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Study the Effect of Operational Parameters of Crops Turbine Sprayer (Turbo Liner) On Spray Drift and Uniformity Using Spectrophotometer

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Abstract: Drift and its destructive effects is the main problem facing today's sprayer users and manufacturers. Whenever spraying is done possible drift should be controlled and reduced. For this reason to evaluate the technical factors affecting the drift, an experiment was carried out using turbine farm sprayer (turbo liner), in three factor factorial experiment with a completely randomized design. The factors and levels were as follows: spraying pressure with three levels of 10, 25 and 35 bar, the fan speed with the two levels of 1998 and 2430 rpm and forward speed in two levels of 9 and 13.5 km /hour. Using a spectrophotometer and software, Excel and SAS and Duncan multiple range test, drift percent, the meeting (L/ha) and spray uniformity was measured. The results showed that treatment p3f1 and p3v2 constant pressure of 35 bars, Fan speed 1998 rpm and the speed of 13.5 km/hr at to 63 and 64 percent, respectively, have the greatest influence on their CV and have the lowest influence on their spray uniformity. The results showed that treatment p3v2 constant pressure of 35 bar and the speed of 13.5 km/hr, have the greatest influence on their drift, to 84 percent.

Keywords: Drift, Spray uniformity, turbo liner**.**

1. INTRODUCTION

Chemical poisons play an important role in rapid progress of agricultural products. Using these poisons, improving and increasing the quality and quantity of products and herbicides pesticides need to control weeds and pests in the workforce, However make extensive use of chemical poisons has been created some serious environmental issues[1] . 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 risen to 80% if no control was applied. According to sources, the Department of Agriculture the amount of pests in annual losses of about 30%. With regard to the above the necessity of fighting against pests is necessary [2].The movement of spray particles and vapors off the target by air is called spray drift. There are many factors like spraying pressure, nozzle hole diameter, speed, wind speed, humidity and air temperature, and the viscosity of the liquid sprayed playing an important role in creating or reducing drift [3] and [4]. However, liquid viscosity and density in the range of agricultural applications have little effect on droplet size [5]. Forward speed, fan speed and spraying pressure which are the most factors influencing the farm turbine sprayer were analyzed, in this study.

During the investigation [6] for standard flat fan nozzles with a decrease in Forward speed of 6 to 4 km/hour, the amount of the average of drift potential was 0.042 to 0.0140 percent and

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nozzles inject of 0.002% in 0.003% reduction. In another research [7] concluded that in the speed range of 3 to 6 kilometers per hour, drift potential for large flat fan nozzle from 23% in 7.42 percent and a wide angle nozzle deflector from 15.2% to 33%. The research results were such that in the speed of 4 to 6 km/hr, reducing potential drift for flat fan nozzles wide (F11003) and increase from 35/3 to 52.9 percent. In order to increase speed, drift potential is reduced; however, no significant difference was found between the rate of 8 and 10 km/hr [8]. Naseri et al (2007) showed that the forward speed on the sprayer spray uniformity Turbo liner was significant at 1% and the amount of spraying uniformity (9.394) on the maximum speed of 8/12 km/hr and the lowest completed (16.34) for forward speed of 5.2 km/hr.

In the minimum pressure of 300 kPa, the lowest rate drift was 17 percent and with the greatest pressure 400 kPa, the highest rate drift was 21% [9], Also Nuyttens et al (2007) concluded that drift increasing according to increasing pressure from 2 bars to 4 bars, The amount of the standard uniform for fan nozzle (F11003) increase from 3.7 percent to 20.8 percent. Research [10] showed that the spray pressure sprayer Turbo liner is not statistically significant effect on the amount of spraying uniform. But [13] in the study, uniformity spraying by 3 pressure levels 3, 4 and 5 bars, respectively, achieved to average values for uniformity spraying 0.96, 0.838 and 0.847, Showed that by increasing the pressure, more uniform particles are sprayed poison

Christovam et al (2012) to check the auxiliary air sprayer to control soybean rust, The air at speeds of 0, 9, 11 and 29 kilometers per hour, The amount of pesticide spraying outside of the spray (poison spilled on the ground), respectively 1.7611, 2.0828, 2.1589 and 4.3292 microliter/ cm3 obtained that Showed that by increasing air velocity sprayer, spray the outside of the spraying poison and eventually drift increases. The effect of pesticides on the plants and cover the fan speed on the size of the droplets, concluded that reducing the fan speed from 2076 rpm to 1557 rpm with coverage at a distance of 24.4 meters drift toxins in the farthest, from 10.1 percent to 0.04 percent reduction [11] .

2. Materials and Methods

To evaluate the factors affecting poison particles drift, the research was conducted at the Agriculture and Natural Resources University of Ramin in Khuzestan, Ahvaz were in the Northeast. Three-factor factorial experiment with three replications in a completely randomized design was performed. The first factor was the pressure sprayed with three levels (10, 25 and 35 bar) and the second factor was fan speed at two levels (1998 and 2430 rpm) and the third factor was forward speed at two levels (9 and 13.5 km/ hr) were applied. To implement the experiment used from turbo linear sprayer which was attached to the JD 3140 tractor. This is done in accordance with the calendar of canola crop spraying in field conditions and the weather was calm. After calibrating the sprayer and determine the sprayer output in liters per ha, by doing experiments, drift potential were measured.

2.1. Poison sediments in containers

Particles are transported by wind; they show the drift, for this purpose, at first by adding different amounts of yellow color Tartrazine with the E102 code to the water and having different concentrations of dye was prepared. Then by spectrophotometer [12], [13] and [14], the Water and color soluble was spectrometery and a reference graph was drawn. Special paint and water in the sprayer tank were cast and the sprayin operation was done. After collecting the containers, the solution in the container with a spectrophotometer was check and deposits on containers according to equation (1) was used to assess drift.

$$D_i = \frac{(\rho_{Smpl} - \rho_{blk}) * V_{dil}}{\rho_{spray} * A_{col}} \qquad (1)$$

Di: Poison sediments in a container (microliter/cm2), ρsmpl: the absorbance of the sample, ρblk: absorption rate control (water), Vdil: liquid volume solution of distilled water (micro-liters), ρspray: absorption concentration in the sample, Acol: within the area to collect the solution (cm2)

2.2. Drift potential value

The drift potential value is the poison sprayer that passes by the air flow out of the region has been shipped; it can be calculated by the equation (2) [Gil et al., 2014]:

$$DPV = \sum_{i=1}^{n} \frac{D_i}{RSD} * 100 \qquad (2)$$

DPV: the potential drift, Di: Poison residue in a container, n: number plate, RSD: sediment control

Due to the width of the spray sprayer up to 20 meters, we were a petri dish on a board, then the boards with a distance of 2 meters from the path of the sprayer [15] along the (wide) spray (perpendicular to the direction of the sprayer), was inserted into the 11 rows of petri dish. The sediment is also to measure the outside diameter of the spray sprayer in six rows that the distance between 2 meters from the last row, the number of petri dish (6) [Douzals et al., 2010, Gil et al., 2014]and [16]. The Petri dish is covered after spraying operations were kept in the dark until transported to the laboratory and by the device, the sediments within them spectroscopy.

3. Results

Analysis of variance of the parameters included the spray pressure, forward speed and fan speed on drift and uniform spray in Table 1 has been shown.

Table 1: Analysis of variance the effect of forward speed, spray pressure and fan speed on drift and spray uniform

Changes Sources	Df	Mean square	
		Drift (lit/ha)	Uniform spray
Pressure (P)	2	693819.56**	0.193**

Fan speed (F)	1	7184.89**	0.015**
Forward speed (V)	1	238249.71**	0.041*
Interaction (P*F)	2	401.052 n.s	0.006**
Interaction (P*V)	2	35476.80**	0.12**
Interaction (F*V)	1	106.45n.s	0.001**
Interaction (P*F*V)	2	621.539**	0.0002 n.s
Error	24	190	0.0001
CV		3.7	4.6

*,** and n.s is significant at 5%, 1% and not significant

4. Discussion

The results of analysis of variance show that, the treatment of spray pressure and fan speed on drift and uniformity spray is significant at 1%, also forward speed on the drift and spray uniform is significant at 1% and 5% respectively. That has been shown in the analysis of variance.

The interaction between the pressure and fan speed on the spray uniformity was significant at the 1%, and the interaction between the fan speed and forward speed on spray uniformity was the significant effect at 5%. Also the interaction between the pressure and forward speed on the drift and spray uniformity was significant at the 1%.

The results of these mean comparisons at treatments in the Figures (1) to (4) have been shown. According to Figure 1 shows, by increasing the pressure and the forward speed, increased drift (lit/ha), that treatment p3v2 with the average 735.1 and treatment p1v1 with 117.1 Had the highest and the lowest effective on drift, The results Erfanian et al., (2009) and Nuyttens et al., (2007) to reduce drift with the reducing the pressure and the results of Nuyttens et al., (2014),[17] and Vanella et al., (2011) to reduce drift by increasing the forward speed, dose corresponded.

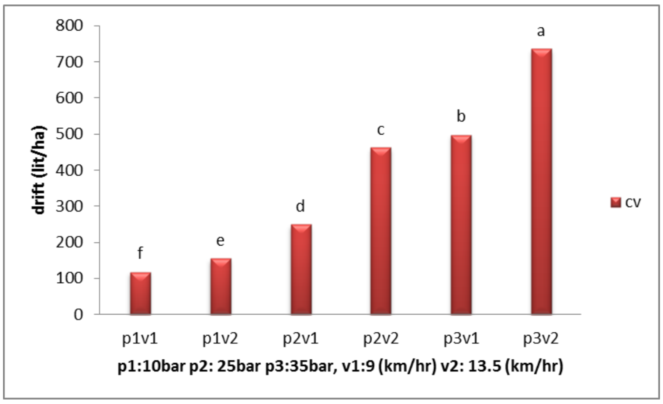

Figure 1: Comparison of interaction between pressure and forward speed on the drift (lit/ha)

According to the Figure (2), by reducing the pressure and increase fan speed, the uniformity reduced (the increase on cv). The treatment p1f2 with 0.46 and treated p3f1 with 0.17 respectively have the lowest and highest effect on the spray uniformity .That the results Landers and Farooq (2004) and Peyman et al., (2011) based on reducing the spray uniformity with increase the fan speed and increase the uniformity with increase the pressure, corresponded.

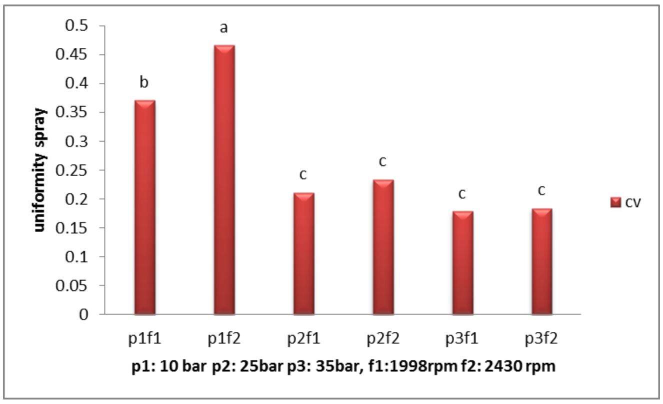

Figure 2: Comparison of interaction between pressure and fan speed on the uniformity of spraying

According to the Figure (3), by reducing the pressure and reduce forward speed, the uniformity reduced (the increase on cv). The treatment p1v1 with 0.48 and treated p3v2 with 0.17 respectively have the lowest and highest effect on the spray uniformity. That the results Naseri et al., (2007) and Peyman et al., (2011) based on reducing the spray uniformity with reduce the forward speed and increase the uniformity with increase the pressure, corresponded.

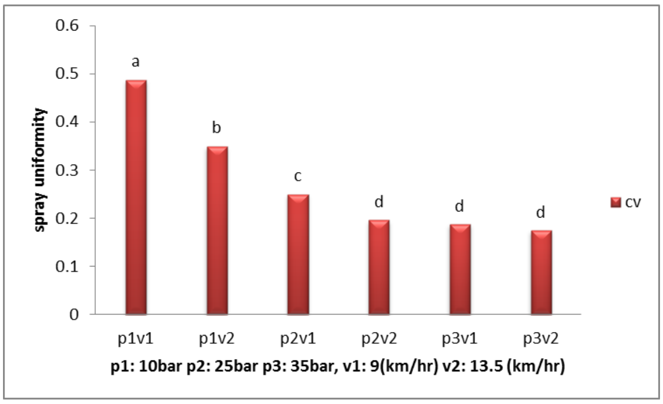

Figure 3: Comparison of the interaction of the pressure and forward speed on the percent drift

According to figure 4, with reduce the fan speed and increase forward speed, spray uniformity was increased (the reducing on the CV). According to figure 4, the interaction between fan speed and forward speed were not significant. That the result Landers and Farooq (2004) and Naseri et al., (2007) based on reducing the spray uniformity with increase the fan speed and increasing the spray uniformity with increase the forward speed corresponded.

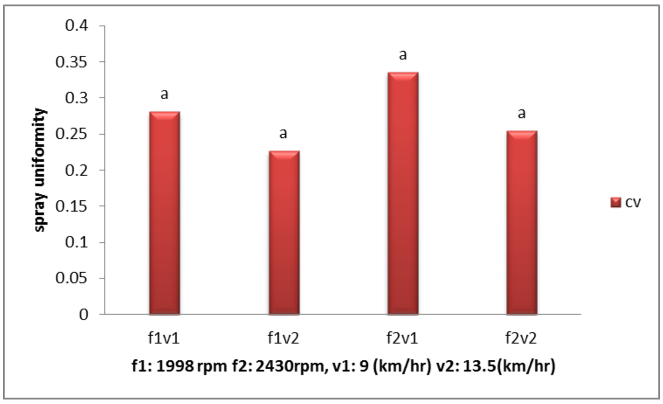

Figure 4: Comparison of the interaction of the fan speed and forward speed of spray uniformity

5. Conclusion

According to the results, treatment p3v2 with the 35 bars pressure and forward speed in 13.5 km/hr Compared with the treatment p1v1 with the 10 bars pressure and forward speed in 9 km/hr, has the greatest effect on the drift and increase the drift amount to 84 percent. Treatment p1f2 with the 10 bars pressure and fan speed of 2430 rpm Compared with treatment p3f1 with a 35 bars pressure and fan speed 1998 rpm, have the lowest influence on spray uniformity and decrease the uniformity to 63 percent. Treatment p1v1 with the 10 bars pressure and forward speed in 9 km/hr Compared with treatment p3v2 with the 35 bars pressure and forward speed in 13.5 km/hr, has the lowest effect on the spray uniformity and decrease the spray uniformity amount to 64 percent.

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