Airborne Spray Drift with Venturi-Type Nozzles

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Introduction

Preliminary test data and visual assessments by producers have shown variations in spray drift characteristics from different manufacturers venturi-type nozzles. To determine spray drift characteristics from such nozzles, wind tunnel studies were conducted. The effect of nozzle manufacturer, nozzle size and nozzle pressure were studied.

Materials & Methods

The wind tunnel used in this study was 14 m long, included a diffuser, contraction chamber, 7 m x 7 m open test chamber and a 1.2 m x 1.2 m x 8 m long closed test chamber. Field wind velocity profiles were simulated by baffles and an artificial wheat crop on the wind tunnel floor. Nozzles were mounted with the spray pattern perpendicular to the air flow. Nozzles used in this study and test conditions are shown in **Table 1.** Spray drift was quantified by counting and measuring airborne spray droplets four meters downwind from two nozzles using a laser particle analyzer. To simplify comparisons, airborne droplet data was normalized to factor out differences in nozzle flow. The cloud of airborne droplets downwind from the nozzles was expressed as the number of droplets/cm^2/L of spray.

Table 1.

Nozzle	Nozzle Size/Color	Nozzle Pressure (kPa)	Nozzle Height (mm)	Wind Speed (km/h)
Turbo TeeJet	015/green	150	600	30
TurboDrop	02/yellow	275	800	45
TurboDrop XL	03/blue	400		
Air Bubble Jet	04/red	525		
Ultra	05/brown	700		
Ultra Lo-Drift				
TurboDrop/Turbo TeeJet				
AI TeeJet				

Preliminary Results

The following graphs illustrate airborne spray drift from Spraying Systems wide angle Turbo TeeJet (TT) nozzles and several manufacturers' venturi nozzles in 30 km/h winds. A low airborne spray drift number means a lower potential for drift in field spraying conditions. **Figure 1** shows spray drift from Turbo TeeJet nozzles at a range of pressures and nozzle sizes. Results were typical of what normally happened with conventional nozzles operating in windy conditions. When pressure was increased, spray droplets got smaller, droplet density increased and drift increased. When larger nozzles were used, spray droplets got coarser, droplet density decreased and drift decreased. A way to reduce spray drift in the past was to use large nozzles, so the majority of application rates were at 110 L/ha.

FIGURE 1. Turbo TeeJet Nozzles @ 600 mm

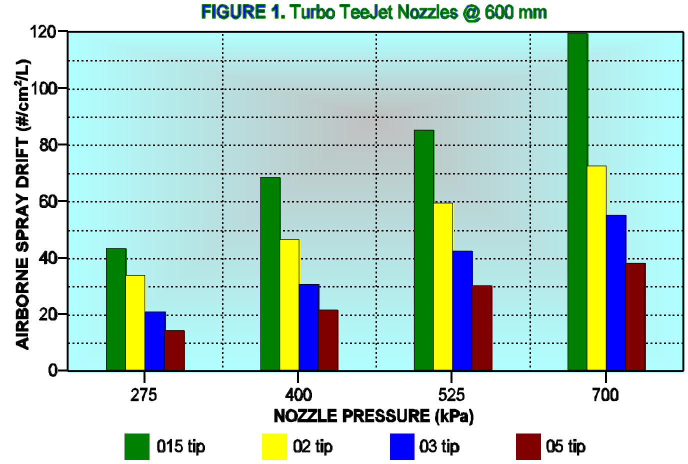


FIGURE 2. TurboDrop Nozzles @ 600 mm

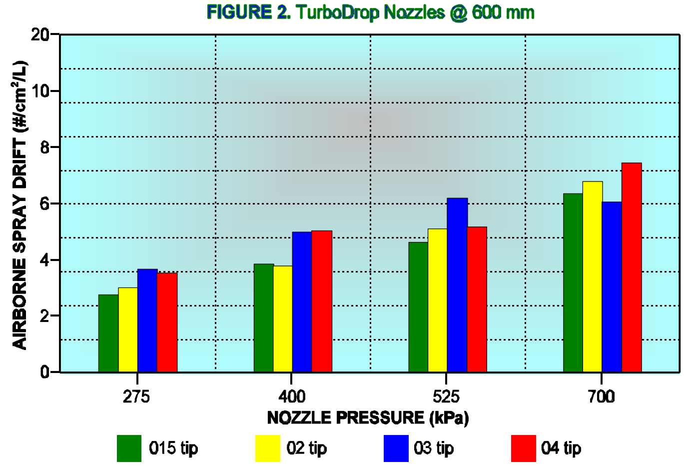
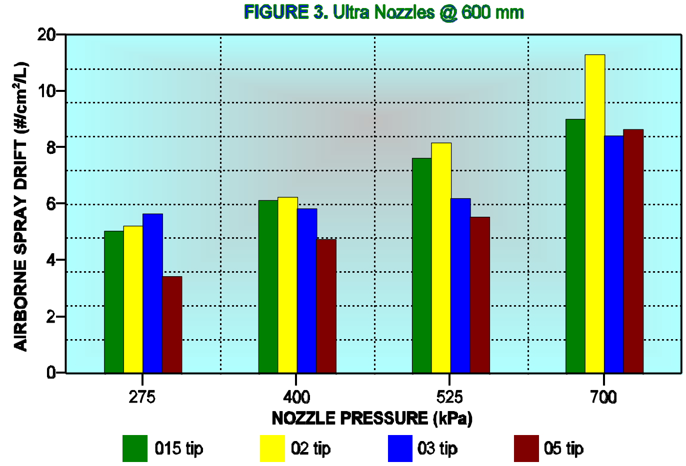


FIGURE 3. Ultra Nozzles @ 600 mm



Figures 2 & 3 show airborne spray drift from TurboDrop and Ultra venturi nozzles, respectively. These venturi nozzles show spray drift increased slightly with increased pressure. Smaller sized venturi nozzles resulted in nearly the same level of drift as large nozzles. These venturi nozzles reduced airborne drift by 60 to 90% when compared with Turbo TeeJet nozzles. Note that Turbo TeeJet nozzles reduced spray drift by 50% when compared with conventional (XR) nozzles.

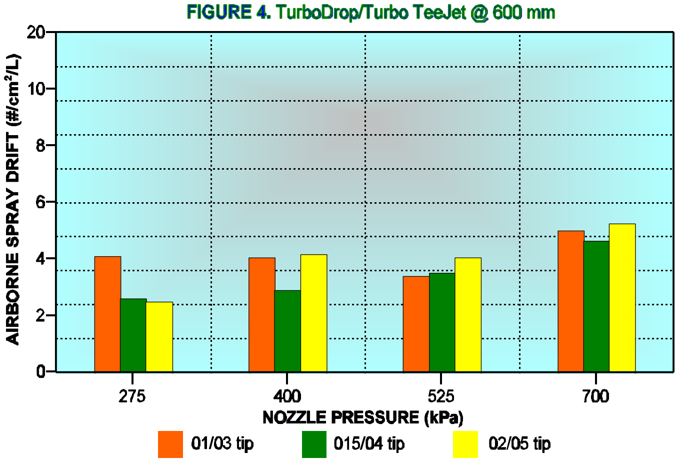
TurboDrop venturis combined with Turbo TeeJet tips resulted in the lowest level of spray drift (**Figure 4**), averaging more than 90% in drift reduction. With this combination, nozzle pressure and size did not affect drift much. What did all this mean? Producers and custom applicators were as confident applying chemicals with small nozzles and high pressures as they were with large nozzles and low pressures in the past. Although drift levels were low, caution is advised when using this combination, especially with larger TurboDrop venturis. Spray droplets are very coarse and may affect herbicide efficacy.

Among the venturi nozzles tested so far, drift levels were highest with Air Bubble Jet (**Figure 5**) and TurboDrop XL venturi nozzles. Even so, these venturi nozzles reduced spray drift by 35 to 60% when compared with Turbo TeeJet nozzles at the same operating pressures. These nozzles have spray drift characteristics similar to conventional nozzles, where drift increased with pressure and decreased with larger tips.

Conclusions

- Turbo TeeJet (TT) nozzles reduced spray drift by 50% over conventional (XR)

FIGURE 4. TurboDrop/Turbo TeeJet @ 600 mm



Discussion

The venturis designed pressure range had a significant effect on spray drift. Venturi nozzles, designed to operate between 100 and 700 kPa, reduced drift less than venturi nozzles designed to operate between 275 and 700 kPa. Based on this study, venturi nozzles were classified into two categories.

Figure 6 shows spray drift between the venturi categories and compares them with Turbo TeeJet nozzles at a spraying pressure of 525 kPa. Those such as Air Bubble Jet, TurboDrop XL and Ultra Lo-Drift, normally designed to operate at conventional pressures between 100 and 400 kPa, were categorized as low pressure venturis. Low pressure venturi nozzles operate best at 275 kPa and can be operated up to 700 kPa if spray drift is not a concern. The AI TeeJet venturi nozzles also fall into this category. These nozzles are well suited for conventional type sprayers with limited pump pressure and where herbicide efficacy is a concern.

Venturi nozzles such as TurboDrop, Ultra and TurboDrop/Turbo TeeJet, designed to operate between 275 and 700 kPa, were categorized as high pressure venturis. High pressure venturi nozzles are more suited for high clearance sprayers and should be operated at pressures above 525 kPa when herbicide efficacy is a concern. These nozzles have operating limits. Spray drift levels are near Turbo TeeJet levels when these high pressure venturi nozzles were operated in 45 km/h winds and spray heights at more than 800 mm.

FIGURE 5. Air Bubble Jet Nozzles @ 600 mm

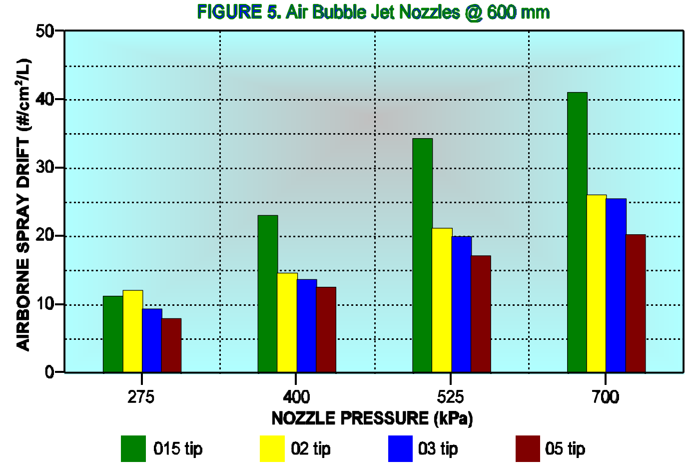
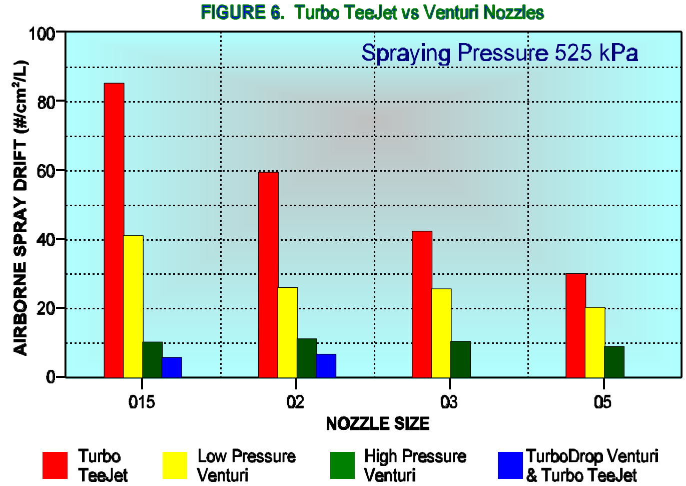


FIGURE 6. Turbo TeeJet vs Venturi Nozzles



Conclusions

- Turbo TeeJet (TT) nozzles reduced spray drift by 50% over conventional (XR) nozzles. *(In a 30 km/h crosswind, drift from XR and TT nozzles was 23 and 12% respectively.)*
- Venturi nozzles designed pressure range had a significant effect on spray drift.
- High pressure venturi nozzles reduced airborne spray drift by 60 to 90%.
- Low pressure venturi nozzles reduced airborne spray drift by 35 to 60%.
- Combining a TurboDrop venturi and Turbo TeeJet tip (TD/TT) reduced spray drift by 90%.

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