Proposal Category: Research

Title: Assessing Pest Management Strategies in Blackberries Produced on a Rotating Cross Arm Trellis.

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Abstract

Cultural controls are often the cornerstone of effective and diversified pest management plans. The RCA trellis system in blackberry has exhibited the potential to impact pest management as the plant canopy is modified to consist of a flat plane of canes, possibly allowing for increased spray penetration, while also creating a less ideal environment for both pest and diseases. We proposed to investigate the spray volume (gallons per acre or GPA) necessary to achieve acceptable coverage in an RCA production system, as well as observe pest complex differences within treatments and in RCA vs. T-trellis systems overall. Ouachita blackberries following a split-plot design with the trellis type (RCA vs. T-trellis) as the split plot factors and spray volume (GPA) as sub plot factors within each split plot were treated with 4 different spray volumes (0,20, 40, and 60 GPA). Overall, the RCA trellis system exhibited lower infestation levels of SWD compared to the T-trellis system, while also exhibiting increased spray coverage. Additionally, we observed spray coverage in the RCA that was acceptable at both 40 and 60 GPA, while our data indicate that the T-trellis would need 60 GPA for acceptable coverage. This showcases the RCA trellis system's ability to be an effective form of cultural control that creates a growing environment that is less preferred by SWD, while also enhancing the ability to prevent infestations with enhanced spray coverage.

Introduction

When considering pest control in perennial small fruits, such as blackberry, cultural controls are the cornerstone of effective pest management plans. With emerging pests such as spotted-wing drosophila (SWD), we've seen an increased reliance on cultural control techniques to manage pests in the Southeast with limited pesticide options, especially in organic plantings. The RCA trellis system has exhibited the potential to impact pest management as the plant canopy is modified to consist of a flat plane of canes. This modification allows for increased air movement and decreased density, especially when compared to the commonly used T-Trellis system. Recent studies have indicated that reductions in canopy density may negatively impact populations of key pests of blackberries. SWD is known to seek shaded areas in the heat of the day within the canopy of blackberry plants (Diepenbrock and Burrack 2017). Although these densely shaded areas are commonplace in T-Trellis systems, the single plane of canes in the RCA system should be a much less favorable environment.

Current research by Amanda McWhirt has indicated that lower rates of % fruit infestation are found in RCA blackberries vs. those fruit grown on T-trellises under similar management programs, but the reason for this decrease is unclear. It's likely this is in part due to a decrease in preferred habitat as mentioned above, but there are other factors in play. The RCA system consists of a flat plane of floricanes that are separated from primocanes, which likely increases the efficiency of spray volume traveling through the blackberry canopy. An increase in spray volume efficiency could lead to better spray coverage on berries and reduce the incidence of SWD infestations. This also begs the question of what amount of spray volume, or gallons per acre (GPA), is necessary when using an RCA system. If the necessary spray volume could be reduced for SWD and other foliar pesticide sprays, farmers could save valuable time and money. Some current adopters of the RCA system have already decreased their spray volume and increased spray time efficiency by angling two RCA rows towards each other and spraying them in 1 pass from each side. However, no data on the effectiveness of this strategy currently exists, and currently no research has studied the impact of reduced sprayer volume in RCA systems vs. traditional trellising systems.

We proposed to investigate the spray volume (GPA) necessary to achieve acceptable coverage in an RCA production system, as well as observe pest complex differences within treatments and in RCA vs. T-trellis systems.

Objectives:

1. To investigate the feasibility of obtaining adequate spray coverage using reduced spray volume (GPA) for pesticides on blackberries grown on the rotating cross arm (RCA) trellis system using water-sensitive spray cards to elucidate the potential for lower input pest management systems in blackberries grown on the RCA.
2. To further investigate differences in spotted wing drosophila (SWD) populations and % SWD fruit infestation in blackberry plants produced on RCA trellis systems compared to traditional T-trellis systems when using varying spray volumes.
3. To observe insect and disease pest complex differences in RCA and T-trellis systems with pesticide treatments made at different spray volumes.

Materials and Methods

Blackberry plantings of the cultivar Ouachita were established at the University of Arkansas Southwest Research and Extension Center in Hope, AR on 5/25/2021. Plantings followed a split-plot design with the trellis type (RCA vs. T-trellis) as the split plot factors and spray volume (Gallons per acre or GPA) as sub plot factors within each split plot (Table 1, Figure 1). Plots consisted of 3 plants with a 2-plant buffer between each plot. Plant spacing was 3ft on the RCA trellis and 2 ft on the T-Trellis. This split plot design allows for baseline differences in pest management to be observed between the two trellis types, as well as the interaction between trellis type and spray volume. Plots were treated in 2022 for spotted-wing drosophila (SWD) using an insecticide delivered at 4 different levels of spray volume (GPA); 0 GPA (untreated) 20 GPA, 40 GPA, and 60 GPA.

Split-Plot Factor	Sub-Plot Treatments
T-Trellis	0 GPA
	20 GPA
	40 GPA
	60 GPA
RCA Trellis	0 GPA
	20 GPA
	40 GPA
	60 GPA

Table 1. Illustration of trial design showing split plot factors of trellis system type and within sub-plot spray volume treatments (Gallons per acre or GPA)

Plots with the treatment 20, 40, or 60 GPA were treated with Mustang Maxx (zeta-cypermethrin) (FMC Corporation, Philadelphia, PA) at 4 fl oz/acre using an appropriate amount of product in separate 3-gallon mixes for each spray volume. Plots were sprayed with a Stihl SR 450 gas-powered blower backpack sprayer with an attached pressure pump kit to assure equal coverage, and each side of a plot was sprayed. Plots were sprayed three times (June 9th, June/ 21st and June 29th) with the first application occurring 1 week after berries were fully mature to help build SWD density. Spray volume treatments were achieved by using a set output (0.122 GPM) on the blower sprayer and adjusting the amount of time each 5-plant plot was sprayed to achieve each spray volume (GPA) treatment. The interior 3 plants of each plot were sprayed and spray times varied for RCA (6.2, 12.4, and 18.6 seconds) and T-Trellis (5.2, 10.4, and 15.6 seconds) as plant spacing was larger in RCA plots.

The interior three plants of each plot were sampled for SWD larvae over the course of 4 weeks (June 14th, June 21st, June 29th and July 6th). A 20-berry sample was collected from each plot and then assessed in the lab for the number of SWD larvae (small and large) and eggs using a salt water rinsed as described by Timmeren et al. (2017). The number of larvae (small + large) found in each plot for each planting date were analyzed using proc GLIMMIX in SAS v 9.4, and a Tukey's HSD post hoc analysis was used to separate means at α=0.05. The interaction of Trellis Type x Spray Volume was first assessed, then main effects alone were explored.

Spray coverage by each spray volume treatment was assessed in both trellis types by utilizing water sensitive paper. TeeJet 1" x 3" water sensitive spay cards were configured to either mimic leaf surface (flat) or berry surfaces (as a rolled card) and attached to leaf petioles or stems using a wooden clothespin (Figure 2) and placed in 6 places throughout the leaf canopy of each plot (3 cards of each configuration per plot). All cards for a trellis x GPA treatment were placed at one time and then an application of water only was made as described above using a Stihl SR 450 sprayer. Spray cards were immediately placed into zip-top plastic bags (1 card per bag) (Figure 3) and then analyzed using SnapCard (Department of Agriculture and Food WA) to determine percent coverage. Average percent spray coverage in each plot for each planting date were compared using proc GLIMMIX in SAS v 9.4, and a Tukey's HSD post hoc analysis was used to separate means at α=0.05. The interaction of Trellis Type x Spray Volume was first assessed, then main effects alone were explored.

Figure 1. Blackberry plots with T-trellis (left) and RCA (right) trellising systems in Hope, AR.

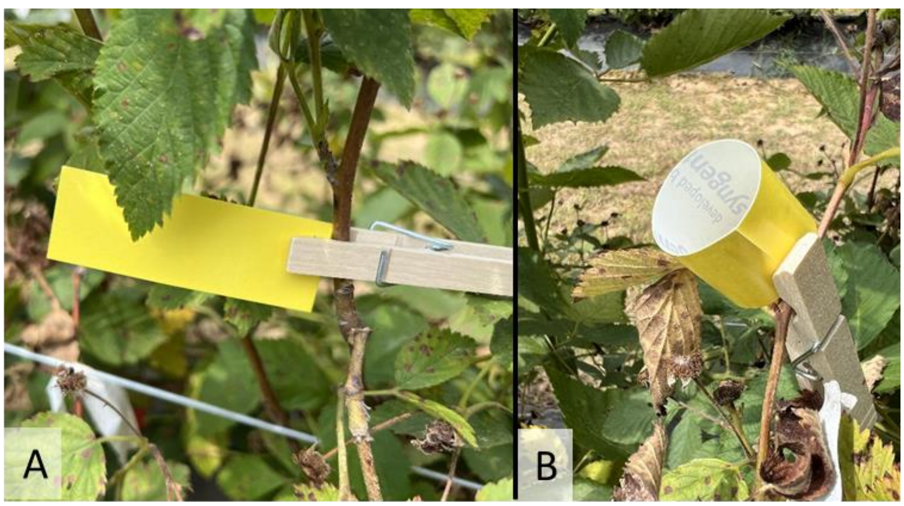

Figure 2. Water sensitive spray cards placed to mimic leaves (A) or berries (B).

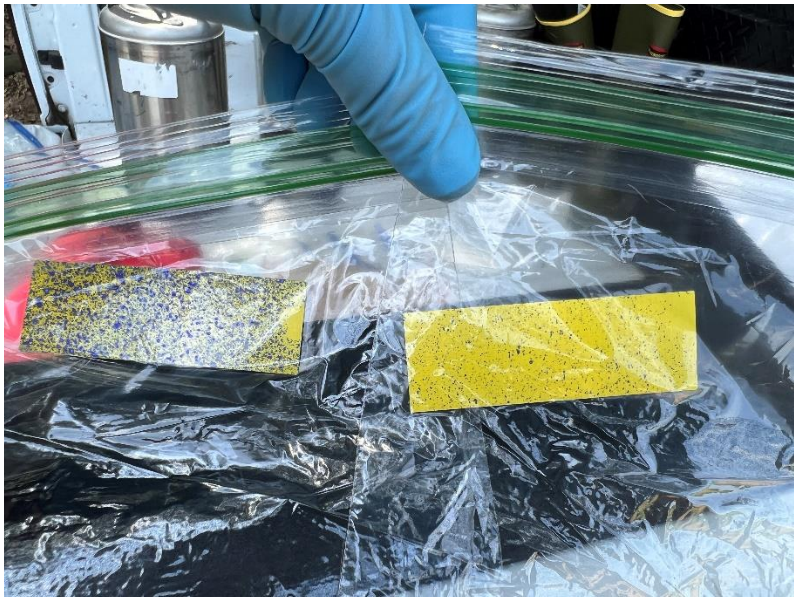

Figure 3. Water sensitive cards after being collected post-application. Purple color on cards indicate contact with water and a larger amount of purple indicates higher spray coverage.

Current Results and Future Plans

Spotted-wing drosophila (SWD) larvae were observed in lower numbers in the RCA trellis system compared to the T-trellis system, but no significant effect of spray volume was observed. No significant interaction was observed when considering the two factors of trellis system and spray volume (P=0.48) (Figure 4), and no main effect of spray volume was observed to be significant (P=0.35). However, a lower number of larvae were observed in the RCA trellis compared to the T-trellis system, with an average of 0.5 and over 2.5 larvae per 20 berries respectively (P<0.05) (Figure 5). In general, SWD populations were much lower than expected with untreated plots only averaging between 0.5 and 2 larvae per 20 berries on the RCA and T-trellis system respectively. These densities were much too low to draw conclusions for effectiveness of spray volume treatments and are reflective of record high temperatures in June which would not favor SWD. However, we still saw significantly less SWD larvae in the RCA trellis system, indicating its effectiveness as a cultural control option.

Higher spray coverage was observed in the RCA trellis system when compared to the T-trellis system, and spray volumes were found to offer significantly different levels of spray coverage. No significant interaction was observed when considering the two factors of trellis system and spray volume (P=0.41) (Figure 6). However, we did observe significantly less coverage on average in the T-trellis system with 12% coverage compared to the RCA trellis system at 14% coverage (P<0.05) (Figure 7). We also observed a significant reduction in spray coverage as our spray volume decreased, with 60, 40, and 20 GPA exhibiting 18.5%, 13.3%, and 6.2% coverage respectively (Figure 8). Overall, we observed spray coverage in the RCA that was acceptable at both 40 and 60 GPA, while our data indicate that the T-trellis would need 60 GPA for acceptable coverage. We expected to observe a significant interaction indicating that the RCA likely needed less spray volume, but it was not found to be significant, although we did see better coverage on average in the RCA trellis system.

Overall, the RCA trellis system exhibited lower infestation levels of SWD compared to the T-trellis system, while also exhibiting increased spray coverage. This showcases the RCA trellis system's ability to be an effective form of cultural control that creates a growing environment that is less preferred by SWD, while also enhancing the ability to prevent infestations with enhanced spray coverage. Replication of this trial is planned for the 2023 growing season where we hope to observe higher densities of SWD. We also plan to assess spray coverage differences on multiple sites in 2023 (including grower sites) and use a new and more sophisticated software for analyzing water sensitive spray cards (USDA DepositScan).

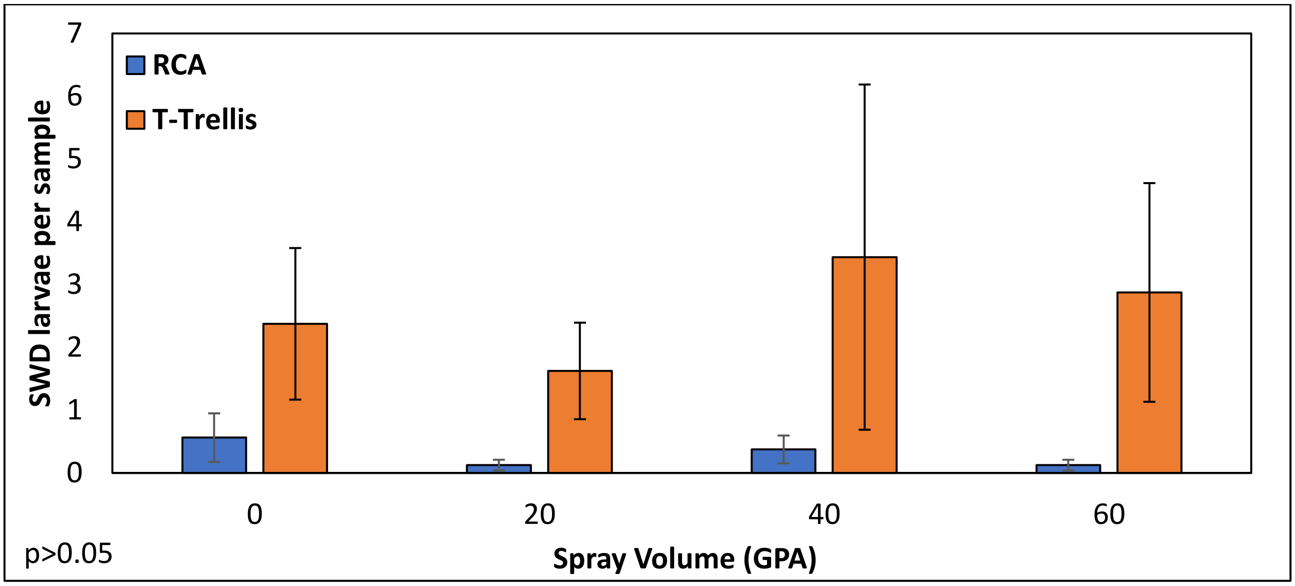

Figure 4. Average number of spotted-wing drosophila (SWD) larvae observed in each spray volume treatment for two trellis systems (RCA and T-Trelli) over four sampling dates in blackberry at Hope, AR (P=0.48)

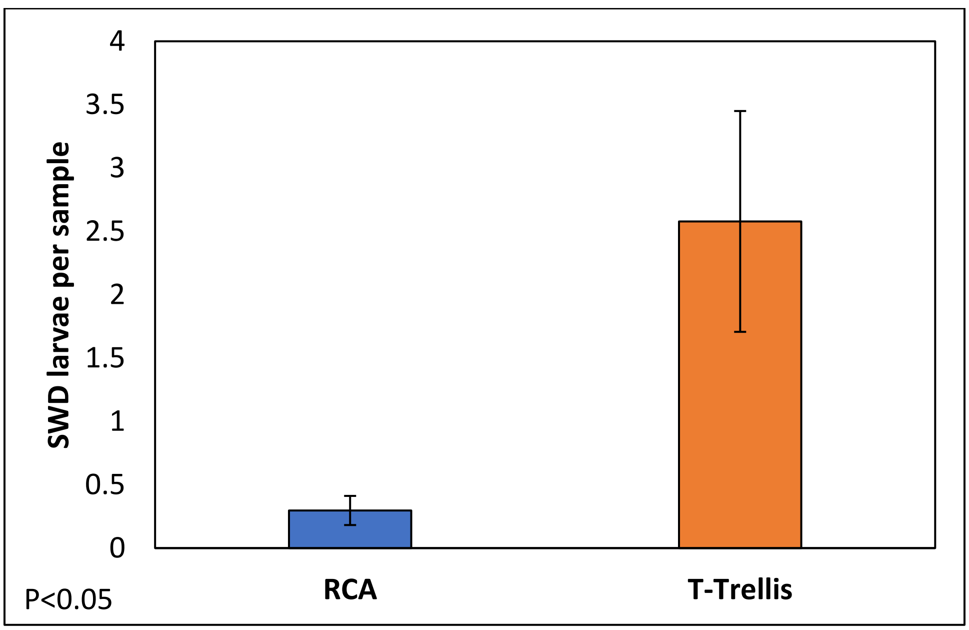

Figure 5. Average number of spotted-wing drosophila (SWD) found in each trellis system across four spray volume treatments and four sampling dates in blackberry at Hope, AR. (P<0.05)

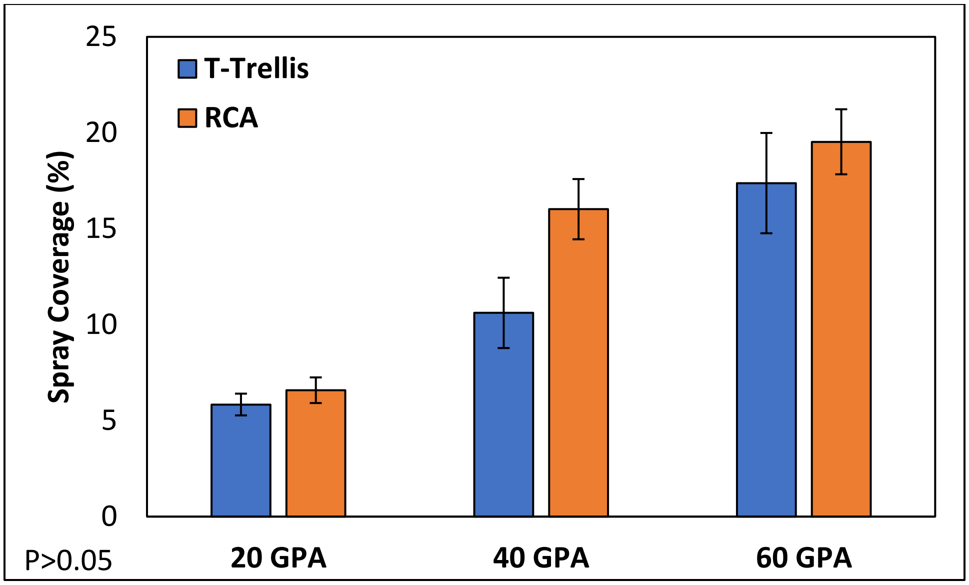

Figure 6. Average percent coverage of water-sensitive spray cards across three spray volume treatments (GPA) in two different trellis systems (RCA and T-Trellis) in blackberry at Hope, AR (P=0.41)

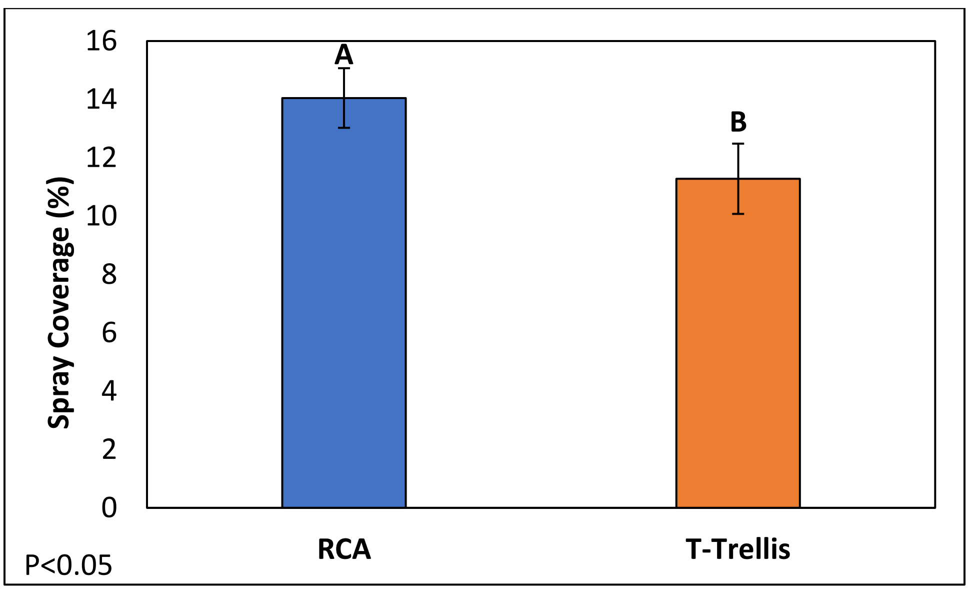

Figure 7. Average percent coverage of water-sensitive spray cards for two trellis types averaged across spray volume treatments in blackberries at Hope, AR (P<0.05)

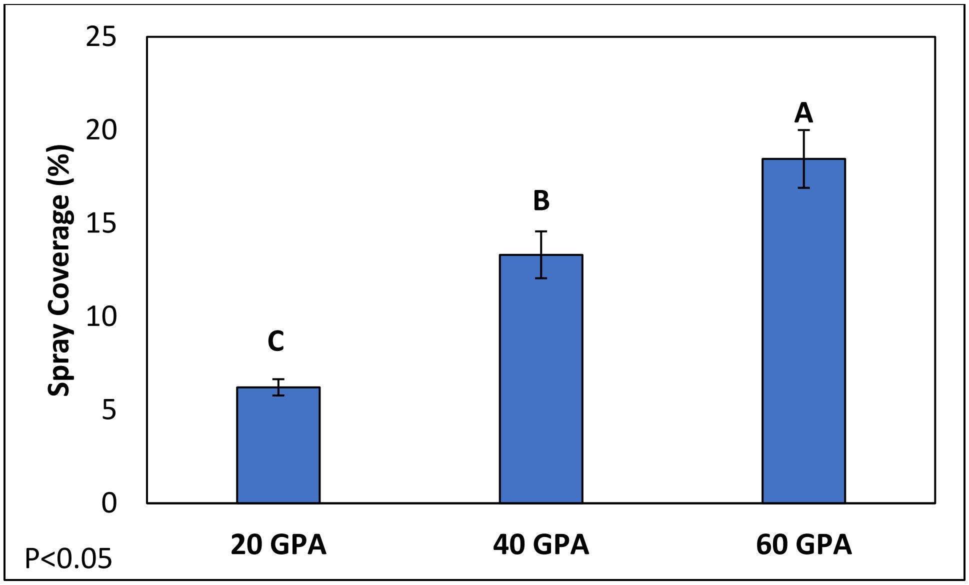

Figure 8. Average percent coverage of water-sensitive spray cards using three spray volume treatments (GPA) averaged across trellis-type in blackberries at Hope, AR (P<0.05)

References Cited

Diepenbrock, L. M. and H. J. Burrack. 2017. Variation of within-crop microhabitat use by Drosophila suzukii (Diptera: Drosophilidae) in blackberry. J. Appl. Entomol. 141: 1-7.

Timmeren, S.V., L.M. Diepenbrock, M.A. Bertone, H.J. Burrack, and R. Isaacs. 2017. A Filter Method for Improved Monitoring of Drosophila suzukii (Diptera: Drosophilidae) Larvae in Fruit. J. Integr. Pest Manag. 8: 1-7.