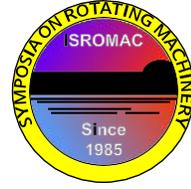


Experimental investigation of droplet diameter and velocity distributions in air-assist boom sprays



Long Abstract

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Introduction

Due to the air-assist boom spray technology has significant effects on improving the work efficiency, increasing the utilization rate of pesticides, reducing the cost of pesticide application and environmental pollutions, it has been extensively used in agricultural engineering field. More and more scholars devote to the research of the flow field of air-assist boom sprayer on account of its important influence on spraying anti-drift, but there are less research on the droplet size and velocity of the flow field of air-assist boom spray.

1. Methods

In this paper, a test system of the air-assist boom spraying was built to study the influence of air flow rate of air-assist, the relative position of air outlet to nozzle and the spraying angle on droplet diameter and droplet velocity distributions. This system is mainly composed of: PDPA measurement system, air-assist operation control system and spraying operation control system. Then a test coordinate system was set up whose coordinate origin is the center position of the air curtain outlet, the Z axis is the direction of the air flow, the Y axis is the direction of the curtain length and the X axis is the perpendicular direction of the YOZ plane. Select the measuring plane at the height of 640mm from the ground and 500mm from nozzles. Select the intersection of YOZ plane and measuring plane as the measuring line. Set 11 measuring points which the distance between every two adjacent points is 50mm on the measuring plane.

Test the droplet size and droplet velocity distribution on 11 test points in the given combined conditions that the nozzle spraying pressure is 0.3 MPa, 0.4 MPa, and 0.5 MPa, the fan speed is 0R/min, 1118 R/min, 1947R/min and 2746 R/min. Each test lasts for 20s and the natural wind speed is 4m/s. The horizontal distance is 130mm and the vertical distance is 260mm between the nozzle and the air curtain outlet, and the spraying angle is 15°. The droplet diameter distributions, velocity distributions and the relationship between air pressure and droplet diameter were analyzed systematically.

2. Conclusions

The test results indicate that the droplet size and velocity distribution curves showed a large concave in the whole flow field of air-assist boom spray. Under the influences of flow field, the higher the air flow rate of air-assisted is, the smaller the droplet diameter is. And its distributions are more symmetrical. With the increase of the distance of air outlet to nozzle, the droplet diameter reduces. The droplet diameter increases along with the increase of spraying angle, at a spray angle of 30°, the droplet diameter tends to be uniform.

The following conclusions can be made from this study. (1) In general, when droplets are released straight down, larger velocity of droplets can be given and better performances can be achieved either in terms of drift reduction or droplet deposition. (2) For air-assist boom spraying, air jet can act directly on the droplets and improve their distribution and movement. With the enhancement of jet velocity, the effect increases obviously. It means larger jet velocity has better performance on the droplet

distribution.(3)On the one hand, due to plant leaves flip under the transportation of air jet, the droplet penetration capacity has been strengthened distinctly. On the other hand,air jet can improve droplet size and velocity distribution,so larger jet velocity has better performance on the drift reduction and droplet deposition.Thus,it can improve the operation efficiency and pesticide utilization rate..

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