INVESTIGATIONS ON SPRAY DRIFT MITIGATION BY MEANS OF ARTIFICIAL BARRIERS IN HIGH TUNNEL STRAWBERRIES

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ABSTRACT

This paper summarises the results of some trials carried out to verify the capability of artificial barriers to mitigate spray drift when treating soft fruits, particularly strawberry, cultivated under high plastic tunnel and treated by cannon sprayers. The possibility to protect plants and their production from atmospheric agents is one of the main reasons for the wide adoption of plastic tunnel in soft fruit cultivations. The protective structure can often integrate a series of tools like anti-insect nets or plastic sheet closures that can help to mitigate drift during spray applications by filtering the airflow mixed with small droplets and catching those prone to drift. Preliminary trials showed the capability of the net to reduce the amount of liquid deposited behind it. Spray application trials in high tunnels showed that drift mitigation is possible when using different types of barriers, but a lower effect can be expected for the anti-insect net and up to almost complete drift reduction with a plastic film. The results of spray deposition in the strawberry canopy could not show a clear effect of interference between the artificial barrier and the mix of airflow and droplets.

Key words: berry fruits, ground deposit, plastic net, plastic shielding, spray drift

1 INTRODUCTION

In Italy strawberry cropping is mainly located in the South of the peninsula especially in Basilicata, Campania, Sicily, and Calabria, but also Northern Regions like Veneto, Emilia-Romagna, Piedmont, and Trentino-South Tyrol produce this important soft fruit that in 2022 counted a total surface around 4,000 ha, considering open air and covered production all together (ISTAT, 2024). The possibility to protect plants and their production from atmospheric agents like wind, hail, frost, and excessive rainfall is one of the main reasons for the wide adoption of plastic tunnel in soft fruit cultivations. Another benefit can arise from the capacity of the coverage to avoid the

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washout of sprayed products due to rain hence, hypothetically extending the biological efficacy action of a plant protection product (PPP) for a longer time. Nevertheless, the use of PPPs is necessary in any case, but it can be considered more efficient and safer for the environment compared to their use e.g. under frequent or heavy rainfall events. The cannon sprayer is widely used to treat strawberry tunnels in Italy. Usually, a sequence of these protective structures attached one each other is treated by the cannon sprayer from the front and rear openings as to ensure a better homogeneity of deposition by overlapping the spray deposits when treating both sides (Guarella et al., 2008). Due to the high drift potential typical of this equipment (Grella et al., 2017; Langkamp-Wedde et al., 2023) its use is generally restricted to certain crops and circumstances, in agreement with the national and local legislation. Thanks to the tunnel structure which can often integrate a series of tools like anti-insect nets or plastic sheet closures, some pesticide drift mitigation actions can easily be adopted to reduce spray drift when spraying close to sensitive areas.

2 MATERIALS AND METHODS

To estimate the drift mitigation potential when treating high tunnel strawberries by a cannon sprayer a series of experiments has been carried out and canopy deposits have been compared as well. Experimental results obtained in different trials and farms of Trentino are summarised and described below. In all the trials a solution of tracer dye (tartrazine) at known concentrations was used to spray the vegetation. After the vegetation drying leaves or paper collectors previously positioned onto the canopy were sampled to quantify the amount of tracer deposited on each sample by means of a spectrophotometer. Whenever opportune a series of paper and Petri dish collectors were also positioned at different distances close to the sprayed areas to estimate the amount of liquid retrieved and compare the drift mitigation effect of the different configurations in evaluation. A first experience of drift mitigation by means of a plastic film partially closing a strawberry tunnel was performed in short protective constructions of about 10 m in length and 5,5 m in width. The top part of the tunnel was open in any case and its size has been estimated in about 6-8% of the total front opening, but the lower part could be closed by a film winding device in case of need. A detailed description of the trial including sprayer characteristics and settings can be found in Bondesan et al., 2022. A statistical approach was carried out for the deposit on the vegetation by the non-parametric Mann–Whitney U test to investigate possible significant differences for tracer recovery on the leaves. As tightly woven nets are often used by growers to protect soft fruits by small insects these tools seemed to be a feasible alternative to be tested as anti-drift closures. Hence the effect of a specific net generally adopted to avoid the spotted wing drosophila (SWD) infestation on soft fruits was preliminary tested on a cherry orchard (cv Kordia and Regina). Its capability to catch part of the sprayed droplets by filtering the treatment airflow was estimated using a tower sprayer adjusted to apply a volume of 500 L/ha with 16 nozzles Albuz ATR yellow at a pressure of 7 bar with a forward speed of 5,6 km/h and comparing uncovered and covered plants; moreover, a second adjustment of the sprayer with a working speed of 4,3 km/ha and a spray pressure of 11,5 bar was used on covered plants. The cherry tree rows were covered per single row and the row distance was 3,7 m.

The third case of study was carried out in parallel strawberry tunnels of 16,3 m in length and 5,5 m in width where the comparison was done considering the open tunnel, the use of an anti-drosophila net and the complete closure of the opposite tunnel front opening with a plastic sheet, to verify once again the drift mitigation effect and the tracer deposit on the canopy. A detailed description of the trial including sprayer characteristics and settings can be found in Bondesan et al., 2024. A statistical approach was carried out for the deposit on the vegetation by the Kruskal-Wallis test for non-parametric analysis of variance.

3 RESULTS AND DISCUSSION

As it can be seen by figure 1, that shows the average trends of ground deposit collected out from the tunnel up to 30 m of distance, the spray drift mitigation effect exceeded 95%. On the other hand, a different displacement of average tracer deposits was found inside the tunnel at the different positions sampled (figure 2), even if not statistically significant between the two spray drift mitigation techniques (Test U, p-values: front, 0,623177; centre, 0,241322; rear, 0,088974). A possible tendency especially for the rear part of the tunnel suggested that it would be necessary to further investigate the effect on the deposit formation process in similar conditions.

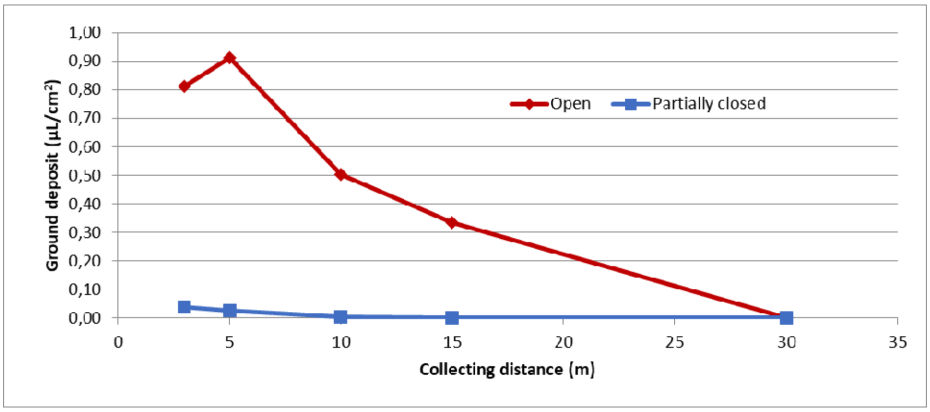

Figure 1: Trend of average ground losses found on Petri dishes 3 to 30 m out of the strawberry tunnel in the trial with tunnel length of about 10 m.

The effect of the net on deposit reduction in different parts of the cherry tree canopy is shown in figure 3. Compared with the same sprayer adjustments, the general deposit reduction was about 49%. By decreasing the sprayer forward speed a deposit increase was possible (average 12%) more marked for the lower internal part (+33%), inferior for the upper canopy (external +14%; internal +9%). No appreciable changes were observed for the outer part of the lower canopy (-2%). Hence the sprayer adjustments seemed to partially influence the retention capability of the netting and therefore the deposition result on different parts of the canopy. In fact, the average overall reduction of spray deposition due to the netting and the low-speed sprayer adjustment was around 43%. Anyway, the effect of the net coverage was much higher than the sprayer adjustment.

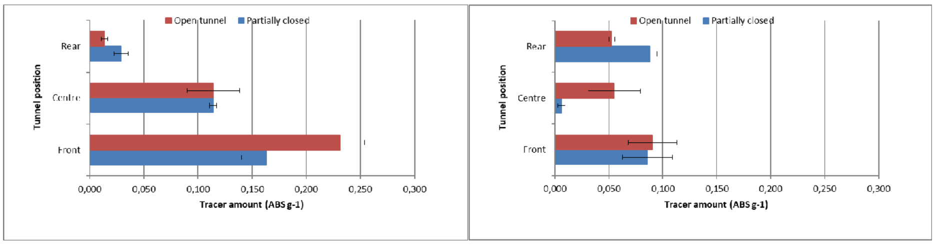

Figure 2: Leaf deposits retrieved on different sampled parts inside the sprayed tunnels for the external (left) and internal (right) parts of the canopy (values expressed as corrected absorbance per fresh leaf mass).

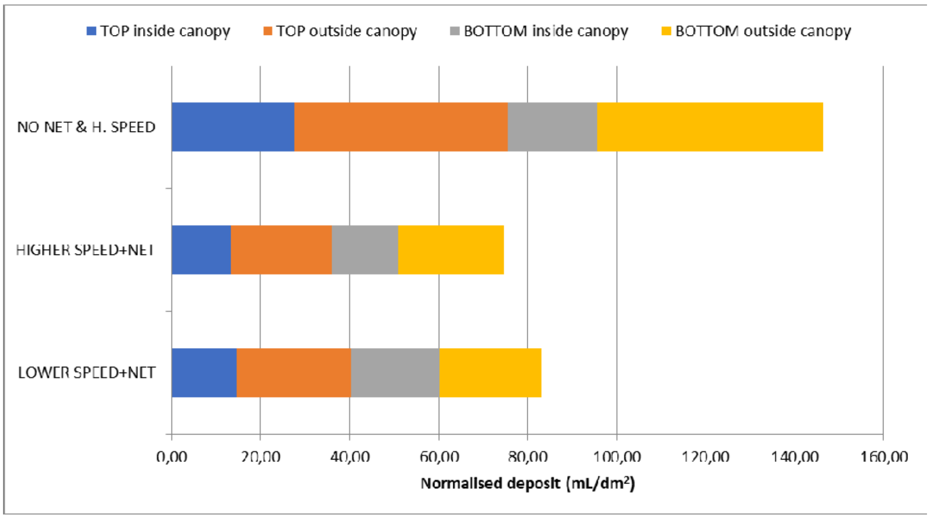

Figure 3: Overall average deposits obtained on cherry tree canopy without and with anti-SWD netting coverage considering a reference and a reduced forwarding speed.

The results of spray drift comparison among the open tunnel, the plastic shielding and the anti-SWD-net configurations are shown in figure 4. The shorter recovery distance compared to the previous drift experience could be partly due to the greater tunnel length and to the lower resolution of the obtained deposits. Anyway, looking at the average deposit trend the net, chosen as an alternative to the partial closure of the tunnel, showed a substantial reduction of the ground retrievements close to 50%. In figure 5 are shown the tracer deposits found inside the tunnel at the different positions sampled. In this trial the deposition trends of the open tunnel and the plastic shielding configurations were very similar and closer than the anti-Drosophila netting ones.

Considering the overall deposits for each tunnel position sampled no statistical differences were found between the three tunnel layouts (Kruskal-Wallis test, values: front, χ^2 [2]=0,3709186; p=0,8307; centre, χ^2 [2]=0,7329233; p=0,6932; rear, χ^2 [2]=1,193353; p=0,5506).

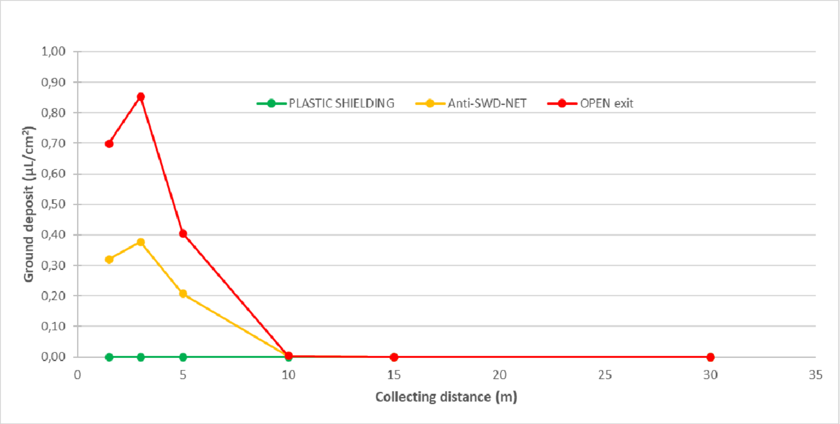

Figure 4: Trend of average ground losses found on Petri dishes 1,5 to 30 m out of the strawberry tunnel in the trial with tunnel length of about 16 m.

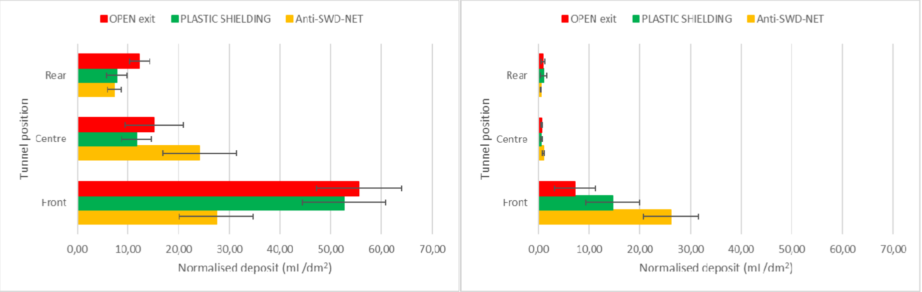

Figure 5: Leaf deposits retrieved on different sampled parts inside the sprayed tunnels for the external (left) and internal (right) parts of the canopy.

4 CONCLUSIONS

Spray application trials in high tunnels showed that drift mitigation is possible using different types of barriers, but a lower effect can be expected for the anti-insect net up to almost complete drift reduction with a plastic film. In that case the integration with other anti-drift devices should be recommended to maximise the mitigation effect. The results of spray deposition in the strawberry canopy could not show a clear interference effect between the artificial barrier and the mix of airflow and droplets.

5 ACKNOWLEDGEMENTS

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