Vertical and horizontal spray distribution of hollow cone nozzles in a wind tunnel. A preliminary study to mitigate spray drift in orchard applications.

J.P. Douzals, M.P. Chalendard

Irstea, UMR ITAP 365 Rue Jean-François Breton, F-34196 Montpellier, FRANCE

Introduction

Hollow cone nozzles are still widely used in orchard spray applications because of their small droplet sizes, visible sound coverage without air assistance on early vegetation stages. However, drift mitigation issues along water courses, sensitive crops and public areas generally imply the use of larger droplets generated by air injection hollow cone nozzles [Polveche et al., 2011]. This preliminary study aims at better defining the correlation between spray distribution patterns [Tamagnone et al, 2011] and drift curves both measured in IRSTEA wind tunnel equipped with a 9 m long distribution test bench. Vertical and horizontal spray orientations were compared with wind velocities of 0-2-4 and 5 m.s-1.

Materials and methods.

Nozzles

4 hollow cone nozzles from ALBUZ Company were tested: ATR Yellow, ATR Red, TVI Lilac, TVI Green, TVI Orange. Spray angle was 80°. Droplet sizes were measured by using a Dantec PDPA device (Power 2.5W, diffusion mode, 600 mm optics).

Table1 : Nozzle characteristics Nozzle type – injection pressure 10 bar

	Flowrate (l.min-1) at 10 bars	VMD (µm)
ATR Yellow	1.03	143
ATR Red	1.72	173
TVI Lilac ISO 80-025	1.83	542
TVI Orange ISO 80 - 010	0.73	581
TVI Green ISO 80 – 015	1.10	702

Wind tunnel

All experiments were conducted in IRSTEA wind tunnel under temperature and air humidity control of 20°C and min. 90% respectively. Each modality (1 nozzle, 1 position, 1 pressure, 1 height) was tested 3 times (3 repetitions). Flow distributions were measured at 1 m height without any wind following 2 positions of nozzles. When wind speed is operated in the wind tunnel, sedimentation values are accumulated along the distance and the opposite value is calculated as a drift ratio [Douzals et al.,2014].

Results

Vertical distribution without wind (1 m height)

Fig 1a and 1b show the distribution patterns of tested nozzles in vertical and horizontal position. Recovery rates were found to vary from 93% (ATR Yellow, TVI Lilac), up to 97% (ATR Red, TVI Orange, TVI Green). Horizontal spray distribution patterns were logically found to be dependent on droplet size with expected differences between ATR and TVI nozzles.

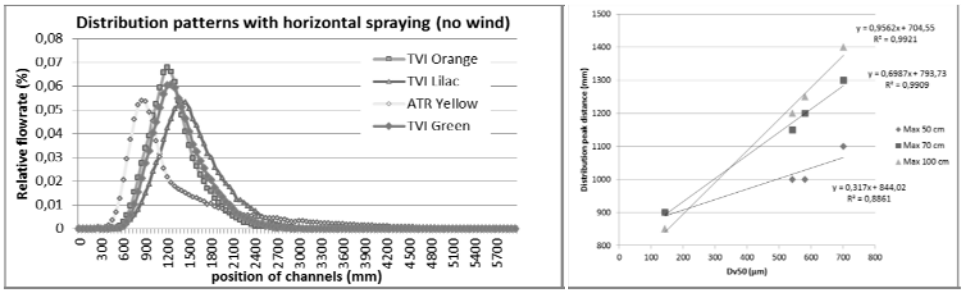
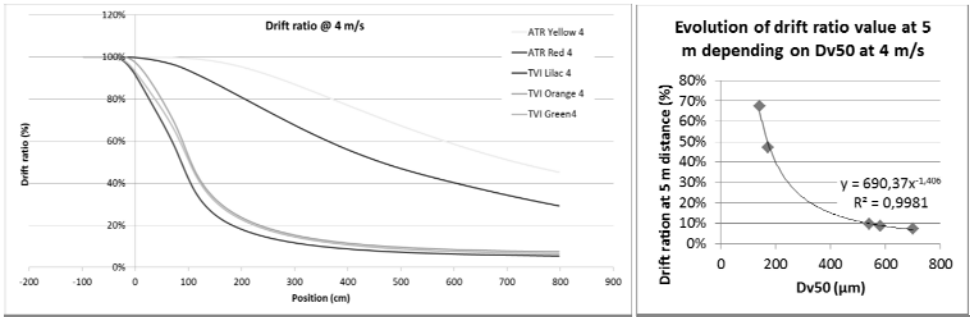


Fig 1a and 1b: Distribution patterns form horizontal spraying (1 m height) and correlation between droplet size and the peak distance

Drift measurements of Hollow Cone nozzles under windy conditions

Fig 2a introduces the relative drift obtained in the wind tunnel for a wind velocity of 4 m.s-1. (horizontal spraying) and Fig. 2b, the correlation between Dv50 and the drift ratio value at 5 m distance.



Drift ratio curves (Fig 2a.) are given as an example among the different wind speeds and nozzle orientation tested. A clear discrimination is observed between nozzle types (ATR vs TVI).

Conclusion

These preliminary results aimed at defining different hollow cone nozzles behavior on a distribution test bench with or without wind. When nozzles are oriented horizontally, the position (distance) where the peak occurs seems a relevant indicator of droplet size. Furthermore, when wind is applied, the spray pattern is modified but the drift ratio at a given distance is quite similar and also related to droplet size.

Acknowledgments

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References

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