

Droplet size and uniformity coefficient: It was observed that with an increase in pressure, NMD decreases. Number median diameter (VMD) varied from 210.10 to 280.17 µm. The minimum VMD was found to be at pressure 4.0 kg/cm^2 and the maximum VMD was at 3.0 kg/cm^2.

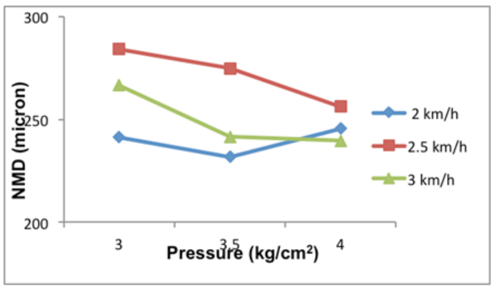

Fig. 4. Effect of forward speed and pressure on NMD.

Similarly, volume median diameter (VMD) varied from 341.57 to 458.01 µm. The minimum VMD was found to be at pressure 4.0 kg/cm^2 and maximum VMD was at 3.0 kg/cm^2.

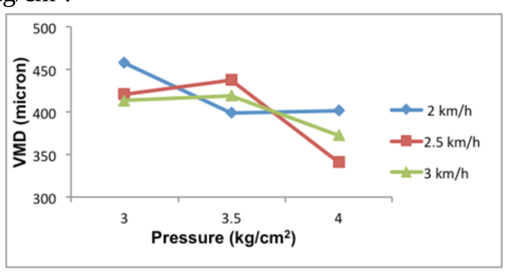

Fig. 5. Effect of forward speed and pressure on VMD.

For all combinations of forward speed and pressure, the uniformity coefficient varied from 1.33 to 1.73 (Fig. 6).

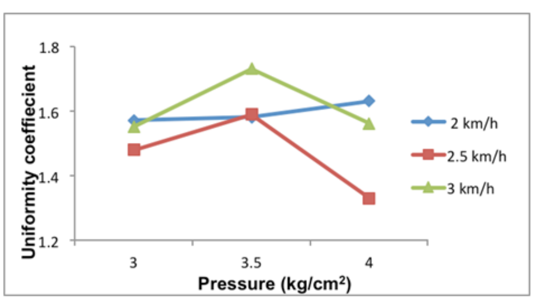

Fig. 6. Effect of forward speed and pressure on uniformity coefficient.

Droplet density in field conditions: The droplet density on upper side of the top leaves varied from 57 to 112 droplets per square centimeter. The droplet density varied from 95 to 112 drops/cm^2 at 4.0 kg/cm^2 was maximum and at 3.0 kg/cm^2 droplet density varied from 57 to 68 drops/cm^2 was minimum. The droplet density at forward speed of 2.0 km/h varied from 68 to 95 drops/cm^2. At forward speed of 2.5 km/h droplet density varied from 62 to 85 drops/cm^2. However, droplet density varied from 57 to 112 drops/cm^2 at forward speed of 4.0 km/h.

The droplet density on upper side of the middle leaves varied from 52 to 72 droplets per square centimeter. The droplet density varied from 65 to 72 drops/cm^2 at 4.0 kg/cm^2 pressure was maximum and at 3.0 kg/cm^2 droplet density varied from 54 to 62 drops/cm^2 was minimum. The droplet density at forward speed 2.0 km/h varied from 62 to 72 drops/cm^2. At forward speed of 2.5 km/h droplet density varied from 56 to 68 drops/cm^2. However droplet density varied from 52 to 65 drops/cm^2 at forward speed of 3.0 km/h.

The droplet density on upper side of the bottom leaves varied from 31 to 57 droplets per square centimeter. The droplet density varied from 42 to 53 drops/cm^2 at 4.0 kg/cm^2 were maximum and at 3.0 kg/cm^2 droplet density varied from 31 to 46 drops/cm^2 was minimum. The droplet density at forward speed 2.0 km/h varied from 46 to 57 drops/cm^2. At forward speed of 2.5 km/h droplet density varied from 40 to 51 drops/cm^2. However, droplet density varied from 31 to 53 drops/cm^2 at forward speed of 3.0 km/h.

Area covered by droplet spots under field conditions: The area covered on the upper side of the top leaves varied from 15.64 mm^2/cm^2 to 24.18 mm^2/cm^2. The maximum area covered was at 4.0 kg/cm^2 and the minimum area covered was at 3.0 kg/cm^2 pressure. The area covered by droplet spots at forward speed 2.0 km/h varied from 20.29 to 23.57 mm^2/cm^2. At forward speed of 2.5 km/h the area covered varied from 15.80 to 24.18 mm^2/cm^2. However, the area covered varied from 15.64 to 18.84 mm^2/cm^2 at the forward speed of 3.0 km/h.

Area covered by droplet spots on the upper side of the middle leaves varied from 14.12 mm^2/cm^2 to 21.10 mm^2/cm^2. The area covered at the forward speed of 2.0 km/h was 14.12 to 18.52 mm^2/cm^2. At forward speed of 2.5 km/h area covered varied from 16.38 to 17.67 mm^2/cm^2. However, the area covered varied from 16.18 to 21.10 mm^2/cm^2 at forward speed of 3.0 km/h.

Area covered by droplets on upper side of the bottom leaves varied from 8.11 mm^2/cm^2 to 15.34 mm^2/cm^2. The area covered at forward speed of 2.0 km/h was varied from 10.91 to 12.04 mm^2/cm^2. At forward speed of 2.5 km/h area covered varied from 8.90 to 15.34 mm^2/cm^2. However, area covered varied from 8.11 to 11.58 mm^2/cm^2 at forward speed of 3.0 km/h.

Volume of spray deposition in field conditions: Volume of spray deposition on upper side of the top leaves varied from 443.51 to 683.65 × 10^{-6} cc/cm^2. The volume of spray deposition at forward speed of 2.0 km/h was varied from 457.46 to 572.37 × 10^{-6} cc^2/cm^2. At forward speed of 2.5 km/h area covered varied from 443.51to 627.46 × 10^{-6} cc^2/cm^2. However area covered varied from 483.31 to 683.65 × 10^{-6} cc^2/cm^2 at forward speed of 3.0 km/h.

Volume of spray deposition on upper side of the middle leaves varied from 356.31to 631.28 × 10^{-6} cc/cm^2. The volume of spray deposition at forward speed of 2.0 km/h was varied from 461.85 to 476.08 × 10^{-6} cc^2/cm^2. At forward speed of 2.5 km/h area covered varied from 356.31 to 599.80 × 10^{-6} cc^2/cm^2. However, area covered varied from 434.81 to 631.28 ×10^{-6} cc^2/cm^2 at forward speed of 3.0 km/h.

The volume of spray deposition on the upper side of the bottom leaves varied from 266.90 to 670.86 × 10^{-6} cc/cm^2. The volume of spray deposition at forward speed of 2.0 km/h was varied from 289.26 to 427.63 × 10^{-6} cc^2/cm^2. At forward speed of 2.5 km/h area covered varied from 339.81 to 670.86 × 10^{-6} cc^2/cm^2. However area covered varied from 266.90 to 476.09 × 10^{-6} cc^2/cm^2 at forward speed of 3.0 km/h.

Field parameters and economic analysis: Field capacity depends upon the swath width of the sprayer and forward speed. Swath width of the sprayer was 15 to 20 m and the sprayer was operated at forward speed of 2.0, 2.5 and 3.0 km/h.

The theoretical field capacity of the sprayer was determined 2.0, 2.3 and 2.51 ha/h at forward speeds of 2.0, 2.5 and 3.0 km/h respectively. The actual field capacity of the sprayer was obtained to be 1.60, 1.86 and 2.03 ha/h at forward speeds of 2.0, 2.5, and 3.0 km/h respectively. The field efficiency of the sprayer was 80 to 80.87 %. The average fuel consumption was obtained to be 5.30 to 5.60 l/h. The cost of operation including the total fixed cost of Rs 616/ha and variable cost Rs 649/ha. The total cost of the operation was Rs 1265/ha.

CONCLUSIONS

In undertaken research work tractor operated aeroblast sprayer was evaluated in laboratory condition and field condition were conducted at three travel speeds 2 km/h, 2.5 km/h and 3 km/h and three fluid pressures 3 kg/cm^2, 3.5 kg/cm^2 and 4 kg/cm^2. The experiment conducted to evaluate an aero blast sprayer, number of observations were recorded, analysed the data and results are drawn. Thus main conclusions from results and discussion are given below.

— The droplet density on the upper side of the top leaves, middle leaves, and bottom leaves varied from 57 to 112 $drops/cm^2$, 52 to 72 $drops/cm^2$, and 40 to 57 $drops/cm^2$ respectively.

— Area covered by droplet spots on the upper side of the top leaves, middle leaves, and bottom leaves varied from 15.64 to 24.18mm^2/cm^2, 14.12 to 21.10mm^2/cm^2, and 8.11 to 15.34mm^2/cm^2 respectively.

— The volume of spray deposition on the upper side of the top leaves, middle leaves and bottom leaves varied from 443.51 to 683.65 × 10-6 cc/cm^2, 356.31 to 631.28 × 10-6 cc/cm^2 and 266.90 to 670.86 × 10-6 cc/cm^2 respectively.

— In laboratory and field test we found that NMD and VMD decreases with the increase in pressure.

— The field capacity and field efficiency of the aero-blast sprayer was found 1.60 to 2.03 ha/h and 80 to 80.87% respectively.

— The fuel consumption of aero-blast sprayer was found 5.30 to 5.60 l/h. The average fuel consumption was obtained to be 5.30 to 5.60 l/h.

— The cost of operation of tractor mounted aero-blast sprayer was computed Rs.1265 /h.

Hence in research work undertaken, the aero blast sprayers performance was found satisfactory and it can be used for other horticultural crops also with little adjustments.

FUTURE SCOPE

The tractor drawn aero-blast sprayer machine has to be tested for their suitability in other horticultural crops like Mango, Guava, Sapota, Citrus etc. More emphasis has to be given to develop aero-blast sprayer or modify it with little adjustments, which are suitable for almost all horticultural crops to enhance the effectiveness in plant protection and cut down the cost of cultivation in view of saving time, energy and labour.

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Conflict of Interest. None.

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