ULTRA-LOW ALTITUDE AND LOW SPRAYING TECHNOLOGY RESEARCH IN PADDY

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ABSTRACT

Aerial application has characteristics of low-volume, small droplet, and possibility of drift. To control rice planthopper, leaf roller and blast, the research aimed at screening agrichemicals and determining the feasibility of using high concentration of conventional dosage for aerial application. The results showed that higher concentration of imidacloprid WP, ME, WG, carbendazim WP and Jinggangmycin were safe for rice; while chlorpyrifos EC, EW, showed significant phytotoxicity. The results of UAV application showed that the droplets in the lower leaves of rice were 92.8 % of those in the upper leaves, which was significantly higher than conventional ground application. The amount of spray drift was 12.9 % of the total spray amount at the flight velocity of 3 m/s and wind speed of 4-5m/s. A 90 % of the spray drift from the spray area was concentrated in the range of 8 m. The spray drift in the air was zero at a distance of 50 m. In the control efficacy field trails, we found that 80 % of the conventional dosage gave the best control effect.

Keywords: UAV, spray drift and deposition, aerial application

INTRODUCTION

Pesticide spray distribution , droplets deposition and drift research & tests on paddy field with UAV (Rotorcraft) are essential because of its advantages of low altitude(3~5m) and low volume . So many studies on aviation spray have been done to optimize the way of spraying and the components of spray equipment in the past. Franz etc. spray fluorescence powder onto light-sensitive test strips fixed on leaves (cotton, Cantaloupe,) to analyze the droplet deposition by the influence of canopy and weather. Doctor Yubin Lan, U.S. Department of Agriculture Southern Research Center , with fixed-wing aircraft spray ,WSPs(water sensor paper) and mylar cards fixed on the cotton canopy were collected and marked in order to calculate and analyze the relationship among droplet deposition, droplet size, droplet coverage, droplet number, adjuvant and droplet drift . The results of the study will be the help of aerial spraying to choose the right anti-drift additives and aircraft spraying operations to meet the air drift standard. Other more, B.K.Fritz, W.C.Hoffmann,etc. have carried out air spray drift and ground equipment spray drift comparison test , for spray drift control technology research.

Research of spray distribution based on the unmanned helicopter in paddy crop, which has been done in this study, is quite rare. In this study, data from UAV(Rotorcraft) spray droplet deposition and drift law experiments have been explored, as a theoretical basis supporting aviation anti-drift standard. The objective of this research was to determine optimum agrichemicals sprays and concentration of the sprays, and characterize spray drift and deposition for low-altitude aerial application.

MATERIAL AND METHODS

Application: Sprayer Settings and Crop Characteristics

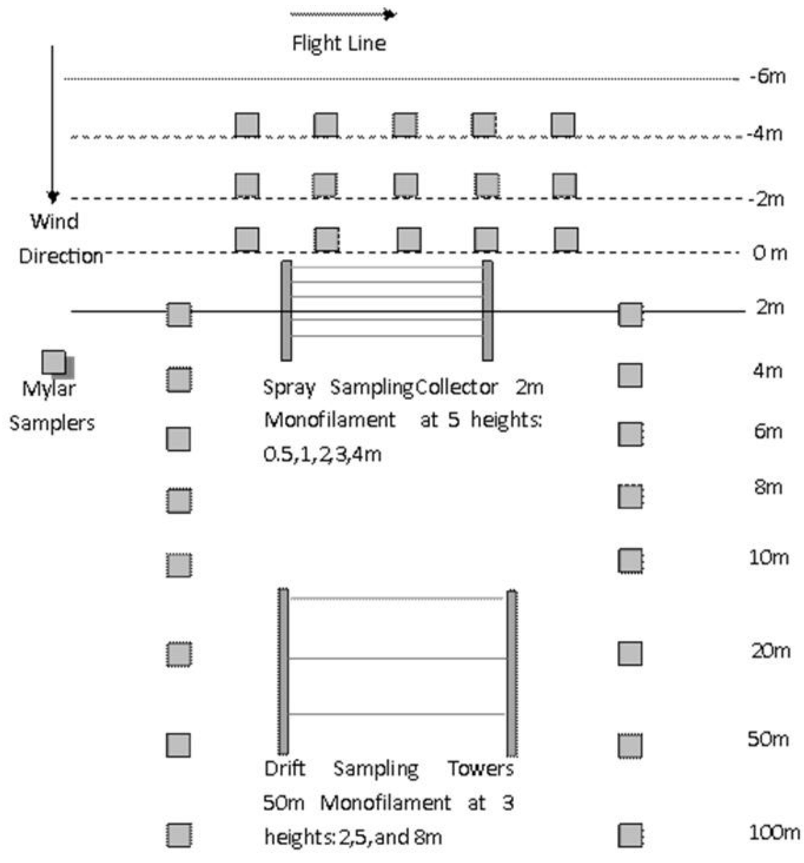
Sprayer boom height	7 m above canopy
Sprayer	Z-3 UAV
Working width	21 m in total; divided in 3sections of 7 m
Driving speed	10.8 km h-1
Spray volume	15 L • ha^{-1}
Rh-B concentration	2 g • L^{-1}
Crop type	rice paddies
Plant age	Mid-tillering stage of crop growth
Soil coverage	90-100% (estimate)
Crop height	0.65-0.70 m
Leaf Area Index	7.05 m^2 • m^{-2}

Flying conditions:

flight altitude: 5m, velocity: 3m/s, wind speed: 4m/s, spray area 1170m^2, air temperature 34℃, spray liquid volume: 1.8L, sampling area: 1000cm^2.

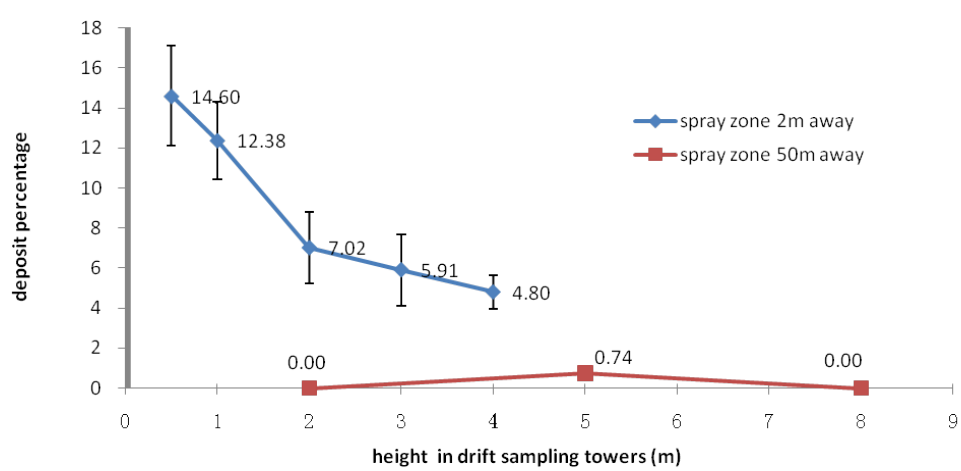
Determination Of Droplet Drift and Deposition

Fluorescent Rhodamine-B 0.2% was added into spray solution. The effective deposition on-target and off-target drift were determined. The receivers were placed in a distance of 2, 4, 6, 8, 10, 20, 50 and 100m from the spray area to determine the distance of droplet drift. Masts were placed in a distance of 2 m and 50 m from the spray area, respectively. Monofilament fiber was placed at heights of 0.5, 1, 2, 3 and 4m and 2, 5, and 8 m of each mast, respectively, to measure the drift of droplets in the air.

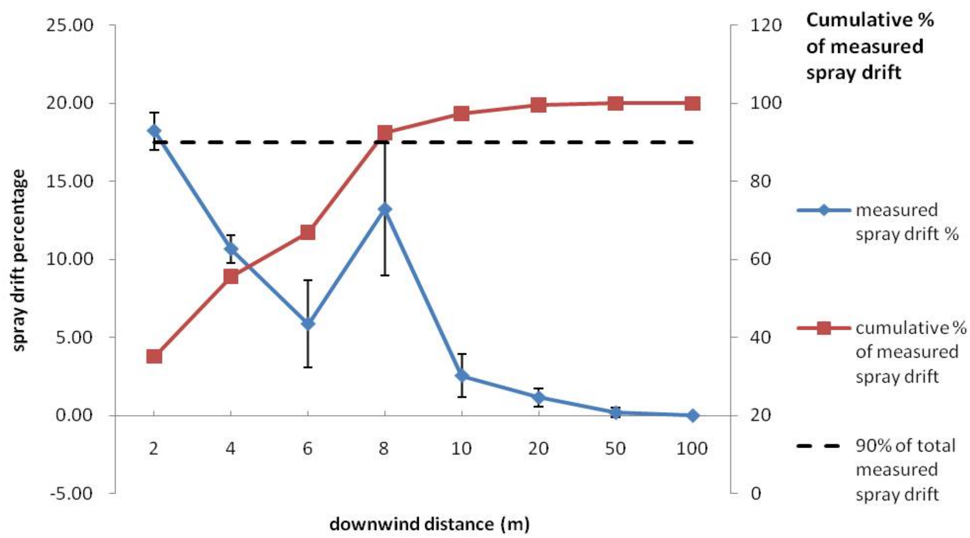


Layout of field sampling locations for aerial drift studies

RESULTS AND DISCUSSION



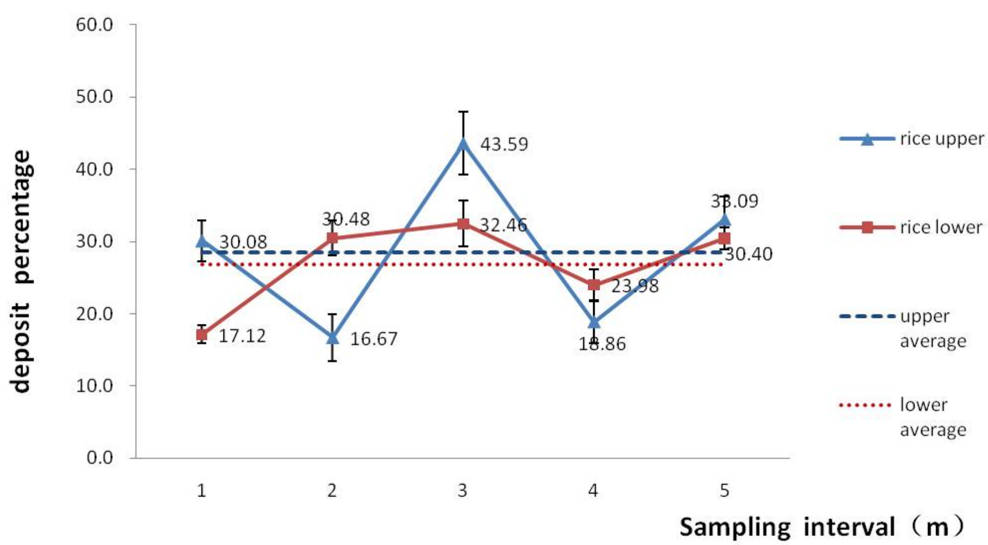
Different heights deposition at the 2m,50m location



different distance deposition(cm^2)

The result showed that the amount of spray drift was 12.9 % of the total spray amount at the flight velocity of 3m/s and wind speed of 4-5m/s. A 90% of the amount of spray drift from the spray area was concentrated in the range of 8m. The spray drift in the air was zero at 50 m.

Low Altitude Spray Deposition

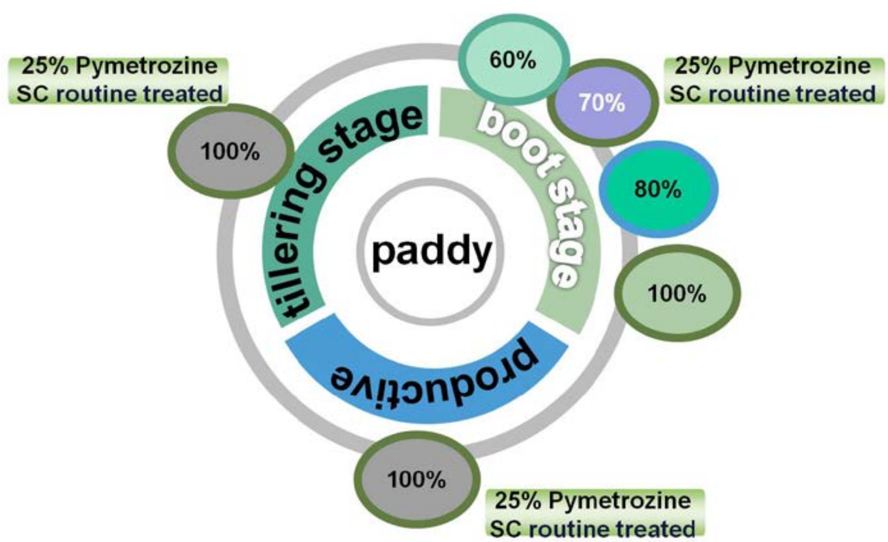


Rice upper and lower deposition(cm^2)

Due to the strong air flow, the upper and lower leaves of rice had a higher deposition. The deposition amount at the upper and lower part of rice was 28 % and 26 % of the total spray amount, respectively.

Field Test

According to the control period of rice planthopper and vertical leaf roller during the rice heading stage, 25 % pymetrozine SC conventional dose spray was used as a control; and 60, 70, 80 and 100% of the conventional dose were used as a gradient concentration for the test at rice tillering and grain filling stages.



The result showed that the reduced pesticide usages were saved 40, 20, and 10% compared to conventional spray dose, respectively. Low-volume aerial application will reduce the pesticide usage up to 20 -40 %.

CONCLUSIONS

The study was conducted to screen low-volume, high-concentration spray formulations, determine the law of low-altitude spray deposition, and test the control effects in the field trails. The results showed the optimum operation parameters for UAV were: flight altitude: 3-5m and wind speed: <4m. The spray dose was 80 % of the total conventional dose and the spray volume was 15L/ha.

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