Can venturi nozzles deliver pest and drift control?

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Abstract

Venturi (AKA Air Induction) nozzles were tested against conventional disc/core nozzles for navel orangeworm control during hull split in a mature almond orchard using 100 or 200 gallons/acre and a 3-spray program. There was no difference in NOW control across all the treatments in Nonpareil nuts at harvest (p=0.30). Untreated damage was 3.6% and reduction in damage ranged from 3-53%. Spray volume had the largest impact on damage, with 200 GPA performing, generally, better than 100 GPA (p=0.11).

In a lab bioassay conducted with sprayed nuts from the field trial, venturi nozzles generally performed as well as disc/core nozzles.

Venturi (AI) nozzles delivered similar performance to disc/core nozzles at 100 GPA or 200 GPA.

Introduction

The almond industry is caught between the need for effective pest control – especially for navel orangeworm (NOW) – in dense canopies of unpruned, vigorous trees using a limited arsenal of pesticides and the need to limit off-target pesticide movement (drift) from those orchards. Current airblast spraying trends in in almonds – engine drive sprayers pushing high volumes of sprayer air and very fine/fine (VF/F) diameter droplets – can deliver effective pest control, but increased spray drift losses can occur if VF/F droplets are pushed past the tree tops. Surface water contamination by drifting pesticides may result in regulatory cancelation of one or more of the few remaining, effective NOW pesticides, making pest control (and resistance management) harder to achieve.

Venturi nozzles (AKA Air Induction nozzles) generate heavy, coarse to extra coarse (C/XC) diameter droplets compared to conventional nozzles using a side air port and large exit orifice (with a flow regulating orifice at the bottom of the nozzle body). Venturi (AI) nozzles are accepted in herbicide spraying in the US and in herbicide and orchard spraying in Europe. Drift and NOW control from these nozzles should be compared to that of conventional spray nozzles in almond orchards.

Two nozzles, different exit orifices, same spray flow rate. AITA (04) on the left, TXR (04) on the right. Nozzle on the L makes coarse droplets. The one on the R makes fine droplets.

Objectives

The main goal of this project is to test if an airblast sprayer with venturi nozzles (TeeJet AITA Conejet®) can deliver NOW control comparable to that from the same sprayer using grower standard hollow cone nozzles (TeeJet TXR Conejet or TeeJet disc/core) at 100 or 200 gallons per acre spray volume with the same per acre rate of pesticide. Measuring drift from similar sprayer set-ups with these nozzles is also an objective.

NOW control was measured using 1) field study and 2) field sprayed nuts tested in a lab bioassay.

Methodology:

A productive, mature almond orchard (20 acres) at the Nickels Soil Lab near Arbuckle, CA (Colusa County) was selected for this trial and divided into 12 plots, each covering 1.2 acres. Each plot was four drive rows (24' spacing) wide and three 32 tree rows (22' spacing) long with a Nonpareil row in the center row of each plot. One additional, 1.2 acre plot was left unsprayed. Four nozzle x spray volume treatments (see below) were arranged in a randomized complete block design with 3 replicates for each treatment.

A Rears PTO Pull-blast sprayer with 38" fan was used throughout this trial (ground speed of 2 MPH) and set up for the following treatments:

1. 100 GPA, disc/core nozzles (D4-D8 nozzles with D25 swirl-plates).
2. 100 GPA, low drift AITXA nozzles (sizes 01, 015 and 02).
3. 200 GPA, disc/core nozzles (D4-D10 nozzles with D45 swirl-plates).
4. 200 GPA, low drift AITXA nozzles (sizes 03 and 04).

70-80% of the spray volume was delivered through the top quarter of nozzle ports on the top half of the spray boom (using five nozzles ports). The remainder of the spray flow went out through the second quarter from the top of the spray boom (using three nozzles). See images below for sprayer set ups. Since the largest AITXA nozzle is an 04 (0.62 gpm at 100 psi), stream splitters were used to allow 2-3 venturi nozzles per nozzle port on the sprayer.

July 12. Intrepid 2F (16 oz/acre) plus 4 oz Broadspread silicon spreader was applied on this date using 100 GPA for all plots, but venturi nozzles used for plots assigned Treatments 1 or 3 (see above) and Treatments 2 and 4 sprayed with disc/core nozzles.

July 26. Intrepid (16 oz/acre) plus Syl-tac (8 oz/100 gallons) was applied on July 26 using all four treatments. The day after spraying (July 27), 50 nuts from each of 5 Nonpareil (NP) trees per treatment were sampled (25 from 6-8' off the ground and 25 from 18-22' height). 5 unsprayed NP trees were similarly sampled. Samples were transported to the USDA ARS Parlier, CA lab of Dr. Siegel where each nut was exposed to 10 NOW eggs placed in the open suture. Nuts were incubated in 5 gallon buckets (100 nuts/bucket) at 86°F for 28 days and then surviving NOW counted.

200 GPA, disc and core nozzles.

200 GPA, AITXA nozzles..

Methodology Continued:

A final insecticide spray -- Brigade (1lb/a), Vigilant (20 oz/a, and Trifol (8 oz/100 gal), using all four sprayer set-up treatments, was applied on Aug 11-12.

Nonpareil harvest was on August 22-24. Pickup was September 2. At pickup, 1000 nuts per row were sampled from each treatment rep and cracked out to determine % worm damage.

Results/Conclusions

Untreated Nonpareil damage in the field samples was 3.6%. Percent damage reduction for each rep in the field study was determined by dividing the damage in each rep by the untreated damage and multiplying by 100. (Table 1). There was no significant difference between sprayer set ups (p=0.30), but 100x3 GPA generally delivered less NOW control than 100 GPA once followed by 2x at 200 GPA, regardless of nozzle choice.

In the lab bioassay, using nuts harvested from the field at 1 DAT (day after treatment), venturi nozzles at 100 or 200 GPA performed as well as disc/core nozzles at 100 GPA. Disc/core nozzles at 200 GPA significantly improved NOW population reduction over disc/core at 100 GPA and venturi nozzles at 200 GPA.

Table 1. Nonpareil nut damage at harvest (sampled from bankout wagon), ranked from highest to lowest damage.

Block	Treatment GPA/nozzles	%NOW damage	% damage reduction over untreated
	untreated	3.6	--
1	100 disc/core	3.5	2.8
2	100 venturi	3.1	13.9
3	100 venturi	3.1	13.9
2	200 disc/core	2.5	30.6
1	200 disc/core	2.4	33.3
1	100 venturi	2.3	36.1
2	100 disc/core	2.3	36.1
1	200 venturi	2.1	41.7
2	200 venturi	2	44.4
3	200 disc/core	2	44.4
3	100 disc/core	1.7	52.8
3	200 venturi	1.7	52.8

Table 2. NOW survival reduction over control in lab bioassay of field-sprayed nuts sampled 1 day after spraying. Data in each column followed by the same letter are not statistically different (at 5%)

Treatments	High in Canopy (18-22')	Low in Canopy (6-8')
100 GPA disc/core	64 a	71 ab
100 GPA venturi	88 ab	74 ab
200 GPA disc/core	92 b	80 b
200 GPA venturi	78 a	63 a

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