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EVALUATION IN THE LABORATORY OF NOVALURON TO CONTROL SOUTHERN GREEN STINK BUG

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Abstract

The efficacy of novaluron (Diamond ™ 0.83 EC) on cotton against southern green stink bug (SGSB), *Nezara viridula* nymphs was investigated in a spray table using two nozzles, 650033 and 8002E which respectively, delivered 2 and 5 gallon spray rates per acre. The 8002E nozzle produced significantly larger droplets, increased droplet density and increased spray coverage compared to 650033 nozzle. Regardless of dosage and spray rate, when novaluron was applied at 3, 6 and 9 oz active ingredients (AI) per acre, the age of the nymphal instars influenced mortality significantly with the suppression of small nymphs (2^{nd} instars) being significantly greater than that of either 3^{rd} or 4^{th} instar nymphs. When novaluron was applied at 9 and 12 oz AI per acre with or without crop oil concentrate, the 8002E nozzle significantly increased mortality of 3^{rd} instar nymphs; however, neither dosage nor addition of crop oil concentrate increased mortality of 3^{rd} instar nymphs. Novaluron did not cause a high level of mortality of 4^{th} instar nymphs. This study suggests that the application of novaluron should be directed at 2^{nd} instar nymphs in order to maximize efficacy for control of SGSB on cotton and that applications with increased droplet size and density may increase efficacy.

Introduction

Novaluron is an insect growth regulator (IGR) which acts on immature insect stages by inhibiting chitin synthesis and deposition of chitin in the exoskeleton of arthropods (Ishaaya et al. 1996). It belongs to the benzoylphenyl urea class of chemistry with a wide spectrum of control activity against Lepidoptera, Coleoptera, Hemiptera and Diptera. Novaluron appears to act through ingestion and contact and is effective against leaf-feeding lepidopteran and sucking insects such as whiteflies (Ishaaya et al. 1996). Because of low mammalian toxicity and compatibility to the environment, novaluron appears to have the potential to compete with the neonicotinoids to control SGSB on cotton (Weiland & Whitehead 2002). Recently, Weiland & Whitehead (2003) evaluated novaluron against SGSB nymphs on cotton @ 9 oz per acre and found that novaluron showed control activity comparable to the neonicotinoids.

The objective of this study was to evaluate the effect of novaluron on nymphal stages of the SGSB in a spray table on cotton. The intent was to determine the efficacy of aerial application parameters on control of SGSB and to identify the relationship between deposition of novaluron and control of the insect.

Materials & Methods

Cotton plants (Deltapine 436 RR) with immature bolls were grown in a greenhouse in 18" long window boxes and thinned to 3 plants/box. Two flat fan nozzles, 650033 and 8002E and different combinations of pressure, speed and height from the spray nozzle to the top of the plant canopy were used to apply novaluron (Diamond ™ 0.83EC) at 2 and 5 gallon spray rates per acre. Spray droplet images captured on water-sensitive paper (WSP) collectors placed near the test plants on a holder were analyzed by WRK Dropletscan ^{TM} software system (Whitney et al. 1997) to determine droplet size and density and % coverage. Three different tests were conducted to evaluate the efficacy of novaluron against SGSB nymphal instars collected from soybean and pearl millet fields in the Brazos River Valley near College Station, TX, during 2004 growing season. In Test 1, novaluron was applied at 3, 6 and 9-oz active ingredient rates (AI) per acre against small, medium and large nymphs with small being 2nd, medium being 3rd and large being 4th instars. Silwet L-77 ® was added to the spray mix @ 0.05% v/v. In Tests 2 and 3, novaluron was evaluated for efficacy against 3rd and 4th instar nymphs, respectively, @ 9 and 12 oz AI per acre with or without Clean Crop ® oil concentrate (Platte chemical Co., Fremont, NE) at 1% v/v. Nymphs were confined on the plants with organza fabric cages and mortality was determined 7 days thereafter and compared to an untreated control. Treatment mortality was corrected for check mortality with Abbott's formula (Abbott 1925). PROC GLM procedures were conducted using SAS Version 8 (SAS 2001) and when F-values were significant ($P < 0.05$), means were separated at the 5% level using the least significant difference test (LSD).

Results & Discussion

Deposition characteristics of novaluron on WSP collectors as demonstrated by droplet size, % coverage and droplet density was significantly influenced by nozzle size with no significant interaction between nozzle size and AI rate (Figure 1). The 8002E nozzle produced significantly larger spray droplets ($F = 523.1$; df = 1, 40; $P < 0.0001$), increased droplet density ($F = 48.75$; df = 1, 40; $P < 0.0001$) and increased spray coverage ($F = 287.1$; df = 1, 40; $P < 0.0001$). The addition of Clean Crop ® oil concentrate @ 1% v/v to the spray mix did not significantly alter the deposition characteristics of novaluron ($F = 0.04$; df = 1, 40; $P > 0.8443$ for droplet size; $F = 0.00$; 1, 40; $P > 0.9811$ for droplet density; $F = 0.06$; df = 1, 40; $P > 0.9210$ for % coverage). There was no significant interaction between nozzle size, AI rate and crop oil concentrate for any of the indices of deposition characteristics studied ($F = 0.09$; df = 2, 40; $P > 0.9157$ for droplet size; $F = 0.41$; df = 2, 40; $P > 0.6668$ for droplet density; $F = 0.07$; df = 2, 40; $P > 0.9305$ for % coverage).

Figure 2 shows that the suppression of small nymphs (2nd instars) was significantly greater than that of either medium (3rd instars) or large (4th instars) nymphs ($F = 19.42$; df = 2, 36; $P < 0.0001$). There was no significant difference in mortality between medium (Mean = 13.3.0%) and large nymphs (Mean = 22.0%). No significant interaction was observed between spray rate, AI rate and size of the nymphal instars ($F = 0.13$; df = 6, 36; $P > 0.991$).

Figure 3 shows that the 8002E nozzle produced significantly greater mortality of 3rd instar nymphs than did the 650033 nozzle ($F = 4.80$; df = 1, 24; $P < 0.05$). Addition of Clean Crop ® Oil Concentrate @ 1% v/v to the spray mix ($F = 1.22$; $P > 0.2799$) or increased AI rate ($F = 0.55$; df = 1, 24; $P > 0.4642$) did not significantly influence mortality of 3rd instar nymphs.

Novaluron did not cause a high level of mortality of 4^{th} instar nymphs (Figure 4). The average mortality of 4^{th} instar nymphs was 21.7%. Neither spray rate ($F = 0.00$; df = 1, 32; $P > 0.9928$) nor AI rate ($F = 0.66$; df = 1, 32; $P > 0.4218$) nor addition of Clean Crop ® oil concentrate to the spray mix ($F = 0.21$; df = 1, 32; $P > 0.6501$) significantly increased mortality of 4th instar nymphs.

This study suggests that the application of novaluron should be directed at younger nymphal instars in order to maximize efficacy for control of SGSB on cotton and that applications with increased droplet size and density may increase efficacy.

Selected References

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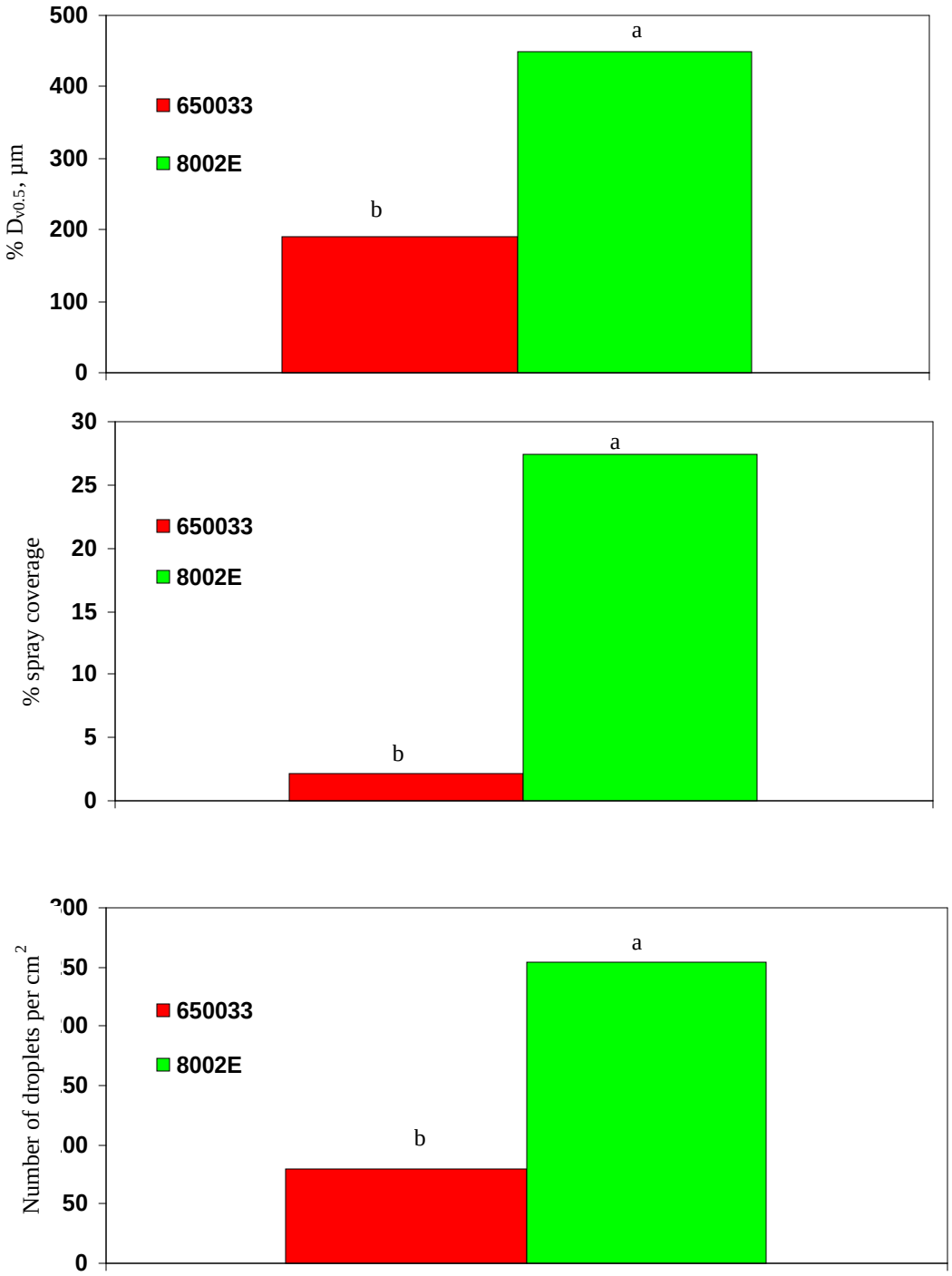

Figure 1. Characteristics of spray droplet size, % coverage and droplet density. Means followed by the same lower case letter are not significantly different according to the protected LSD test (P = 0.05). Nozzle: P < 0.0001; Dosage: NS; Crop Oil: NS; Interaction: NS. See text for details.

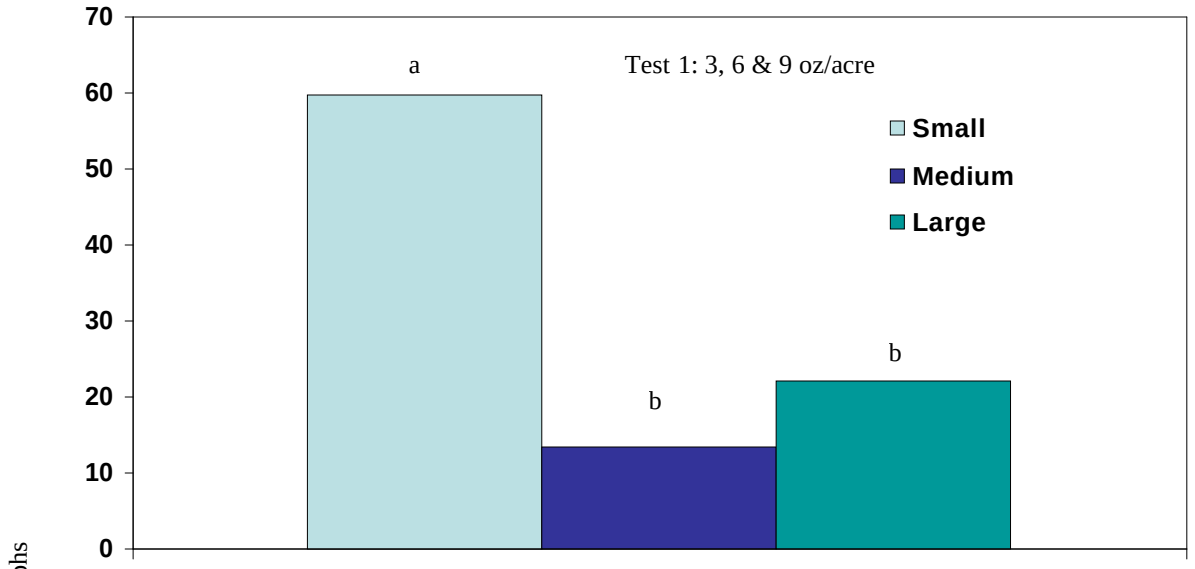

Figure 2. Mortality of 2na (small), 3ra (medium) and 4^{tn} (large) instar nymphs. Means followed by the same lower case letter are not significantly different (P = 0.05). Nozzle: NS; Dosage: NS; Instar Size: P<0.0001: Interaction: NS. See text for details.

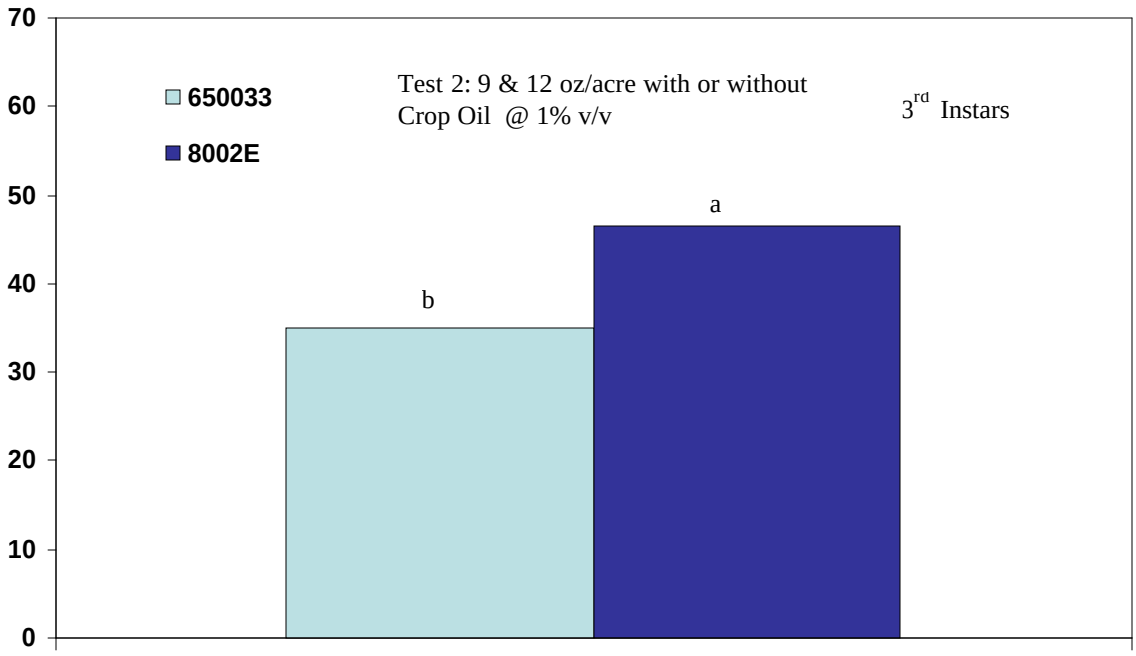

Figure 3. Mortality of 3ra instar nymphs. Means followed by the same lower case letter are not significantly different (P = 0.05). Nozzle: P < 0.05; Dosage: NS; Interaction: NS. See text for details.

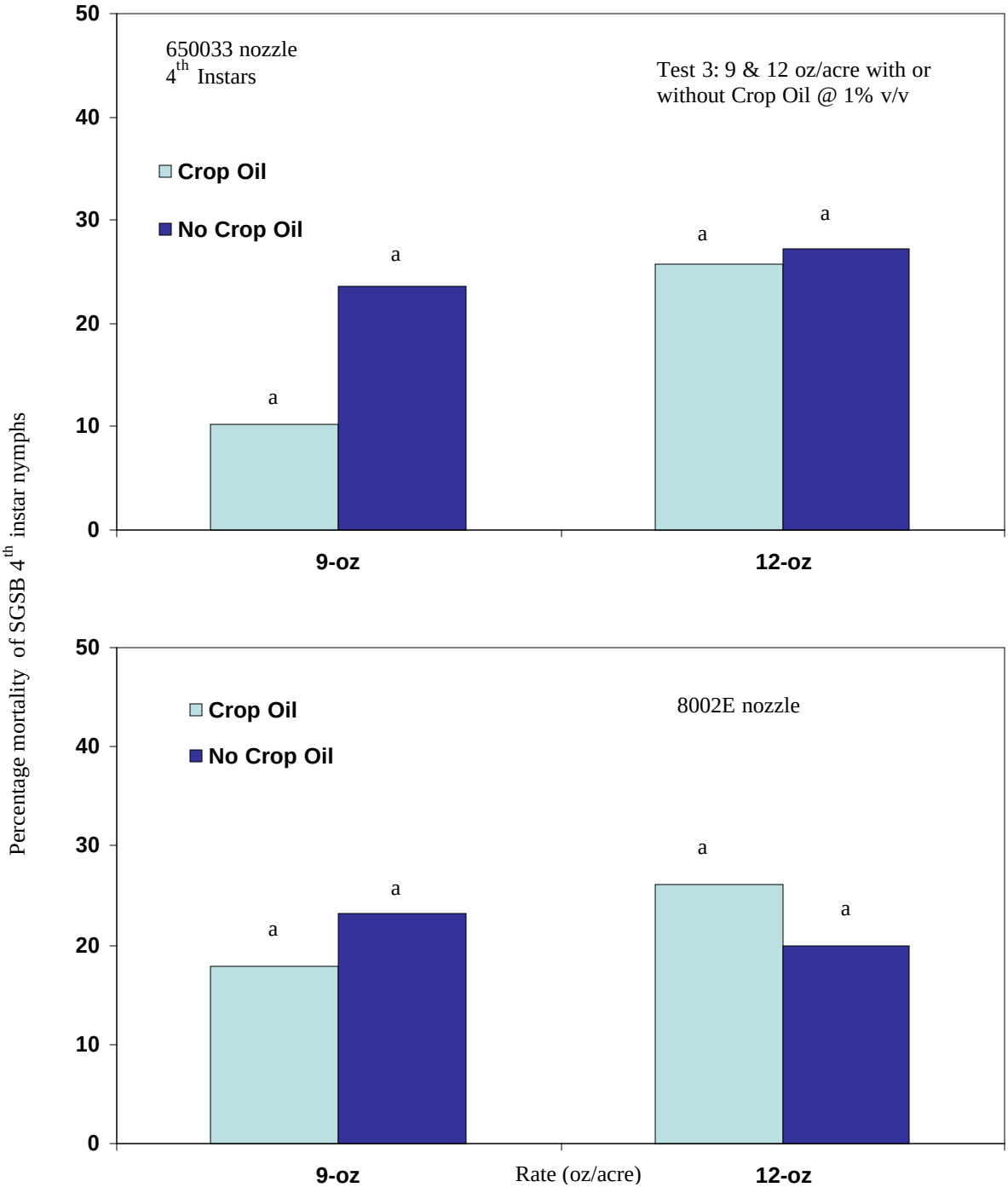

Figure 4. Mortality of 4[tn] instar nymphs. Means followed by the same lower case letter are not significantly different (P = 0.05). Nozzle: NS; Dosage: NS; Crop Oil: NS; Interaction: NS. See text for details.