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Study of the operational parameters of crops turbine sprayer (turbo liner) on spray quality and diameter of droplets, using image processing

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Introduction

Today, attention to safety and environmental issues in all sectors in agriculture, industry and services is very important. Chemical poisons play an important role in rapid progress of agricultural products. Every year about 25 to 35 percent of the world's crops are affected by insects, weeds and plant pathogens disappear and this figure would be raised to 80% if no control was applied. Drift problem and its devastating effects are the most important issue which related to users and sprayers manufacturers. Spray drift reduction and improvements in the efficiency of pesticide application processes are global goals. Where ever spraying is applied, drift will be produced and it must be controlled by controlled of the droplet size. The application of these sprayers is the high in the farms (the number of 2303 in Iran). So, this research was carried out to improve the quality of work in these sprayers by studying the droplets diameter and the spray quality index.

Materials and Methods

The research was conducted at the University of Khouzestan Ramin Agriculture and Natural Resources. Tests were done with 20 m of water sensitive papers at a distance of 2 meters from each other. To evaluate the technical items affecting on drift, an experiment was conducted using a turbo liner sprayer (TURBINA S.A. 800) and the John Deer (JD) 3140 tractor. A completely randomized factorial design was applied. By using 3 replications and the factors were spraying pressure applying three levels (10, 25 and 35 bar), the fan speed with two levels (1998 and 2430 rpm) and forward speed with two levels (9 and 13.5 km hr^{-1}). The sprayer started the application, spraying a solution of water and tracer (yellow Tartrazine E 102), 15m before the water sensitive papers and then moved over the water sensitive papers. The spraying was continued 15 m after the end of the sampling area. After spraying, sensitive papers were photographed and then volume diameter of 50% (DV_{50}) and median numerical diameter (NMD) and spraying quality indicator were calculated. A Spectrophotometry device at the wavelength of 427 nm, Image J and sas 9.2 software were used for measurement. This research was carried out in accordance with the calendar crop canola spraying in field conditions and the weather was calm that the wind speed was 0- 2.5 km hr^{-1}, relative humidity was 29.7% - 32.5% and air temperature was 18.8˚C – 20.7˚C.

Results and Discussion

According to the results sprayer pressure, fan speed and forward speed were shown significantly different ($P \leq 0.01$) on the volume diameter of 50% (DV_{50}) and median numerical diameter (NMD). The effect of spraying pressure on distributing quality indicator was shown significant ($P \leq 0.01$), but the fan and forward speed did not

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shown any significant effect. Mean comparison of the interaction of pressure and forward speed on the spray quality index and the number median diameter were shown significant ($P \leq 0.01$), but they did not shown any significant effect on the volume diameter of 50% (DV_{50}). With increasing spraying pressure and fan speed, the droplet size, volume diameter of 50% (DV_{50}) at 72% and numerical median diameter (NMD) at 69% and distributing quality indicator at 46% were decreased that were corresponded with the result of Czaczyk *et al.* (2012), Peyman *et al.* (2011), Nuyttens *et al.* (2009) and Landers and Farooq (2004). With increasing spraying pressure and forward speed, the droplet size, numerical median diameter (NMD) at 63% and distributing quality indicator at 35% were decreased that these resulted were corresponded with the results of Naseri *et al.* (2007) and Dorr *et al.* (2013).

Conclusions

With increasing spraying pressure, fan and forward speed, the droplet size, volume diameter of 50% (DV_{50}) and numerical median diameter (NMD) were decreased. Therefore, spraying quality indicator was decreased. The maximum pressure (35 bars), maximum fan speed (2430 rpm) and maximum forward speed (13.5 km hr^{-1}) were able to produce the minimum spraying quality indicator (10.3). At the minimum pressure (10 bars), maximum fan speed (2430 rpm) and minimum forward speed (9 km hr^{-1}), the maximum spraying quality indicator (2.91) was resulted.

Keywords: Drift, Image processing, Turbo linear sprayer, Volume diameter, Spray uniformity

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