Effect of netting on aerial fruit fly bait spray deposition in citrus orchards - a preliminary investigation

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Summary

A preliminary investigation was carried out to determine the effect of shade netting on aerial fruit fly bait spray deposition in citrus orchards. The study was conducted in Navel orange orchards on a farm near Nelspruit, Mpumalanga Province. An aerial application of the commercially available fruit fly bait GF-120 was carried out in January 2017 in two orchards which were under a 20% white shade net and in two orchards which were uncovered. In each orchard, sheets of paper were placed on the ground and over a tree in areas which were along and adjacent to the flight line respectively. Additionally, leaves were collected from selected trees in each orchard and were examined for GF-120 spray deposition. Coverage of aerial GF-120 spray deposits were fairly similar in orchards under net and in uncovered orchards. There were significant differences in sizes of aerial GF-120 spray droplets between orchards under netting and those which were uncovered. Despite these differences, mean droplet sizes recorded in all orchards were within the recommended ranges for GF-120.

Opsomming

'n Voorlopige ondersoek is uitgevoer om die invloed van skadunet op die neerslag van vrugtevlieglokaas lugbespuitings in sitrusboorde te bepaal. Die ondersoek is in Navel lemoenboorde op 'n plaas naby Nelspruit, Mpumalanga gedoen. 'n Lugbespuiting met die kommersiële beskikbare vrugtevlieglokaas GF-120 is in Januarie 2017 in twee boorde gedoen wat bedek is met 20% skadunet en in twee boorde wat nie bedek is met skadunet nie. In elke boord was papiervelle op die grond en oor 'n boom geplaas in die areas wat onderskeidelik inlyn en aangrensend met die vluglyn was. Daar is ook addisioneel blare van geselekteerde bome versamel in elke boord en dit is ondersoek vir GF-120 spuitneerslag. Die spuitneerslag van die GF-120 lugbepuiting was min of meer dieselfde in boorde onder net en in nie-bedekte boorde. Daar was 'n betekenisvolle verskil in die grootte van die GF-120 lugbespuiting spuitneerslag tussen die boorde onder net en nie-bedekte boorde. Ten spyte van die verskille in die GF-120 druppelgrootte in die boorde onder net en nie-bedekte boorde, was die gemiddelde druppelgrootte in al die boorde (onder net en sonder) nog steeds binne die aanbevele groottes vir GF-120.

Introduction

There is currently an increasing use of netting in all citrus production areas in South Africa (Brodie, 2015; Stander and Cronje, 2016). Nets in citrus orchards are set up mainly to mitigate the risk of yield losses due to unfavourable climatic conditions like temperature extremes, hail and high winds and for some late mandarin cultivars to ensure production of seedless fruit by keeping bees out (Brodie, 2015; Stander and Cronje, 2016).

Fruit flies are important pests of citrus in South Africa and are problematic, mainly due to the phytosanitary concern associated with these pests (Manrakhan, 2016). Fruit fly pests are controlled using attract and kill methods such as protein-based insecticidal bait sprays or bait stations.

In South Africa, aerial application of fruit fly bait sprays is increasingly being used in many citrus production areas across the country. With aerial fruit fly bait spray application, large areas of citrus can be covered in a relatively short period of time.

The question recently raised by the citrus producing community was whether nets used over citrus orchards would impede aerial bait spray deposition within the orchards.

A preliminary investigation was therefore initiated in January 2017 in the Schoemanskloof valley, near Nelspruit, Mpumalanga Province, to compare aerial fruit fly bait spray deposition in Navel orchards which were under netting with those that were uncovered.

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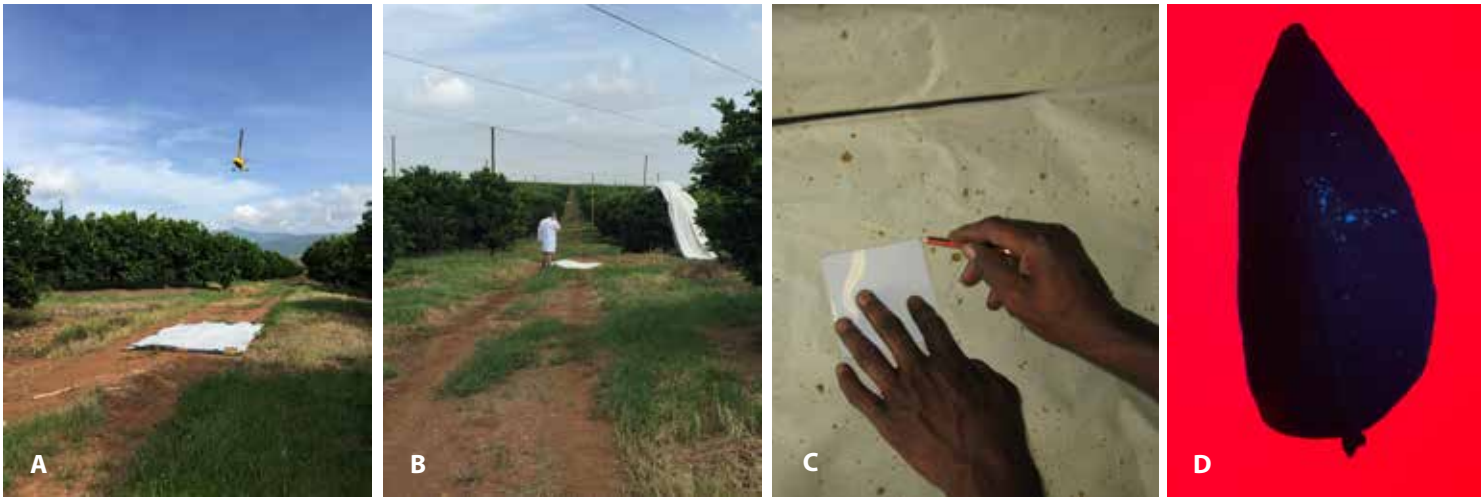

Figure 1. Methods used for assessment of aerial GF-120 spray deposits in orchards under net and in open orchards: (A) Paper sheets placed on the ground along the flight line of the gyrocopter, (B) Sheets placed over the tree and on the ground, (C) Drawing of squares on sheets of paper containing aerial GF-120 spray deposits and (D) Visual assessment of GF-120 spray deposits containing fluorescent pigment under UV light.

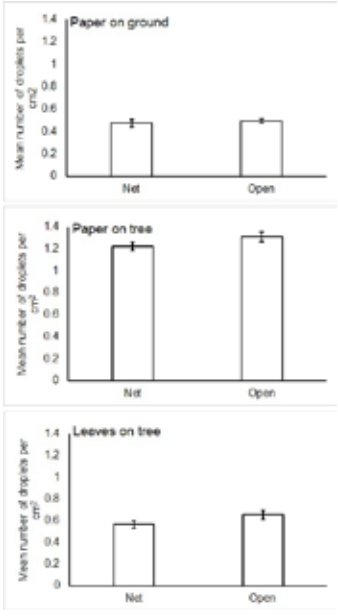

Figure 2. Coverage of aerial GF-120 spray deposits in Navel orchards under net and in uncovered Navel orchards as obtained by three methods of assessment: (1) paper sheets placed on the ground, (2) paper sheets placed on the tree canopy and (2) leaves collected on the trees.

Materials and methods

Study site

This study was conducted in four Navel orange orchards in a farm at Schoemanskloof (S25° 24' 35.53" E30° 37' 31.10"), near Nelspruit, Mpumalanga Province, South Africa. Two of the orchards were under a white 20% shade net and two were uncovered. The selected orchards were between 2.3 to 14.7 ha in size.

Aerial bait spray application

An aerial application of a commercially available fruit fly bait, GF-120 (Dow AgroSciences Southern Africa, South Africa), was carried out using a gyrocopter on 31 January 2017. GF-120 was applied at the rate of 1 L GF-120 diluted with 1 L of water per ha. GF-120 was thoroughly mixed with water before being added into the spray tank. Before application, Yellow Fluorescent Pigment SC (South Australian Research and Development Institute, Australia) was added to the GF-120 mixture at the rate of 1 ml per L. GF-120 bait was applied using the standard Albuz nozzle with an orifice of 5 mm diameter. There were two nozzles, one on either side of the spray boom. The swath width, speed of the gyrocopter, pressure of the spray pump and height of spraying above canopy were kept at 30 m, 130 km/h, 1.1 bar and at ~5 m, respectively. On the day of the bait spray application, the mean temperature and mean relative humidity in the area were 25.8°C and 69.3% respectively. The wind speed recorded in the area at the time of spraying varied between 6 and 11 km/h.

Assessment of bait spray deposition

Three methods were used to assess the coverage (number of droplets per unit surface area) and diameter of aerial bait spray droplets in the orchard.

Bait deposition on paper sheets placed on the ground and on the tree

In each orchard, two parallel borders along the flight lines were selected. Along each border, three matt white paper (Mondiscript 70 g bond, Mondi, South Africa) sheets (2.0 m x 2.4 m per sheet) were placed on the ground (Fig. 1 A). The sheets were placed at three distances from the start of the flight line in the orchard. The distances between the sheets were approximately 70 m. The sheets on the ground spanned a total flight distance of approximately 140 m in each orchard.

In each orchard, one tree was selected in the middle of the border row located on the northern side. The selected tree was adjacent to the flight line. A matt white paper sheet of 10 m x 1.6 m was rolled out over the tree such that it could cover the entire canopy (Fig. 1B).

In total therefore, there were six paper sheets on the ground and one paper sheet on the tree canopy in each orchard.

Approximately one hour after the spraying, all paper sheets were folded, labelled and brought back to the laboratory at Citrus Research International (CRI) in Nelspruit for analysis. Fifteen squares of 100 cm^2 were drawn along the section of the sheet where most of the aerial bait deposition occurred (Fig. 1 C). For the sheet

which was on the tree canopy, only the middle section of the sheet was used to determine the droplet deposits on top of the canopy. Squares were evenly spread across the entire length of the selected sheet section. Droplets of GF-120 were brown in colour and could be recognised as such on the sheets. The droplets in each square were counted such that the number of droplets per cm2 could be determined. The diameter of up to 30 randomly selected droplets within each square were determined using a digital caliper.

Bait deposition on leaves

Six trees located at the borders of each orchard adjacent to the flight lines were selected. On each tree, 10 leaves on a horizontal plane were selected and collected immediately after the aerial sprays. There were therefore 60 leaves from each orchard.

The collected leaves were brought back to the CRI laboratory and checked under the UV light (Fig. 1 D). Droplets containing the fluorescent pigment were counted on each leaf (Fig. 2). The diameter of each droplet found on the leaves was determined using a digital caliper. Following the spray deposition analysis on each leaf, the surface area of each leaf (without the petiole) was determined using an Image Analysis System (Win DIAS 3) at the Agricultural Research Council, Nelspruit. This way the number of droplets per cm2 leaf area could be determined.

Data analysis

Coverage of aerial GF-120 spray deposition was expressed as number of droplets per cm2 in all methods of assessment. Comparisons of coverage and sizes of aerial GF-120 spray droplets between orchards under netting and uncovered orchards were carried out using the Student's t test (XLSTAT, Addinsoft). Data were log (x+1) transformed prior to statistical analysis.

Results and Discussion

Coverage of aerial GF-120 spray deposition was similar in orchards under nets and in uncovered orchards, when assessment of deposition was carried out on paper sheets placed either on the ground or on top of the tree canopy (P>0.05; Fig. 2). However, when aerial GF-120 spray deposition was evaluated on leaves, coverage of spray deposition was found to be slightly lower on leaves collected from trees under nets than on leaves collected from uncovered trees (P<0.05; Fig. 2). This could be due to a denser tree canopy in orchards under nets compared to those in the open. Raveh et al. (2003) reported enhanced vegetative growth of young de-fruited citrus trees under shade net. It is possible that aerial GF-120 spray deposits could be slightly more scattered in trees with denser canopies.

There were significant differences in sizes of aerial GF-120 spray droplets between orchards under net and those which were uncovered (P<0.05, Fig. 3). On paper sheets placed on the ground or on the tree, GF-120 spray droplets were larger in orchards under net than in uncovered orchards. However, spray droplets were smaller on leaves collected from trees under net than from uncovered trees. There were also large differences in droplet sizes between paper and leaves. This could have been due to absorption of droplets on the paper. Despite the differences in GF-120 droplet sizes between orchards under net and those which were uncovered, mean droplet sizes on both paper and leaves were within the recommended ranges for GF-120 in both orchards under net and in uncovered orchards.

Conclusion

This preliminary investigation has shed some light on aerial fruit fly bait spray deposition in orchards under net. The results from assessments of aerial GF-120 spray deposits on paper sheets placed on the ground and on top of the tree canopy have indicated that a 20% shade net might not be a barrier to the penetration of the spray droplets onto the tree canopy.

Acknowledgments

We acknowledge Kenneth Mgwenya for laboratory assistance and Mark Manana for field assistance. We are grateful to Johan De Vries, Joubert & Seuns, for access to the study sites and logistical support. We thank James Warrington for advice on the field study. We are grateful to Mark Penter, Agricultural Research Council, Nelspruit, for the use of the Image Analysis System in determining leaf area. We thank Chanel Steyn and Rochelle Clase for assistance in data entry. We acknowledge Sean Moore and Tim Grout for the review of an earlier draft of the article. This study was funded by Citrus Research International.

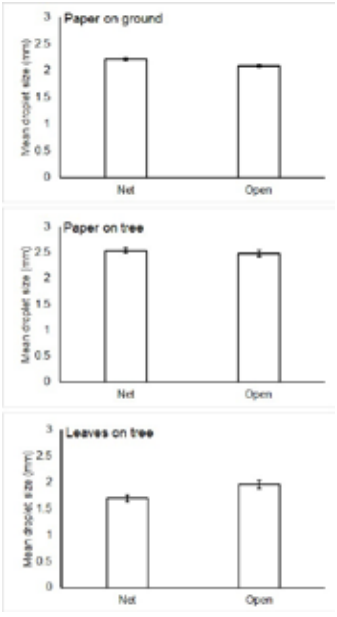

Figure 3. Sizes of aerial GF-120 spray droplets in Navel orchards under net and in uncovered Navel orchards as obtained by three methods of assessment: (1) paper sheets placed on the ground, (2) paper sheets placed on the tree canopy and (2) leaves collected from the trees.

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