www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; SP-10(6): 57-59

www.thepharmajournal.com
Received: 21-04-2021
Accepted: 12-05-2021

Dr. Pathak SV
Professor (CAS), Department of Farm Machinery and Power, CAET, Dapoli, Maharashtra, India

Er. Shirsat NA
Assistant Professor, Department of Farm Machinery and Power, CAET, Dapoli, Maharashtra, India

Dr. Shahare PU
Professor and Head, Department of Farm Machinery and Power, CAET, Dapoli, Maharashtra, India

Er. Pawar PS
M.Tech. Student, Department of Farm Machinery and Power, CAET, Dapoli, Maharashtra, India

Corresponding Author:
Dr. Pathak SV
Professor (CAS), Department of Farm Machinery and Power, CAET, Dapoli, Maharashtra, India

A review study on vertical boom sprayer for orchard

Dr. Pathak SV, Er. Shirsat NA, Dr. Shahare PU and Er. Pawar PS

Abstract
Mango is most important commercial grown fruit crop and World's mango production is averaging about 22 million metric tons per year. India is largest fruit producer after China. However, the country having advantages over mango producing countries, but productivity continues to be low. To increase the overall plant health and fruit yield as well as to protect the trees from harmful fungal diseases, spraying is necessary for mango orchard. Aero blast and air assisted sprayers are commonly used for spraying orchards, but energy required for spraying is more as compared to boom type sprayer. Loss of pesticides also observed with these sprayers. This study paper presents details about development and performance of better boom type orchard sprayers; which can reduce spraying cost and loss pesticides.

Keywords: Boom, nozzle, orchard, sprayer, droplet

Introduction
Mango (*Mangifera indica* L.) belonging to family Anacardiaceae is the most important commercially grown fruit crop. It can also be grown in subtropical conditions and up to elevations of 1400 meters above the mean sea level. The optimum temperature range for growth is 18 °C to 35 °C and it can tolerate temperature as high as 48°C. Burondkar *et al*., 2018 [3]. The mango tree reaches heights of 15-30m; cultivated trees are usually 3-10m high when mature. Bally S.E. India is largest fruit producer country in the world after China, 6.9 million ha area is under fruit cultivation with production of 81.2 million tons. R.S. Patil, 2018 [3]. World's mango production is averaging about 22 million metric tons per year. As per statistical data of horticultural crops in India; the mango production is 21,253 thousand metric tons and area under mango cultivation is 2,288 thousand ha (2017-18).
However, despite the country having a comparative advantage over other mango producing countries in terms of total production, the productivity continues to be low. Production of mango decreases mainly due to attack of insects and pests.
Mango is attacked by about 400 insects and mite pests Reddy, 2018 [12]. To increase the production of mango and to protect orchards during production spraying of agrochemicals is necessary. Pesticides and insecticides are sprayed by using various types of sprayers. Power sprayers are suitable for spraying in orchards, tea, coffee plantations, vineyards and field crops. Power sprayers are used for tall trees up to a height 15 meters. Power sprayers are operated by tractor and power tiller. Boom sprayer, Aero-blast sprayer and Air-assisted sprayer are some types of power sprayers. Boom type tractor operated sprayers are used for spraying in vegetable gardens, flower crops and for tall field crops like cotton, sugarcane, maize, sorghum, millets etc. It is suitable when crop is small and it is not used for tall fruit crops.
Pest control is effective when spraying is done by tractor operated boom type sprayer. In conventional sprayer, the pressure in the spray line forces the fine drops out of nozzle with a force at some distance, after that drops are free in atmosphere which causes loss of it due to wind velocity. Boom type sprayers apply pesticides nearer to the crop; hence the loss of pesticides is reduced.

Methodology
In order to study the boom spraying effect on mango tree following methodology has been discussed.

Tree properties
Five instruments for measuring tree height were evaluated by Michael *et al*. 1994 [8]. The five instruments were tested for reliability in measuring tree heights under realistic conditions. Readings from different measuring instruments were compared to the values which were

obtained by tree climbers. Indirect method for determining variation in canopy characteristics was studied by Rajan *et al*. 2001. It was concluded from study that indirect method for canopy structure measurement of mango tree was not available and direct measurement technique being tedious and practically impossible for large mango tree canopy. The effect of post-harvest pruning on the control of tree size and yield of mango was studied by Uddin *et al*. 2014 [15]. It was concluded from study that, pruning is an important practice in mango plants for quality of mango production and controlling tree size and high yield. Pruning was done once in every five years. Plant height was the maximum (5.36 m) in pruning treatment.

Spray volume condition

The air and spray volume requirement of mango tree for air carrier pesticide application was estimated by Dhande *et al*. (2015). The canopy volume and total leaf area of mango trees were used to determine the spray volume requirement per hectare of mango trees. The spray volume requirement ranged from 7.04 l/tree and 10.56 l/tree for effective pest control. The canopy volume found out by using spheroid formula. The average canopy volume of Alphanso mango tree was found to be 1040 m^3. The spray and air volume requirement for high density plantation mango orchard was determined by Badgire *et al*. (2020) [1]. Tree parameters canopy volume, mean leaf area, leaf density and total leaf area of tree were estimated for estimation of spray and air volume. The required spray volume application rate per hectare ranged from 144.24 lit/ha to 216.36 lit/ha and air volume requirement was 2.5 m^3 /s for effective spraying operation on high density mango orchard.

Nozzle

Developed spray boom set up on field sprayers and recommended the nozzle spacing depending on the application rate (gallons per acre) by Klein and Kruger 2011 [6]. The most common nozzle spacing is 20 to 30 inches. Two attributes were considered while selecting booms i.e. stability and strength. Field conditions may vary widely, but for uniform application, stability must be maintained. Performance of power tiller operated tall tree sprayer was evaluated by Kumar *et al*. 2018 [7]. The performance testing of the sprayer was done in LICHI orchards. Hollow cone type nozzle was used and its included angle determined at fixed distance of 31.5 cm from object.

Development of boom sprayer

Generally, Boom type sprayers used for spraying in vegetable crops and tall field crops like cotton, sugarcane, maize, sorghum etc. In this section we discuss about developments in the boom type sprayers.

Tractor mounted boom sprayer

A 12 m tractor mounted boom sprayer considering the various components of existing boom sprayer for cotton crop developed and modified by Gholap *et al*. (2014) [5]. Design deficiencies were identified of existing boom sprayer and then modifications and developments in the components of existing boom sprayer were done. The boom was fabricated with M.S. pipe of square cross section as it is stronger than circular pipe and boom stand also fabricated which was part of main frame. Boom stand helped in guiding the vertical movement of boom to adjust spraying height.

Animal drawn ground metered axle mechanism for boom sprayer

Animal drawn ground metered axle mechanism boom sprayer for rural farmers in Northern Nigeria was designed and developed by Michael *et al*. (2014) [9]. The equipment consist of a boom with a multiple controlled Droplet Applicator (CDA) atomizer nozzles, a gear pump a chemical tank, and chair for an operator; all attached to a framework bolted to a rear axle. The boom was attached at rear side of the framework. An attachment for animal harness was installed at the front of the framework.

Stabilization system of suspended sprayer boom

A new structure of the stabilization system of a suspended sprayer boom was developed by Michal and Josef (2015) [10]. This structure was developed for stabilizing sprayer boom. Fluctuations of a sprayer boom were observed due to uneven field surface which causes incorrect methods of spraying. To avoid deposition of liquid the simplest way to ensure that during the spraying treatment a sprayer boom was constantly parallel to the sprayed surface of plants.

Bi-cycle wheel operated boom sprayer

A Bi-cycle wheel operated boom sprayer was developed by Shankar *et al*. (2017) [13]. It was powered by bicycle wheel connected to the reciprocating lever mechanism and existing manual sprayer with set of nozzles. The sprayer was developed relatively few number of mechanical parts. It had a cycle wheel, chain drive, reciprocating mechanism and a piston or poppet with hollow pressure chamber connected to a liquid container. The Bi-cycle wheel operated sprayer was tested and compared with the power sprayer. It was observed that the sprayer worked satisfactorily and the efficiency of the developed sprayer was 3-4 times more than that of manually operated sprayer and it was operated continuously.

Performance of sprayer

Performance of tractor mounted tall tree air carrier sprayer for spraying on mango orchard was evaluated by Tekade *et al*. 2008 [14]. The performance of tractor mounted tall tree air carrier sprayer studied and compared with rocking and power sprayer. Flow rate, spray swath, air trajectory and spray deposition are the parameters which were considered for study. The flow rate of sprayer measured at three different speeds i.e. 7, 8.5, 10 km/h.

Different types of sprayers for application of pesticides in mango orchards were performed by Dhande *et al*. 2010 [14]. Three sprayers were selected for evaluating performance *viz*. rocking sprayer, power sprayer and tall tree air carrier sprayer. A field experiment was conducted to study the performance of sprayers. From the study concluded that, the vertical and horizontal throw of air carrier sprayer increases with increase in speed. Air carrier sprayer sprays uniformly on inner and outer sides of leaves. The air carrier sprayer sprays at faster rate as compared to rocker and power sprayer.

The performance evaluation of newly developed variable rate sprayer for spray deposition in guava orchard was studied by Wandkar *et al*. 2017 [16]. For this purpose the sprayer was operated at three different forward speeds (2, 3 and 4 km/hr) with four air velocity levels (20, 25, 30 and 35 m/s). The spray deposition was measured at six different plant positions *viz*. at face of upper and lower leaf surface of top, middle and bottom plant positions.

Conclusion

Air assisted and aero blast sprayers are mainly used for spraying in orchards. In this power sprayers air stream is used for atomization of drops and carrying these droplets on the trees. But, due to air velocity droplets are not deposited properly on leaf surfaces. The costly pesticide is sprayed to a site other than the crop area by aero blast and air assisted sprayer; which causes loss of pesticides. Boom type sprayers mainly used for spraying in vegetable gardens, tall field crops like sugarcane, sorghum, maize, millets, cotton etc. This sprayer used for spraying overhead of the crop and nearer to the plant, so that pest control is effective, and loss of pesticide due air velocity is not observed. The energy required for spraying in aero blast and air assisted sprayer is more as compared to boom type sprayer. If boom type sprayer developed for orchards it will reduce energy required for spraying and it will reduce loss of costly pesticides. Hence, there is scope for developing boom type sprayer for mango orchard.

References

1. Badgire BB, Mathur SM, Rathod RK, Tiwari GS. Determination of spray and air volume requirement for high density plantation mango orchard. International Journal of Current Microbiology and Applied Sciences 2020;9(2):2406-2414.
2. Bally SE. *Mangifera indica* (mango). Species profiles for pacific island agroforestry 2006. www.traditionaltree.org
3. Burondkar MM, Kulkarni MM, Salvi BR, Patil KD, Narangalkar AL, Joshi MS *et al*. Mango: an economic pillar of Konkan region of Maharashtra. Advanced Agricultural Research & Technology Journal 2018;2(2):160-170.
4. Dhande KG, Powar AG, Tekade MP, Kadam GS. Performance of different types of sprayers for application of pesticides in mango orchards. Green Farming 2010;1(6):615-617.
5. Gholap B, Gonjari VV, Mathur R, Jadhav P. Development and Performance evaluation of tractor operated boom type field sprayer for cotton crop. Green Farming 2014;5(5):930-933.
6. Klein RN, Kruger GR. Spray boom set–up on field sprayers 2011. http://extension.unl.edu/publications.
7. Kumar V, Sinha AK, Bharti N, Ram RB. Performance evaluation of power tiller operated tall tree sprayer. International Journal of Current Microbiology and Applied Sciences 2018;7:5277-5283.
8. Michael S, William V, Labau V. Five instruments for measuring tree height: An evaluation. Southern Journal of Applied Forestry 1994;18(2):76-82.
9. Michael CA, Suleiman ML, El-Okene A, Ibrahim OA, Makoyo M. Design and development of animal drawn ground metered axle mechanism boom sprayer. International Journal of Engineering Research and Applications 2014;4(9):01-09.
10. Michal S, Jozef A. A new structure of the stabilization syatem of a suspended sprayer boom. Agricultural Engineering 2015;1(153):127-132.
11. Patil R, Deshmukh R, Bhaskar K, Jahagirdar S. Growth and export performance of mango in India. International Journal of Current Microbiology and Applied Sciences 2018;6:2667-2673.
12. Reddy P, Gundappa B, Chakravarthy A. Pests of mango 2018.
13. Shankar M, Vinod VR, Mohithkumar GV, Vidyashree SM. Design and development of Bi-cycle wheel operated boom sprayer. Trends in Biosciences 2017;10(20):3760-3763.
14. Tekade MP, Kadam GS, Dhande KG, Powar AG. Performance evaluation of tractor mounted tall tree air carrier sprayer for spraying on mango orchard. International Journal of Agricultural Engineering 2008;1(2):30-34.
15. Uddin MS, Hossain MF, Islam MS, Hossain MM, Uddin MS. Effect of post- harvest pruning on the control of tree size and yield of mango. Journal- Faculty of Agriculture Kyushu University 2014;37:41-46.
16. Wandkar S, Bhatt Y, Jain HK, Dhande KG. Performance evaluation of newly developed variable rate sprayer for spray deposition in guava orchard. International Journal of Plant Protection 2017;10(1):96-102.