Novel Pyrethroid Combinations for Control of Sweetpotato Whitefly and their Impact on *Lygus*

P.C. Ellsworth & D.L. Meade

Abstract

Combinations of two insecticides, often a pyrethroid with an organophosphate, have been used more successfully in sweetpotato whitefly (SPWF) control programs rather than single insecticides when SPWF populations are chronically high. Ten combinations of various insecticides were compared for their effectiveness against all SPWF stages. Applications were by ground, broadcast over-the-top of plots 12 rows x 40 ft on five application dates. Three sampling methods were used: leaf turns and sweeps for adult counts, and microscopic leaf counts for immature stages. Danitol®+Orthene® emerged as the most consistently effective combination on all SPWF stages when compared to the untreated plots. Over all dates and SPWF life stages, the combinations were ranked according to the following order of descending efficacy: Danitol+Orthene ≤ Danitol+Lorsban® ≤ Karate®+Penncap-M® = Scout X-tra®+Orthene = Asana®+Curacron® = Asana+Orthene < Asana+Phaser® = Scout+Phaser = Asana+Lorsban = Asana+Vydate® < untreated check. Yields were also affected by the combinations, but attributed to SPWF and Lygus *suppression. Orthene treatment combinations yielded consistently greater than other entries and was likely due to superior* Lygus *control and at least average SPWF control. The Asana+Vydate was ranked among the best in* Lygus *control but low in SPWF control, while Karate+Penncap, Danitol+Lorsban, and Asana+Curacron were ranked high in SPWF control but low in* Lygus *control. The remaining treatments were more or less intermediate in SPWF and* Lygus *control. Rankings of these combinations for* Lygus *control were in the following order of descending efficacy: Asana+Vydate = Scout+Orthene = Asana+Orthene = Danitol+Orthene < Scout+Phaser = Danitol+Lorsban = Karate+Penncap < Asana+Curacron < Asana+Phaser =Asana+Lorsban < untreated check.*

Introduction

The use of highly efficacious control tactics is an integral factor in any sweetpotato whitefly (SPWF) integrated pest management system. Resistance problems can cause insect control costs to soar by requiring higher frequencies of insecticidal applications to achieve minimal control levels. When suspected resistance impairs the usefulness of single compounds, carefully selected combinations have sometimes been used successfully to achieve acceptable levels of field control. Combinations which appear to be most effective are synthetic pyrethroids tank mixed with another chemical class, often an organophosphate. Synergistic activity enhances efficacy to levels greater than can be achieved by the level of additive control expected from individual insecticides. However, limited information is available which evaluates the efficacy of the many combinations that are possible. Additionally, there are several newer insecticides entering the market which need to be evaluated for their compatibility in combinations. This test was designed to evaluate the effectiveness of ten selected pyrethroid combinations. The primary objective was to evaluate several combinations for their ability to provide whitefly control effectively and economically. Applications reflected on-farm economic considerations in designing combinations which ranged in cost ($13.00–17.00 each). Total cost plus application costs were estimated to be $75.00–100.00 per acre for all applications. Costly pyrethroids were used at lower label rates while other, less expensive insecticides were used at moderate to high label rates. All tank-mix partners were used at a rate of one-half pound per acre. These tank-mix partners are believed to pre-condition SPWFs for the lethal action of pyrethroids by blocking binding sites of pyrethroid detoxification.

Materials and Methods

Deltapine 5415 was planted on 14 April 1993 at the Maricopa Agricultural Center, in plots 12 rows x 40 ft., (1600 sq ft) in size using 40" rows. There were 10 insecticide entries (Table 1), four replications, and a randomized complete block design. Bareground areas separated plots and reps by, 6 and 13 feet, respectively. Insecticidal applications began 21 July and continued weekly at four to eight day intervals until mid-August for a total of five application dates. In the Danitol+Lorsban entry, various pyrethroids were rotated with Lorsban as follows: Capture (week 1), Danitol (week 2), Karate (week 3), Danitol (week 4), and Danitol (week 5). Applications were by ground, broadcast over-the-top. Nozzles were TwinJet® 8003 at 20" spacing and 20 GPA. Three sampling methods were used: leaf turns, microscopic leaf counts, and sweeps. Leaf turns monitored adults weekly and began 26 May. Leaf undersides from the second–fifth node position below terminals were examined in-field for counts of adult whiteflies. For leaf counts five leaves per plot were selected from the fourth or fifth nodal position below terminals. These were microscopically examined for total immatures in a one inch square, based at the petiole and bordered by the two lateral major veins. All insect species and numbers caught in 25–100 sweeps per plot were categorized and totaled within the laboratory. Data were analyzed using JMP® software (SAS Institute, 1993) and transformed as needed prior to analysis in order to normalize the data or equalize variances. Entry means were compared against the check using Dunnett's T-test (0.05). Harvest was conducted 4 November by a modified two-row picker. Cotton from four center rows per plot was picked, bagged, and weighed to obtain a yield. Smaller cotton samples were taken for ginning (Continental 10-saw), percent turnout, and stickiness analysis.

Results and Discussion

Adults: Prespray analysis revealed no significant differences among SPWF numbers in treatment plots or in replications. Low average SPWF numbers (< 2 adult/leaf) were observed until 20 July when they reached an average of 8.8 adults/leaf. Applications started a day later. Treatment effects on adult numbers were significant after the first application and continued on all subsequent dates ($P \leq 0.012$). Most treatments were effective relative to the untreated plots; however, only one entry consistently had significantly lower adult numbers on all dates. Danitol+Orthene was the most effective treatment on every date in comparison to the untreated plots (Figure 1). Adult control ranked in descending order of efficacy was: Danitol+Orthene < Danitol+Lorsban = Asana+Curacron = Karate+Penncap = Asana+Orthene = Scout+Orthene < Scout+Phaser = Asana+Phaser = Asana+Lorsban = Asana+Vydate < untreated check.

Immatures: Prespray data showed both immature forms of whiteflies, nymphs and eggs, to be at moderate levels: nymphs/sq.in. = 8.9 and eggs/sq.in. = 46.9. No significant differences were found in treatment plots or replications prior to application.

Eggs: On all subsequent dates there were significant effects of treatment on egg numbers ($P \leq 0.048$). As in the adult counts, Danitol+Orthene was again the most consistently effective combination when compared to the untreated check (Figure 2). Performance rankings for egg control in descending order of efficacy were: Danitol+Orthene < Danitol+Lorsban < Asana+Curacron = Karate+Penncap = Asana+Orthene = Scout+Orthene < Asana+Phaser = Asana+Lorsban = Scout+Phaser = Asana+Vydate < untreated check.

Nymphs: Two dates in particular, 27 July and 9 August did not show significant effects ($P \geq 0.38$) while on all other dates there were significant treatment effects ($P \leq 0.012$). Danitol+Orthene was most consistently effective relative to the untreated check (Figure 3). Mean numbers of nymphs for Danitol+Orthene actually declined over the test period: 25.2, 26.1, 8.2, 4.9, and 3.2 nymphs/sq.in.. Meanwhile nymphal means in the untreated check exploded over the same period: 33.7, 68.0, 49.9, 34.7, and 321.3 nymphs/sq.in.. Nymphal control was ranked in descending order of efficacy as follows: Danitol+Orthene < Danitol+Lorsban ≤ Asana+Curacron ≤ Karate+Penncap = Scout+Orthene = Asana+Orthene < Scout+Phaser = Asana+Lorsban = Asana +Vydate = Asana+Phaser < untreated check.

Yields: Insecticidal treatments also affected yields ($P<0.10$). Combinations using Orthene as a tank mix partner had consistently greater yields than all other treatments (Figure 4), though all combinations had significantly higher yields than the check. *Lygus* populations were high during this study, and it is likely that this insect had as great or greater impact on yields than did sweetpotato whitefly (see next section). Gin turnouts were very high, ranging from 39.8% in untreated plots to a maximum 41.2% in the Asana+Orthene plots.

Lygus: This test was impacted greatly by the presence of large and continuous *Lygus* populations. Although the application of these combinations was not intended for *Lygus* control, evaluations were made both pre- and post-spray for both nymphs and adults of this pest. The Orthene combinations and Asana+Vydate provided the greatest degree of Lygus suppression. Several other combinations were intermediate in efficacy while Asana+Phaser and Asana+Lorsban failed to achieve adequate adult control relative to the check (Figure 5). Overall *Lygus* control was ranked in descending order of efficacy as follows: Asana+Vydate = Scout+Orthene = Asana+Orthene = Danitol+Orthene < Scout+Phaser = Danitol+Lorsban = Karate+Penncap < Asana+Curacron < Asana+Phaser =Asana+Lorsban < untreated check.

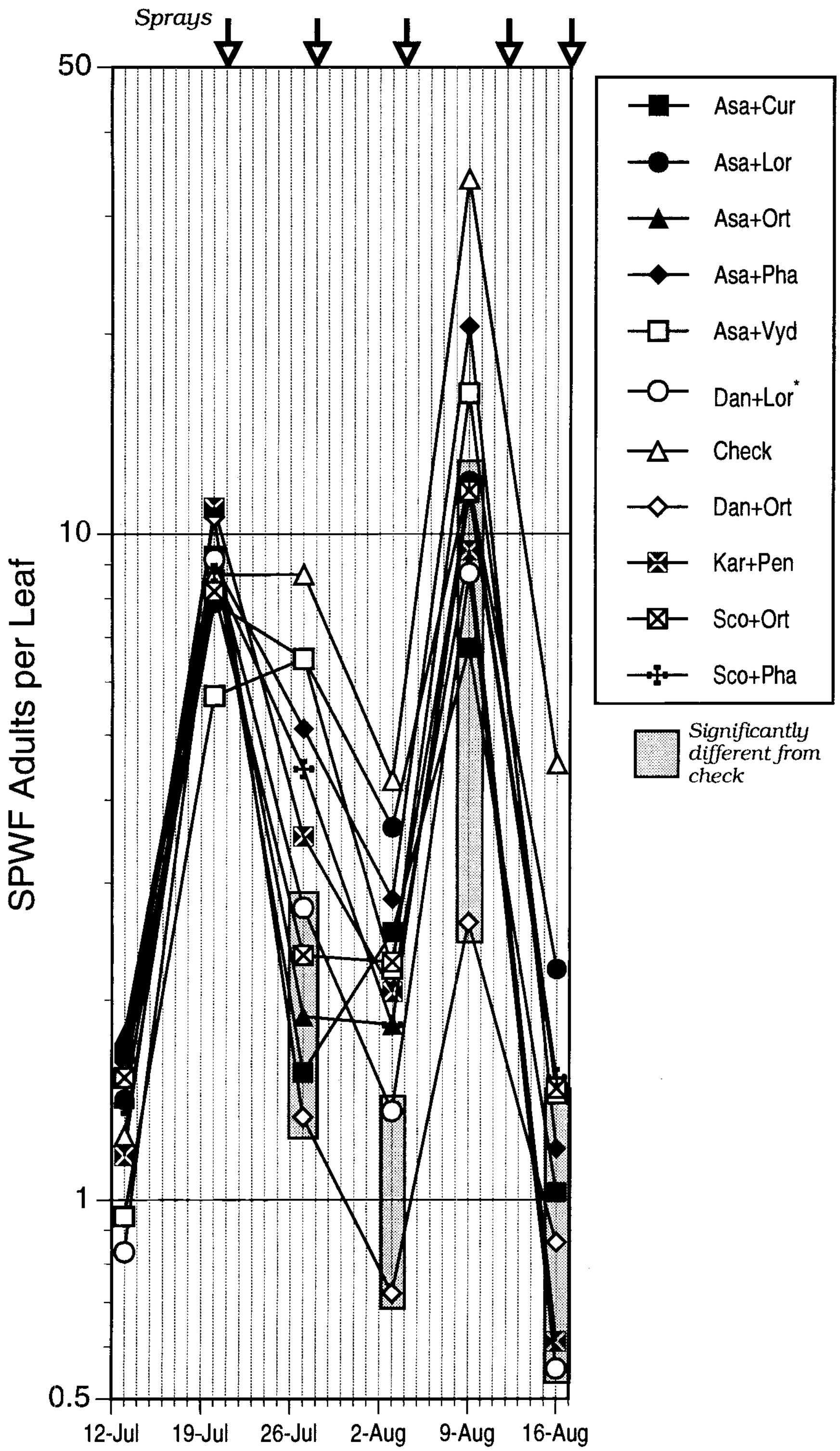

Figure 1. Number of SPWF adults / leaf for each sample date. Arrows indicate spray applications; Shaded boxes indicate treatments which were significantly different from the check (Dunnett's 0.05).

Table 1. Treatment list of pyrethroid combinations tested & their rates.

Compound	Rate (lb ai / A)
Untreated Check	—
Asana XL + Endosulfan-Phaser	0.05 + 0.50
Asana XL + Lorsban 4E	0.05 + 0.50
Asana XL + Orthene 90S	0.05 + 0.50
Asana XL + Vydate C-LV	0.05 + 0.50
[a] Danitol 2.4 EC + Lorsban 4E	0.15 + 0.50
Danitol 2.4 EC + Orthene 90S	0.15 + 0.50
Scout X-tra + Endosulfan-Phaser	0.024 + 0.50
Scout X-tra + Orthene 90S	0.024 + 0.50
Asana XL + Curacron 8E	0.05 + 0.50
Karate 1EC + Penncap-M 2F	0.04 + 0.50

[a] Pyrethroid rotated: Capture(.04), Danitol, Karate(.04), Danitol, Danitol.

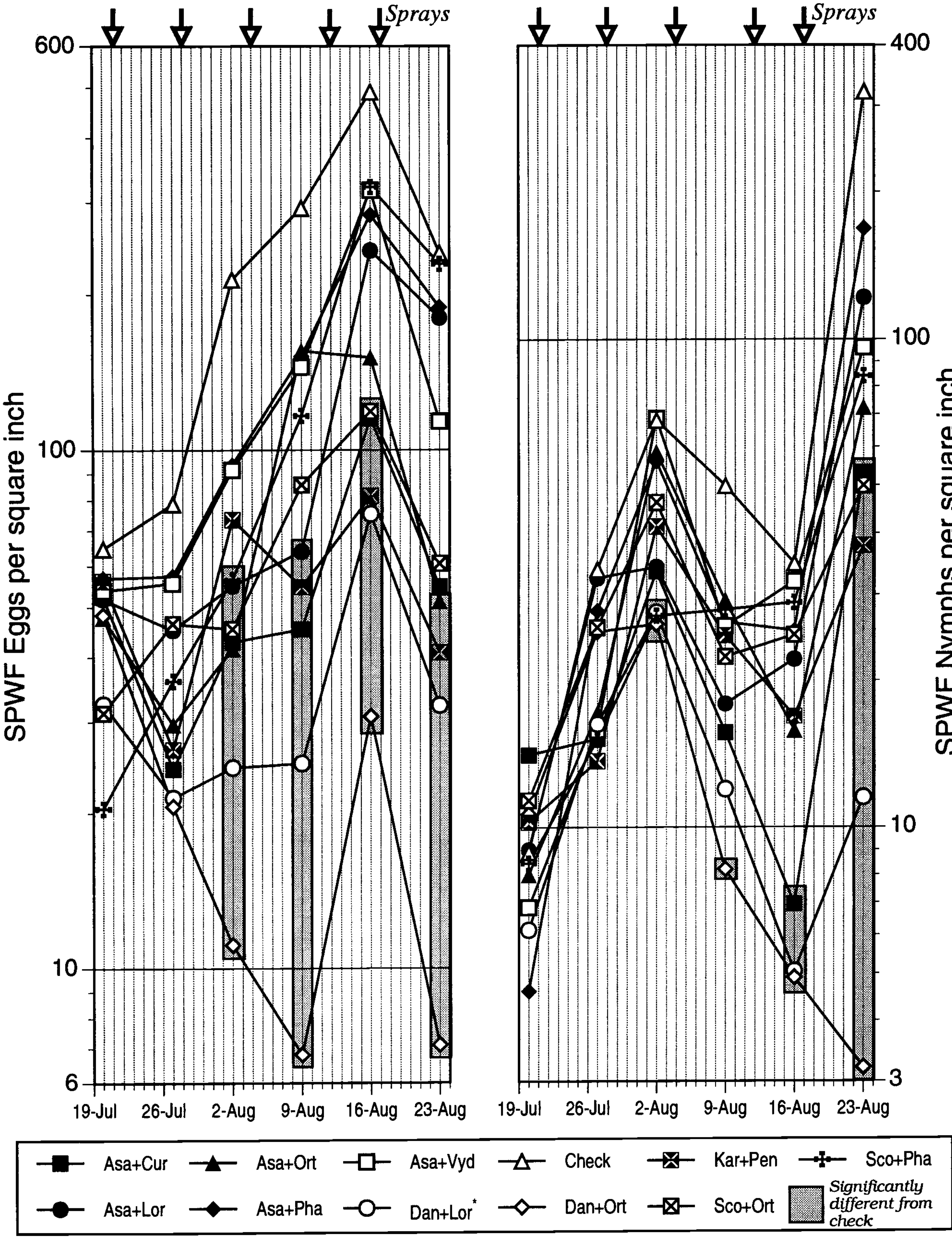

Figure 2. Number of SPWF eggs / sq. in. of leaf for each sample date. Arrows indicate spray applications; Shaded boxes indicate treatments which were significantly different from the check (Dunnett's 0.05).

Figure 3. Number of SPWF nymphs / sq. in. of leaf for each sample date. Arrows indicate spray applications; Shaded boxes indicate treatments which were significantly different from the check (Dunnett's 0.05).

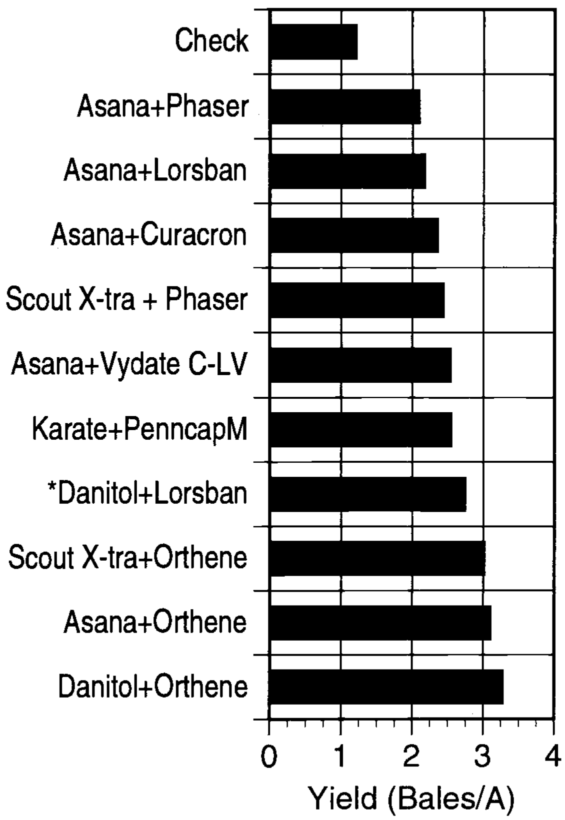

Figure 4. All yields were significantly higher than the check (Dunnett's 0.05).

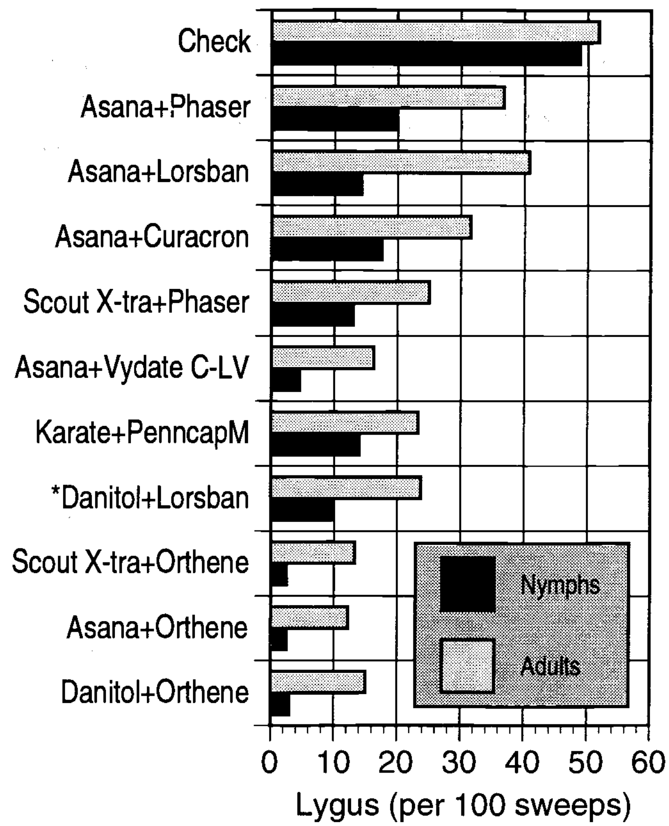

Figure 5. Adult and nymphal counts of *Lygus* per 100 sweeps (seasonal means) were significantly lower than the check (Dunnett's 0.05) for all combinations, except for Asana +Lorsban and Asana+Phaser on adults.