# Section 2

## Field Data of Pesticide Spray Drift on Coffee Crop

**J. P. Arantes Rodrigues da Cunha[1], G. Sousa Alves[2]**

[1] Universidade Federal de Uberlândia, Uberlândia, BRAZIL
[2] Universidade Federal de Uberlândia, Uberlândia, BRAZIL

### Introduction

Coffee (*Coffea arabica* L.) production represents an important agricultural activity in South America and Brazil is the biggest world producer and exporter of coffee. The crop is subject to various pests and diseases that, in many cases, require chemical control. However, little information exists about technology for the application of insecticides and fungicides on coffee. Knowledge of the performance of pesticide-spraying equipment is very important for appropriate application, ensuring both biological efficacy and environmental safety. Coffee plant architecture is different from the most common orchard crops. The plant is a woody perennial dicotyledon, cylindrical shaped and with high leaf area index. Despite the scenario of environmental risk from pesticides, there is a lack of studies evaluating pesticide spray drift under the specific conditions of coffee production, especially under tropical conditions. The objective of this work was to determine spray drift curves generated by traditional and low-drift applications of pesticides on coffee plants.

### Materials and Methods

This study was performed at the Coffee Production Sector of the Federal University of Uberlândia (Minas Gerais, Brazil). All the applications used a hydropneumatic airblast sprayer (Arbo 360, Montana, Brazil) with 12 nozzles (6 on each side) coupled to the hydraulic system of a tractor (265E, Massey Ferguson, Brazil). The evaluated nozzles were of the hollow cone jet type with and without venturi, corresponding to the ATR 80º Orange 3.0 nozzle (Albuz, France) (traditional application) and the TVI 8002 nozzle (Albuz, France) (low-drift application), respectively. A spray volume of 400 L $ha^{-1}$ was used. The displacement velocity of the machine was 8.2 km $h^{-1}$ and the air flow rate was 1.61 $m^3$ $s^{-1}$. The working pressures for the ATR and TVI spray nozzles were 1.567 MPa (227.5 lb $in^{-2}$) and 1.447 MPa (210 lb $in^{-2}$), respectively. For the drift study, the rhodamine B tracer was used (Synth, Brazil) at a concentration of 100 mg $L^{-1}$ added to the spray for later quantification by fluorimetry. The applications were conducted in an area planted with Catuaí Vermelho coffee (LAI: 4.38) spaced 3.8 m between lines and 0.7 m between plants. The experimental design consisted of randomized blocks in a 2 x 20 split plot with 10 replicates, with the first factor referring to the spray nozzles and the second referring to the number of distances evaluated in relation to the last line sprayed. Prior to the applications, blotting papers (Jprolab, Brazil) were fixed at ground level in an area adjacent to the crops outside of the target area perpendicular to the direction of the sprayer application and in the main direction of the wind (downwind). The papers were placed from a distance of 2.5 m from the center of the last pass of the sprayer up to 50 m, spaced 2.5 m from each other, totaling 20 distances in relation to the last sprayed line. The four lines of plants adjacent to the drift-evaluation area were sprayed, for a total length of 50 m. Meteorological conditions were monitored during the applications. With the deposition data from the collectors, the percentage of drift for each distance was calculated, relating the deposit to the quantity applied in the field. The data were subjected to analysis of variance and the nozzles were compared to each other for each distance using Tukey's test at 0.05 significance, while a regression analysis was performed for the distances. The spray drift curves obtained for each nozzle were compared to each other using the confidence interval of the equation parameters. For this comparison, the data were linearized using the log(x) function and subjected to regression analysis. The upper and lower limits of each equation parameter were identified, and if the intervals were not superimposed at the 95% confidence level, the curves were considered different.

## Results

The applications made on coffee plants with the venturi hollow cone nozzle (TVI) caused less spray drift than those with the ATR nozzle up to 20 m of distance from the last line sprayed (Table 1). Beyond this distance, there was no difference between the nozzles. Thus, the TVI nozzle reduced spray drift for the areas closest to the crop. Based on regression analysis, the power model showed good fit to the data for both of the sprayer nozzles, although the $R^2$ for the TVI nozzle is lower than for the ATR nozzle, which is most likely associated with the difference between the value observed and the value estimated for the 2.5 m distance (Figure 1). The application with hollow cone nozzle results in 6.68% of maximum spray drift in the nearest collectors of treated area.

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Table 1. Drift percentage (Field data) resulting from the use of sprayers with standard hollow cone (ATR) and venturi nozzles (TVI) in coffee plants applying a spray volume of 400 L $ha^{-1}$ (1)

| Distance from the treated area (m) | Spray nozzle | |
|---|---|---|
| | ATR[1] | TVI[2] |
| 2.5 | 6.68 b | 5.06 a |
| 5.0 | 2.75 b | 1.59 a |
| 7.5 | 1.67 b | 0.85 a |
| 10.0 | 1.33 b | 0.63 a |
| 12.5 | 1.03 b | 0.47 a |
| 15.0 | 0.82 b | 0.40 a |
| 17.5 | 0.69 b | 0.35 a |
| 20.0 | 0.52 b | 0.30 a |
| 22.5 | 0.45 a | 0.29 a |
| 25.0 | 0.41 a | 0.31 a |
| 27.5 | 0.37 a | 0.30 a |
| 30.0 | 0.35 a | 0.29 a |
| 32.5 | 0.33 a | 0.28 a |
| 35.0 | 0.32 a | 0.30 a |
| 37.5 | 0.30 a | 0.30 a |
| 40.0 | 0.30 a | 0.33 a |
| 42.5 | 0.30 a | 0.30 a |
| 45.0 | 0.28 a | 0.31 a |
| 47.5 | 0.29 a | 0.30 a |
| 50.0 | 0.29 a | 0.32 a |
| $F_{nozzle}$ = 8.282*; $F_{dist}$ = 108.860**; $F_{int}$ = 2.965* | | |
| OR: $F_{Levene}$ = 23.267**; K-S = 0.272**; $F'_{Tukey}$ = 858.318** | | |
| T: $F_{Levene}$ = 13.567**; K-S = 0.164**; $F'_{Tukey}$ = 351.741** | | |

(1)Means followed by equal letters, in the rows, do not differ by Tukey's test, at 5% probability. $F_{nozzle}$, $F_{dist}$ and $F_{int}$: values of F calculated for the nozzle, distance and interaction, respectively. **Significant at 1% probability; *Significant at 5% probability. $F_{Levene}$, K-S and $F'_{Tukey}$: values of the F statistic for the Levene test, K-S for the Kolmogorov-Smirnov test and F for Tukey's test for the additivity of the blocks, respectively, which test the assumptions of the original data (OR) and the data transformed (T) by arc-sin√(x/100). [1]ATR: hollow cone jet nozzle; [2]TVI: venture hollow cone jet nozzle.

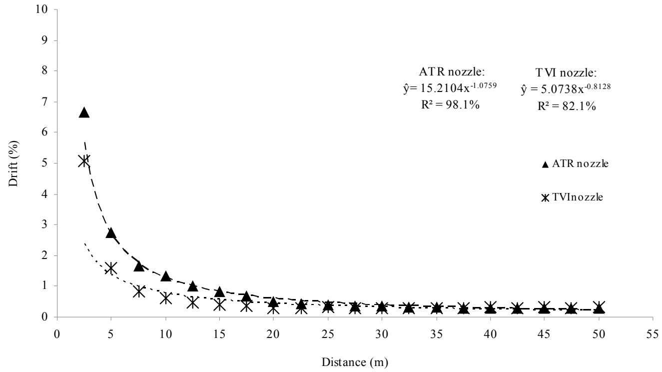


Figure 1. Drift curves from applications on coffee plants made with standard hollow cone (ATR) and venturi (TVI) spray nozzles applying a spray volume of 400 L $ha^{-1}$.