A Comparison of Airblast and Proptec® Rotary Atomizer Spray Technologies

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Abstract

A comparison of airblast and Proptec® rotary atomizer spray technologies. , C.C. REILLY (1), K.C. Taylor (2) and M.W. Hotchkiss (1). (1) SE Fruit and Tree Nut Research Laboratory, USDA-ARS, Byron, GA and (2) Department of Horticulture, University of Georgia, Byron, GA.

Pesticide application with a commercial airblast sprayer was compared to that of a rotary atomizer, low volume sprayer (Proptec) in a 40 acre, 6-year-old, Sunprince peach orchard. Standard cover sprays, throughout the season using phosmet (2 lb/A), sulfur (9-12 lb/A) or propiconazole (4 oz/A) employed the two technologies. Airblast sprays (50 GPA) were applied at 2 mph with 100% of the pesticide rate while Proptec sprays (25 GPA) were at 5 mph and at 80% of the rate. Eighty ripe fruit, picked from each treatment in each of four blocks, were rated for scab, brown rot, insect damage and blemishes. Scab and blemish ratings indicated a difference between the treatments. We tested spray coverage in two ways: dye (Rhodamine B) and residue of phosmet. Leaf rinses or residue detection from each method indicated equal coverage from both application methods. Phosmet drift was reduced 59% in the first adjacent row and 93% in the fifth row from the application row by Proptec compared to airblast drift.

Introduction

Stone fruit production is second only to peanuts in the southeastern United States pesticide use with pecan production third. Concerns for perceived negative impacts on the environment are always present especially for pesticide drift during application. A major problem in fruit production is windy conditions during the March and April bloom sprays resulting in excessive drift.

The airblast sprayer is the current technology employed by the stone fruit industry for pesticide application. A typical tractor towed unit is powered by the tractor's power take off to run the circulating and pressure pumps and the air fan. Pesticides are typically delivered at a rate of 50 GPA and dispersed as fine droplets (ca. 250µm) by using high-pressure nozzles mounted around the air fan (Fig. 1 A). The rotary atomizer technology uses hydraulic pesticide delivery and low pressure atomization to disperse microfine droplets (ca. 60µm) (Fig. 1 B).

This study reports the results of comparisons between airblast and rotary atomizer technology including disease incidence of brown rot and scab, insect damage, peel blemish, spray coverage and pesticide drift.

Materials and Methods

A 40 acre block of six year old peach trees at 20 x 20 ft spacing with 72 trees per row, containing non irrigated Sunprince cv., was managed as suggested in the 2000 Southern Peach, Nectarine and Plum Pest Management and Culture Guide (1). Fungicides, sulfur and propiconazole (Orbit) and insecticide, phosmet (Imidan) were applied following the Pest Management and Culture Guide (1) using the Proptec unit, calibrated to deliver 25 GPA at 5 MPH and the airblast sprayer calibrated to deliver 50 GPA at 2 MPH.

The orchard was divided into 4 paired blocks consisting of 6 rows for treatment by the airblast sprayer and 4 blocks consisting of 12 rows for treatment by the Proptec sprayer. The study was conducted during the 2000 growing season and repeated in 2001.

Figure 1. Comparison of drift during pesticide application: A) Airblast sprayer, B) Proptec sprayer.

Fruit samples were taken one day before the first commercial harvest by randomly removing 80 fruit from the middle one third of the two middle rows in each treatment block. The samples were rated for insect damage (Fig. 2A), blemishes (Fig.2B) and scab incidence (Fig. 2C), then stored at room temperature for 7 days in apple crates on cardboard trays. After 7 days the fruit were rated for brown rot (Fig. 2D) incidence.

Spray coverage and drift. Rhodamine B was applied by airblast or Proptec sprayer at a concentration of 250 ppm. One day after application, leaves were collected from the inside and outside areas of the canopy of each treatment. A determination of Rhodamine B on leaf surfaces was made by rinsing the leaves for 90 minutes in 1.5N NaOH. Spray distribution was determined by measuring the absorbance at 460 nm by visible spectrophotometry of the eluted dye obtained from the leaves. Spray drift was determined by applying phosmet at 2 lb/A with the airblast and 1.6 lb/A with the Proptec sprayer. Then after 0, 1, 3, and 6 days after application leaf samples were collected from the first, third and fifth adjacent rows from the treatment row. Leaf samples were submitted to a commercial laboratory for pesticide analysis.

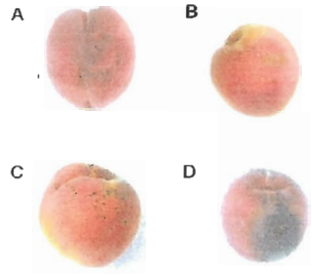

Figure 2. Disorders and diseases of peach fruit rated during evaluations of the sprayers; A. insect damage, B. blemish, C. peach scab (*Cladosporium carpophilum*), and D. brown rot (*Monilinia fructicola*).

Results and Discussion

The rotary atomizer technology applies 25 gal. of spray material per acre to two rows over the top of the trees on each pass through the orchard at a ground speed of 5 mph. The obvious advantages in comparing Proptec technology to existing airblast sprayers are reduced gallons per acre, reduced fill up times, increased number of acres sprayed per given time and reduced overall cost of equipment and man power. Because only alternate middles are traversed by the sprayer, fewer fruit are bumped or knocked off as limbs sag when fruit mature. We found there was no difference in damage from insects (Fig. 2A) in plots treated with the airblast or Proptec sprayers in the 2000 or 2001 seasons (Fig. 3). Fruit blemish (Fig. 2B) was also measured for the two seasons (Fig. 4). The ratings indicate a difference between the two sprayers for the 2000 season, but no difference for 2001.

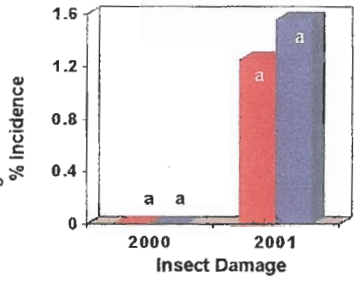

Figure 3. Insect damage detected in plots treated with airblast or Proptec sprayers during the 2000 and 2001 seasons.

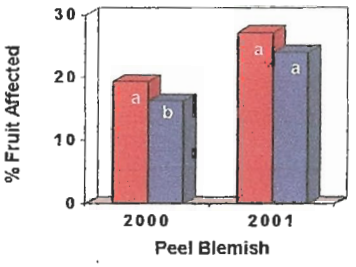

Figure 4. Peel blemish detected in plots treated with airblast or Proptec sprayers during the 2000 and 2001 seasons.

Differences were detected during both seasons for peach scab (Fig. 2C), with the Proptec plots having a higher incidence (Fig. 5). We suspect that failure to control scab may be related to the reduced (20% less) sulfur applied with the Proptec sprayer, an amount below the recommended level (1). Brown rot (Fig. 2D) incidence was greater for the airblast treatment in the 2000 season, but not different for either treatment in 2001 (Fig. 5).

Spray coverage on mature peach trees using Rhodamine B as an indicator was the same within the canopy when the sprayers were compared (Fig. 6). In contrast, drift was reduced 58.6% the first adjacent row to the treatment row, 64.7% the third row and 93.3% in the fifth row (Fig. 7) in the Proptec.

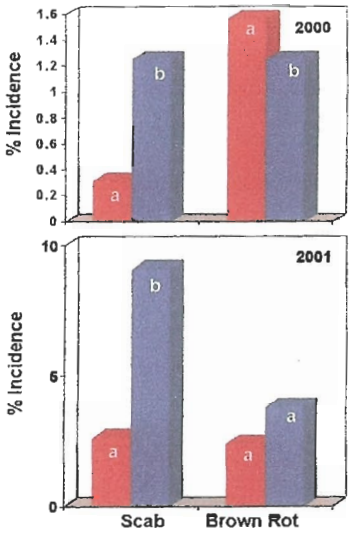

Figure 5. Incidence of peach scab and brown rot detected in field plots treated with the airblast or Proptec sprayer during the 2000 and 2001 seasons.

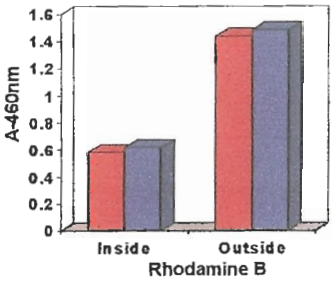

Figure 6. The recovery of Rhodamine B from the interior and outer surface of peach tree canopy treated with airblast or Proptec sprayers.

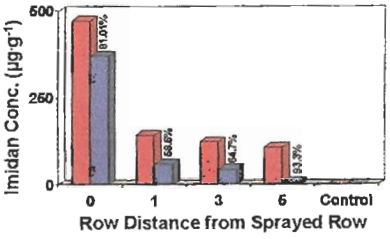

Figure 7. Spray drift from the airblast or Proptec sprayers at 1, 3 and 5 rows from the treated row. Proptec applied 20% less Imidan to treatment row, percent on rows 1, 3 and 5 are differences between Proptec and airblast residue detected.

Reference

1. 2000 Southern Peach, Nectarine and Plum Pest Management and Culture Guide. DL Horton, C Gorsuch and D Ritchie (eds.) Bull. 1171, Univ. GA Coop Ext. Ser.

Ptr ToxA, a host-selective toxin produced by *Pyrenophora tritici-repentis*, is a 13.2 kDa directly encoded for by the *ToxA* gene. Amino acids 140 - 142 of Ptr ToxA form an RGD motif, a sequence found in animal proteins that bind to integrins. Integrin binding can regulate various cellular processes, including apoptosis. Since Ptr ToxA induces a programmed cell death in wheat, we hypothesized that the RGD is involved in toxin action. *ToxA* was mutated by PCR to change the RGD in toxin to RAD and to RGE. A control G to A mutation at amino acid 96, not expected to affect activity, was included. After sequencing, wild type and the three mutant *ToxA* clones were expressed in *E. coli*. Host necrosis developed in response to wild type Ptr ToxA and the control mutation, but the RAD and RGE mutations were inactive. In other experiments, 2 mM RGD tripeptide gave 68% protection from electrolyte leakage when co-infiltrated with Ptr ToxA; RGES control peptide gave no protection. The RGD motif is required for Ptr ToxA action, possibly by interacting with a toxin receptor. If so, the receptor may possess features of animal integrins.

Pathogenicity of some fungi associated with *Melaleuca quinquenervia* in south Florida. M. B. RAYACHHETRY (1), T. K. Van (2), P. D. Pratt (2), and T. D. Center (2). (1,2) Fort Lauderdale Research & Education Center, University of Florida, Fort Lauderdale FL 33314. Phytopathology 91:S75. Publication no. P-2001-0543-AMA.

Melaleuca (*Melaleuca quinquenervia*) is one of the most invasive weeds in south Florida. A few fungal species are associated with melaleuca roots, stems, and leaves. Two fungal species, *Botryosphaeria ribis* and *Puccinia psidii* have been studied as potential biological control agents of melaleuca *Botryosphaeria ribis* was determined to be a stress related canker-pathogen of melaleuca stems. It is compatible with the active ingredient imazapyr in the herbicide Arsenal®. Application of the mixture of imazapyr and *B. ribis* inocula reduced the melaleuca stump regrowth. The rust *P. psidii* primarily attacks healthy young leaves and soft stem-tips. Severe infections cause twig defoliation, localized swellings, and tip dieback. Out of the 18 species in 11 genera of myrtaceous plants tested in Florida, 7, 3, and 8 species were immune, resistant, and susceptible, respectively. *Puccinia psidii* virulence was highest among three exotic species: *M.quinquenervia*, *Pimenta dioica*, and *Eugenia reinwardtiana*.

The effect of relative humidity on the lesion expansion, sporulation and germination efficiency of Uncinula necator. C. REA and W. D. Gubler. Department of Plant Pathology, University of California, Davis, CA 95616. Phytopathology 91:S75. Publication no. P-2001-0544-AMA.

A grape powdery mildew epidemic is commonly suspected to occur first and more seriously in the lowest, wettest part of the vineyard. However, precise data on the effects of relative humidity on the lifecycle of Uncinula necator is necessary for an improved forecast and a more efficient control of the disease. Isolates were collected from Kern, Fresno, Sacramento and Santa Barbara counties, representing four geographically distinct environmental regions of California. 6 to 8 week old Carignane seedlings were inoculated with conidia from each isolate. The infected seedlings were incubated under temperatures within the optimal growth range and a wide range of humidities. The rate of lesion expansion, condial production per unit of infected tissue and germination efficiency were compared. A moderate humidity and temperature favored hyphal growth while a high humidity favored germination. Sporulation data are discussed. Isolates from the more temperate climates showed significantly better growth than those from the more extreme conditions.

New resistance to plant viruses in pepper. B. B. REDDICK and L. F. Habera. Department of Entomology and Plant Pathology, The University of Tennessee, Knoxville, TN, USA. Phytopathology 91:S75. Publication no. P-2001-0545-AMA.

Capsicum spp. is one of the most diverse vegetable species, varying in pod shape and color, and pungency levels. It is also considered a high-value crop whose use has increased more than 21% since 1994 with more than 7.5 million acres grown worldwide. Plant virus diseases can cause losses of up to 90% and are difficult to control. Over 350 lines of *Capsicum* spp. were tested for resistance to cucumber mosaic virus (CMV), pepper mottle virus (PMV), potato virus Y (PVY), and tobacco etch virus (TEV). Plants were grown in 72-cell float trays in the greenhouse and inoculated at the 4-leaf and cotyledon stages. Plants were evaluated for symptom expression, and infection confirmed by enzyme linked immunosorbent assay. Seeds were collected from resistant plants and retested as above. More than 40 lines were resistance to one or more of the viruses in preliminary tests; however, some of these failed to show resistance when retested. Twenty two lines or cultivars did show operational immunity to one or more viruses when inoculated at the 4-leaf stage. Only thirteen lines were resistant to at least one virus when inoculated at the cotyledon stage. These pepper lines need to be evaluated further with more virus strains so the breath of the resistance can be determined.

Transmission of maize streak virus genome monomers to maize kernels by vascular puncture inoculation. M. G. REDINBAUGH. USDA-ARS and Department of Plant Pathology, The Ohio State University, Wooster, OH. Phytopathology 91:S75. Publication no. P-2001-0546-AMA.

The infectivity of monomeric clones of maize streak virus (MSV) was tested using vascular puncture inoculation (VPI). VPI is an effective technique for mechanical transmission of viruses to maize (*Zea mays* L.) kernels that uses a jeweler's engraving tool to drive minuten pins through virus inoculum and into the scutellum of germinating kernels. The source of inoculum was native plasmid DNA containing either a single copy of the MSV genome (MSV monomer) or a head to tail dimer of the MSV genome (MSV dimer) cloned into the BamHI site of pUC19. VPI of kernels with the MSV dimer incited infection in 38±12% of inoculated plants. In contrast, VPI with the MSV monomer produced no infection. However, if the MSV monomer was digested with BamHI prior to VPI, 16±3% of plants became infected. Thus, monomers of the MSV genome were infectious after the pUC19 vector sequences were removed. Extracts of infected leaves from plants inoculated with either the MSV dimer or the BamHI-digested MSV monomer were equally infectious suggesting the inocula produced similar systemic infections.

Evidence for a type III secretory pathway in the biocontrol bacterium *Stenotrophomonas maltophilia* strain C3. R. M. REEDY and D. Y. Kobayashi. Dept. Plant Pathology, Rutgers Uuiv., New Brunswick, NJ 08901. Phytopathology 91:S75. Publication no. P-2001-0547-AMA.

Stenotrophomonas maltophilia strain C3 is a biocontrol agent of several fungal diseases. C3 produces several extracellular enzymes, such as chitinases and beta-1,3-glucanases, which are implicated in biocontrol activity of this bacterium. In addition, C3 colonizes fungal mycelia in a unique and discrete manner suggestive of a pathogenic interaction. A type III secretory pathway was sought to provide genetic evidence that C3 is pathogenic towards fungi. A conserved region of the *hrpB6* gene, which encodes an ATPase from *Xanthomonas campestris* pv. *vesicatoria*, was used as a probe in Southern hybridizations to identify and clone a *hrpB6* homologue from strain C3. Sequence analysis of the gene indicates significant homology to ATPases of known type III secretory pathways from both animal and plant pathogens. Further analyses indicate the gene is linked to regulatory and structural gene homologues that are also associated with type III secretion pathways. These observations not only provide supportive evidence for the existence of the pathway, but also for a pathogenic interaction between strain C3 and fungal hosts.

A comparison of airblast and Proptec rotary atomizer spray technologies. C. C. REILLY (1), K. C. Taylor (2), and M. W. Hotchkiss (1). (1) SE Fruit and Tree Nut Research Laboratory, USDA-ARS, Byron, GA and (2) Department of Horticulture, University of Georgia, Byron, GA. Phytopathology 91:S75. Publication no. P-2001-0548-AMA.

Pesticide application with a commercial airblast sprayer was compared to that of a rotary atomizer, low volume sprayer (Proptec) in a 40 acre, 6-year-old, Sunprince peach orchard. Standard cover sprays, throughout the season using phosmet (2 lb/a), sulfur (12 lb/a) or propiconazole (4 oz/a) employed the two technologies. Airblast sprays (50 gpa) were applied at 2 mph with 100% of the pesticide rate while Proptec sprays (25 gpa) were at 5 mph and at 80% of the rate. Eighty ripe fruit, picked from each treatment in each of four blocks, were rated for scab, brown rot, bacterial spot, insect damage, blemishes, percent redness, and peel discolorations. Only scab ratings indicated a difference between the treatments (airblast, 0.31%; Proptec, 1.25%). We tested spray coverage in two ways: dye (Rhodamine B) and residue of phosmet. Leaf rinses or residue detection from each method indicated equal coverage from both application methods. Phosmet drift was reduced 59% in the first adjacent row and 93% in the third row from the application row by Proptec compared to airblast drift.

Hypodermal suberization leads to effective structural barriers in barley roots against *Chaetomium globosum* invasion. A. REISSINGER and R. A. Sikora. Univ. Bonn, Inst.fuer Pflanzenkrankheiten, 53115 Bonn, Germany. Phytopathology 91:S75. Publication no. P-2001-0549-AMA.

Histological studies were conducted to determine the role of preformed structural barriers in barley roots for successful defense against infection by *Chaetomium globosum*. Plants were either grown in aeroponic culture to simulate water deficiency stress, or in hydroponic culture. In aeroponic culture, the