

## ALERT<sup>R</sup> (CHLORFENAPYR): A NEW MITICIDE FOR USE IN FLORIDA CITRUS

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**Abstract.** The pyrrole Alert<sup>R</sup> (AC303,630) has been evaluated against citrus mite *Phyllocoptruta oleivora* (Ashmead), in Florida citrus on 9 occasions since 1989. Formulations, rates/acre, tank mix compatibility and spray volume/acre were investigated in an attempt to elucidate its capabilities as a potential miticide for citrus rust mite management. A 2 lb./gallon suspension concentrate (2SC) formulation was eventually selected for evaluation. It was compatible in tank mixes with chlorpyrifos, a shotgun nutritional mix, tribasic copper, and in oil emulsion sprays. Other mixtures were not tested. It was effective in spray volumes of 100 to 500 gallons and successful rates in those volumes ranged from 0.1 to 0.3 lb. AI pyrrole. Results with lower rates were inconsistent.

### Introduction

There are 11 materials in the '1998 Citrus Pest Management Guide' (Knapp 1998) that the citrus grower can choose from for his citrus rust mite management program. The materials include natural products, organophosphates, carbamates, a chlorinated hydrocarbon, a sulfite, and an organotin as well as representatives of macrocyclic lactone, phenyl urea and pyridazinone chemical families. Their individual modes of action include asphyxiation, smothering, inhibition of nerve transmission, preventing chitin synthesis and blocking cell respiration. This is an excellent array of materials, providing a broad spectrum of activity that minimize the threat of efficacy loss because of overuse. This report presents information on a representative of yet another chemical family, a pyrrole, that attacks the insect mitochondria and interferes with conversion of ADP to ATP.

It entered our screening program as American Cyanamid's AC303,630 [4-bromo-2-(4-chlorophenyl)-1-(ethoxymethyl)-5-(trifluoromethyl)-1H-pyrrole-3-carbonitrile]. A proactive compound, it is metabolized within the insect cells.

### Materials and Methods

Field experiments were conducted against citrus rust mite between 1989 and 1996. In 1989, two rates of AC303,630 1.97E as aqueous and oil emulsion sprays were applied during June to 12-year-old 'Hamlin' orange trees planted at a 15 × 30 ft. spacing on single beds. Treatments were applied with a truck-mounted FMC sprayer operated at 200 psi and equipped with a handgun. In 1990, two rates of a new formulation (12%E) were applied in July to 13-year-old trees in a different area of the same 'Hamlin' block used in 1989. Treatments were applied with the same equipment as above. In 1991, three rates of a new formulation (2SC) as aqueous and oil emulsion sprays were applied in June with the same equipment to 14-year-old trees in a different area of the same 'Hamlin' block used in 1989 and 1990. In 1992, a single rate of a new formulation (3SC) was tank mixed separately with 4 compounds in July sprays applied to 6-year-old 'Valencia' orange trees planted at a 15 × 30 ft spacing on single beds. Treatments were applied with the same equipment used above. A second test in 1992 compared a single rate of AC303,630 3SC at 0.125 lb AI as an aqueous spray and oil emulsion sprays containing 0.09, 0.125 and 0.17 lb AI to Vendex vs. rust mite-infested 'Valencia' orange trees planted at a 15 × 30 ft spacing on single beds. Treatments were applied with a John Bean FMC trailer-mounted sprayer operated at 200 psi and equipped with a duplex handgun. In 1993, the 2SC formulation was applied by airblast sprayer in 3 volumes of spray/acre during June to 7-year-old trees in a different area of the same 'Valencia' block used in 1992. A tractor-mounted Rear's PTO driven airblast sprayer was calibrated with D8 and D4 nozzles tips at 150 psi to deliver 100, 250 and 500 GPA at a 1H mph forward speed. In 1994, four rates of 2SC formulation were applied as oil emulsion sprays to 8-year old 'Valencia' orange trees during June with the air-blast sprayer used in 1993. In 1995, three rates of the 2SC formulation were applied during June as oil emulsion sprays to 25-year-old 'Marsh' grapefruit and 'Pineapple' orange trees planted at a 15 × 29 ft spacing on double beds. Treatments were applied as 2× concentrate sprays (250 GPA) with a John Bean 587 Speed Sprayer pulled through the groves at 1.25 mph. In 1996, two rates of the 2SC formulation were applied as aqueous spray during June to 10-year-

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old ‘Valencia’ orange trees planted at a 15 × 30 ft spacing on single beds. Treatments were applied with a truck-mounted FMC sprayer operated at 200 psi and equipped with a handgun. On occasions when other pests were present in a test site, data was collected on Alert’s performance against them, but they are not presented here.

Treatments were assigned to single tree plots in a randomized complete block design and replicated either 4 or 5 times for all handgun experiments. Each sample tree was separated from adjacent treatment replicates by

at least 1 tree within the tree row and 1 row between treatments. For airblast sprayer experiments, treatments were assigned to variable numbers of trees within the row in a randomized complete block design replicated 3-4 times. Rust mite populations were monitored by examining two 1.2 cm<sup>2</sup> 10× lensfields on the shaded peel of 10 fruit randomly selected on each of the survey trees. Efficacy data were compared by analysis of variance and means separated using Duncan’s multiple range test.

Table 1. Efficacy of American Cyanamid candidate miticide AC303,630 1.97E vs. citrus rust mite on ‘Hamlin’ orange trees at Ft. Pierce, FL—1989.

|                     | Amount per  |       | Mean mite population per lensfield                               |       |        |        |        |        |        |       |
|---------------------|-------------|-------|------------------------------------------------------------------|-------|--------|--------|--------|--------|--------|-------|
|                     | 100 gallons |       | at indicated days before and after spraying 2 June: <sup>z</sup> |       |        |        |        |        |        |       |
|                     | 1b AI       | fl oz | -7                                                               | +7    | +14    | +28    | +35    | +42    | +49    | +56   |
| AC 303,630 1.97E    | 0.02        | 1.4   | 2.0                                                              | 0.1 a | 0.1 a  | 0.5 a  | 0.9 a  | 2.0 ab | 4.6 a  | 4.4 a |
| AC 303,630 1.97E    | 0.03        | 2.1   | 1.7                                                              | 0.1 a | 0.1 a  | 0.8 a  | 1.1 a  | 1.3 a  | 3.8 a  | 3.4 a |
| AC 303,630 1.97E    | 0.02        | 1.4   |                                                                  |       |        |        |        |        |        |       |
| + 0.5% oil emulsion |             | 64.0  | 1.7                                                              | 0.1 a | 0.1 a  | 0.5 a  | 1.1 a  | 4.2 bc | 5.3 a  | 3.5 a |
| Avermectin          | 0.15%E      | 1.0   | 2.2                                                              | 0.1 a | 0.3 ab | 1.1 ab | 0.9 a  | 2.8 ab | 4.3 a  | 4.9 a |
| Control             | —           | —     | 2.6                                                              | 2.6 b | 3.2 b  | 12.4 b | 13.4 b | 11.4 d | 14.4 b | 8.4 b |
|                     |             |       | NS                                                               |       |        |        |        |        |        |       |

<sup>z</sup>Means within columns separated by Duncan’s Multiple Range Test, 5% level. NS = no significance.

## Results

1989 Test. Both aqueous and oil emulsion sprays of AC303,6300 1.97E at 0.02 lb. AI and a 0.03 aqueous spray were equivalent to the standard Avermectin on every occasion and were always superior to control in suppressing mite population development. Control with the 0.20 lb. AI rate was not improved with addition of oil (Table 1). 1990 Test. Both rates of AC303,630 as aqueous sprays (0.1 and 0.2 lb. AI) and the low rate in an oil emulsion spray were similar in ability to suppress mite populations below that found in untreated control throughout the 77-day test period and was equal to the standard Vendex (Table 2). 1991 Test. All rates (0.025, 0.05, 0.1 and 0.2 lb. AI) AC303,630 2SC in aqueous and oil emulsion formulations performed well through 56 days post-treatment in controlling mite population which increased during the test period. AC303,630 at 0.1 and 0.2 lb. AI aqueous and 0.1 lb. AI oil emulsion and the standard Vendex continued to perform in a superior manner through 63 days post-treatment (Table 3). 1992 Test. AC303,630 3SC alone at 0.125 lb. AI aqueous spray and at 0.09, 0.125 and 0.17 lb. AI in oil emulsion sprays were equal to Vendex through 56 days post-treatment. The aqueous spray failed on the 63<sup>rd</sup> day and the natural population crashed thereafter. The 0.09 lb. AI oil emulsion was equal to the 0.125 lb. AI rate aqueous spray overall dates. Higher rates of AC303,630 3SC in oil did not improve efficacy of the sprays (Table 4). 1992 Test. AC303,630 3SC at 0.125 alone and in tank mixes with nutritional, copper, oil and Lorsban were equal to Vendex and provided significant control of rust mite for 56 days. Tank mixes with copper, nutritional, and Lorsban

commenced to weaken by the 63<sup>rd</sup> day and the natural population crashed thereafter (Table 5). 1993 Test. A late June application of AC303,630 2SC was effective in suppression of citrus rust mite populations for 70 days at 0.2 lb. AI in 3 spray volumes (100, 250 and 500 GPA). Its performance was statistically equal to Agrimek and significantly superior to untreated control throughout the test period (Table 6). 1994 Test. A late June application of Alert 2SC at 4 rates (0.1, 0.15, 0.2 and 0.3 lb. AI) in oil emulsion sprays was effective for 84 days in controlling a rising mite population. Performance of all rates was equal to Agrimek except 0.1 AI + 0.5 oil at 70 and 77 days (Table 7). 1995 Test. All AC303,630 2SC treatments (0.15, 0.2 and 0.3 lb. AI) as oil emulsion sprays were equal to each other and Agrimek in performance through 56 days. The 0.3 lb. AI rate continued to equal Agrimek in efficacy through 77 days (Table 8). 1996 Test. Both 0.1 and 0.3 lb. AI rates of Alert 2SC were equivalent in performance to Agrimek through 49 days and the high rate continued an additional week in the presence of a crashing mite population (Table 9). Additional data (not presented here) indicate that residues from a foliar spray containing 0.6 lb. AI/100 gallons of water provided 94% kill of *Diaprepes* adults at the end of 1 week. Sprays containing 0.15 lb. AI resulted in significantly fewer live citrus leafminer larvae than were found in untreated leaves after 4 days, and significantly fewer 6-spot mites and citrus red mites were found on treated foliage compared to untreated foliage at 21 days post-treatment.

## Discussion

Alert compared favorably with both Agrimek and Vendex, at least equaling the performance of the 2 stan-

dards in all 9 tests. Although the addition of oil extended

Table 2. Efficacy of American Cyanamid candidate miticide AC 303,630 12% EC vs. citrus rust mite on 'Hamlin' orange trees at Ft. Pierce, FL—1990.

|                   | Amount per         |       | Mean mite population per lensfield                               |       |       |        |        |       |       |       |     |
|-------------------|--------------------|-------|------------------------------------------------------------------|-------|-------|--------|--------|-------|-------|-------|-----|
|                   | 100 gallons        |       | at indicated days before and after spraying 6 July: <sup>z</sup> |       |       |        |        |       |       |       |     |
|                   | 1b AI              | fl oz | -8                                                               | +7    | +14   | +21    | +28    | +35   | +42   | +49   | +63 |
| AC 303,630 12%EC  | 0.1                | 12    | 17.4                                                             | 0.3 a | 0 a   | 0.1 a  | 0.5 a  | 0.1 a | 0.4 a | 0.1 a | 3.5 |
| AC 303, 630 12%EC | 0.2                | 24    | 14.9                                                             | 0.1 a | 0 a   | 0 a    | 0.1 a  | 0.1 a | 0 a   | 0.1 a | 1.1 |
| AC 303,630 12%EC  | 0.1                | 12    |                                                                  |       |       |        |        |       |       |       |     |
|                   | +0.5% oil emulsion | 64    | 22.5                                                             | 1.3 a | 0 a   | 0.1 a  | 0.2 s  | 0.1 a | 0.1 a | 0.3 a | 1.1 |
| Vendex 4L         |                    | 6.4   | 20.6                                                             | 0.3 a | 0.1 a | 0.1 a  | 0.1 a  | 0 a   | 0.1 a | 0.3 a | 1.1 |
| Control           | —                  | —     | 14.1                                                             | 34.8b | 39 b  | 24.7 b | 15.9 b | 5.2 b | 3.8 b | 3.5 b | 2.9 |
|                   |                    |       | NS                                                               |       |       |        |        |       |       |       | NS  |

<sup>z</sup>Means within columns separated by Duncan's Multiple Range Test, 5% level. NS = no significance.

Table 3. Efficacy of American Cyanamid candidate miticide AC 300,630 2SC vs. citrus rust mite on 'Hamlin' orange trees at Ft. Pierce, FL.—1991.

|                    | Amount per  |       | Mean mite population per lensfield                                |       |       |        |        |        |        |        |        |          |
|--------------------|-------------|-------|-------------------------------------------------------------------|-------|-------|--------|--------|--------|--------|--------|--------|----------|
|                    | 100 gallons |       | at indicated days before and after spraying 10 June: <sup>z</sup> |       |       |        |        |        |        |        |        |          |
|                    | 1b AI       | fl oz | -6                                                                | +7    | +14   | +21    | +28    | +35    | +42    | +49    | +56    | +63      |
| AC 303, 630 2SC    | 0.05        | 3     | 2.7                                                               | 0 a   | 0.1 a | 0.2 a  | 0.4 a  | 1.5 a  | 5.2 a  | 5.3 ab | 7.6 ab | 10.9 bcd |
| AC 303,630 2SC     | 0.1         | 6     | 3.1                                                               | 0 a   | 0 a   | 0.1 a  | 0.1 a  | 0.2 a  | 2.8 a  | 1.9 a  | 2.6 a  | 5.2 abc  |
| AC 303,630 2SC     | 0.2         | 12    | 3.1                                                               | 0 a   | 0 a   | 0.1 a  | 0.1 a  | 0.3 a  | 0.15 a | 0.5 a  | 0.9 a  | 0.4 a    |
| AC 303,630 2SC     | 0.025       | 1.5   |                                                                   |       |       |        |        |        |        |        |        |          |
| +0.5% oil emulsion |             | 64    | 8.2                                                               | 0.4 a | 0.4 a | 0.1 a  | 1.2 a  | 0.6 a  | 3.5 a  | 2.4 a  | 5.1 ab | 10.8 bcd |
| AC 303,630 2SC     | 0.05        | 3     |                                                                   |       |       |        |        |        |        |        |        |          |
| +0.5% oil emulsion |             | 64    | 6.3                                                               | 0.5 a | 0.3 a | 0.6 a  | 0.5 a  | 0.7 a  | 3.0 a  | 3.1 ab | 5.8 ab | 6.4 abcd |
| AC 303,630 2SC     | 0.1         | 6     | 7.2                                                               | 0 a   | 0.1 a | 0.1 a  | 0.1 a  | 0.1 a  | 0.7 a  | 1.1 a  | 1.1 a  | 0.6 ab   |
| +0.5 oil emulsion  |             | 64    | 6.3                                                               | 0.5 a | 0.3 a | 0.6 a  | 0.5 a  | 0.7 a  | 3.0a   | 3.1 ab | 5.8 ab | 6.4 abcd |
| Vendex 4L          |             | 4     | 6.4                                                               | 0 a   | 0.1 a | 0.6 a  | 0.3 a  | 0.5 a  | 1.3 a  | 1.8a   | 1.6 a  | 4.9 abc  |
| Control            | —           | —     | 2.2                                                               | 11.3  | 7.9 b | 14.8 b | 16.1 b | 27.4 b | 28.6 b | 32.4 c | 25.9 c | 15.9 d   |
|                    |             |       | NS                                                                |       |       |        |        |        |        |        |        |          |

<sup>z</sup>Means within columns separated by Duncan's Multiple Range Test, 5% level. NS= no significance.

Table 4. Efficacy of American Cyanamid candidate miticide AC303,630 oil emulsion sprays vs. citrus rust mite on 'Valencia' orange trees at Ft. Pierce, FL.—1992.

|                     | Amount per  |       | Mean mite population per lensfield                                |        |       |        |        |        |       |       |        |      |
|---------------------|-------------|-------|-------------------------------------------------------------------|--------|-------|--------|--------|--------|-------|-------|--------|------|
|                     | 150 gallons |       | at indicated days before and after spraying 15 June: <sup>z</sup> |        |       |        |        |        |       |       |        |      |
|                     | 1b AI       | fl oz | -1                                                                | +7     | +14   | +21    | +28    | +35    | +42   | +49   | +56    | +63  |
| AC 303,630 3SC      | 0.125       | 5     | 6.9                                                               | 0.1 a  | 0.1 a | 0.1 a  | 0.1 a  | 0.2 a  | 0.3 a | 0.5 a | 3.4 a  | 11.7 |
| AC 303,630 3SC      | 0.09        | 3.6   | 6.3                                                               | 0.2 a  | 0.1 a | 0.1 a  | 0.4 a  | 0.4 a  | 0.2 a | 0.2 a | 1.8 a  | 5.1  |
| + 0.5% oil emulsion |             | 64    |                                                                   |        |       |        |        |        |       |       |        |      |
| AC 300,630 3SC      | 0.125       | 5     | 6.8                                                               | 0.1 a  | 0.1 a | 0.1 a  | 0.1 a  | 0.2 a  | 0.3 a | 1.5 a | 0.7 a  | 1.1  |
| + 0.5% oil emulsion |             | 64    |                                                                   |        |       |        |        |        |       |       |        |      |
| AC 300,630 3SC      | 0.17        | 7     | 1.8                                                               | 0.1 a  | 0.4 a | 0.1 a  | 0.1 a  | 0.1 a  | 1.3 a | 0.5 a | 0.4 a  | 0.6  |
| +0.5% oil emulsion  |             | 64    |                                                                   |        |       |        |        |        |       |       |        |      |
| Vendex 4L           |             | 3     | 7.0                                                               | 0.4 a  | 0.3 a | 0.1 a  | 0.3 a  | 0.1 a  | 0.3 a | 0.7 a | 0.3 a  | 0.8  |
| Control             |             |       | 5.4                                                               | 11.6 b | 10.0b | 17.8 b | 25.0 b | 35.8 b | 37.6b | 38.8b | 25.9 b | 10.2 |
|                     |             |       | NS                                                                |        |       |        |        |        |       |       |        | N/S  |

<sup>z</sup>Means within columns separated by Duncan's Multiple Range Test, 5% level. NS = No significance.

Table 5. Efficacy of American Cyanamid candidate miticide AC 300,630 3SC in tank mixes vs. citrus rust mite on ‘Valencia’ orange trees at Ft. Pierce, FL.—1992.

|                            | Amount per 150 gallons |        | Mean mite population per lensfield at indicated days before and after spraying 15 June: <sup>z</sup> |       |        |        |        |        |        |        |        |      |
|----------------------------|------------------------|--------|------------------------------------------------------------------------------------------------------|-------|--------|--------|--------|--------|--------|--------|--------|------|
|                            | 1b AI                  | fl oz  | -1                                                                                                   | +7    | +14    | +21    | +28    | +35    | +42    | +49    | +56    | +63  |
| AC 303,630 3SC             | 0.125                  | 5      | 9.7                                                                                                  | 0.1 a | 0.1 a  | 0.7 a  | 0.2 a  | 0.2 a  | 0.3 a  | 0.5 a  | 4.8 a  | 5.8  |
| AC303,630 3SC              | 0.125                  | 5      |                                                                                                      |       |        |        |        |        |        |        |        |      |
| + 53% tribasic copper      |                        | 0.8 lb | 7.9                                                                                                  | 0.1 a | 0.1 a  | 0.2 a  | 0.2 a  | 1.5 a  | 0.9 a  | 3.2 a  | 6.0 a  | 14.9 |
| AC 303,6340 3SC            | 0.125                  | 5      |                                                                                                      |       |        |        |        |        |        |        |        |      |
| + nutritional <sup>y</sup> |                        |        | 7.2                                                                                                  | 0 a   | 0.1 a  | 0.2 a  | 0.1 a  | 0.2 a  | 0.5 a  | 5.5 a  | 10.2 a | 11.2 |
| AC 303,630 3SC             | 0.125                  | 5      |                                                                                                      |       |        |        |        |        |        |        |        |      |
| +Lorsban 4L                |                        | 1 pt   | 5.7                                                                                                  | 0 a   | 0.1 a  | 0.2 a  | 0.4 a  | 0.5 a  | 1.1 a  | 1.7 a  | 8.3 a  | 7.7  |
| AC 303,630 3SC             | 0.125                  | 5      |                                                                                                      |       |        |        |        |        |        |        |        |      |
| + 0.5% oil emulsion        |                        | 64     | 0.8 a                                                                                                | 6.5   | 0 a    | 0.1 a  | 0.2 a  | 0.1 a  | 0.1 a  | 0.1 a  | 1.0 a  | 1.3  |
| Vendex 4L                  |                        | 8      | 7.1                                                                                                  | 0 a   | 0.1 a  | 0.4 a  | 0.3 a  | 0.1 a  | 0.3 a  | 0.7 a  | 2.1 a  | 1.3  |
| Control                    | —                      | —      | 8.1                                                                                                  | 9.9 b | 15.7 b | 21.1 b | 17.0 b | 32.0 b | 40.8 b | 37.1 b | 32.6 b | 7.1  |
|                            |                        |        | NS                                                                                                   |       |        |        |        |        |        |        |        | NS   |

<sup>z</sup>Means within columns separated by Duncan’s Multiple Range Test, 5% level. NS = no significance.

<sup>y</sup>1.6 lbs 50% copper, 1.5 lbs AG zinc, 1.25 lbs Techmangam.

effectiveness of Alert an extra week on several occasions, the differences were not significant. Nor did tribasic copper or Lorsban significantly alter its performance. Alert’s compatibility with several tank mix partners en-

Table 6. Efficacy of American Cyanimid candidate miticide AC303,630 2SC in 3 different volumes of water per acre vs. citrus rust mite on ‘Valencia’ orange trees at Ft. Pierce, FL—1993.

|                     | Amount per 250 GPA |        | Mean mite population per lensfield at indicated days before and after spraying 15 June: <sup>z</sup> |       |       |       |       |        |        |       |        |        |        |
|---------------------|--------------------|--------|------------------------------------------------------------------------------------------------------|-------|-------|-------|-------|--------|--------|-------|--------|--------|--------|
|                     | 1b AI              | fl oz  | -2                                                                                                   | +7    | +14   | +21   | +28   | +35    | +42    | +49   | +56    | +63    | +70    |
| AC 303,630 2SC      | 0.2                | 13     | 1.4                                                                                                  | 0.1 a | 0.1 a | 0.1 a | 0.1 a | 0.6 a  | 0.2 a  | 0.4 a | 0.6    | 2.6 a  | 4.5 a  |
| AC 303,630 2SC      | 0.6                | 36     | 2.0                                                                                                  | 0.1 a | 0.1 a | 0 a   | 0 a   | 0.1 a  | 0.1 a  | 0.2 a | 0.8 a  | 1.3 a  | 1.5 a  |
|                     | Amt./100 GPA       |        |                                                                                                      |       |       |       |       |        |        |       |        |        |        |
| AC 303,630 2SC      | 0.2                | 13     | 2.7                                                                                                  | 0.1 a | 0.1 a | 0.1 a | 0.1 a | 0.1 a  | 0.4 a  | 0.7 a | 1.3 a  | 2.8 a  | 6.3 a  |
|                     | Amt./500 GPA       |        |                                                                                                      |       |       |       |       |        |        |       |        |        |        |
| AC 303,630          | 0.2                | 13     | 2.2                                                                                                  | 0.5 a | 0 a   | 0.1 a | 0.2 a | 0.1 a  | 0.1 a  | 0.3 a | 0.9 a  | 3.4 a  | 2.8 a  |
|                     | Amt./250 GPA       |        |                                                                                                      |       |       |       |       |        |        |       |        |        |        |
| Agrimek 0.15EC      |                    | 4      |                                                                                                      |       |       |       |       |        |        |       |        |        |        |
| +0.25% oil emulsion |                    | 2.5 qt | 0.9                                                                                                  | 0.2 a | 0.1 a | 0.1 a | 0.1 a | 0.3 a  | 0.1 a  | 0.1 a | 0.7 a  | 1.2 a  | 1.6 a  |
| Control             |                    | —      | 1.3                                                                                                  | 4.1 b | 4.4 b | 5.1 b | 6.6 b | 13.9 b | 10.5 b | 7.0 b | 29.4 b | 17.4 b | 16.7 b |
|                     |                    |        | NS                                                                                                   |       |       |       |       |        |        |       |        |        |        |

<sup>z</sup>Means within columns separated by Duncan’s Multiple Range Test, 5% level. NS = no significance.

Table 7. Efficacy of several rates of American Cyanamid’s Alert 2SC as oil emulsion sprays vs. citrus rust mite on ‘Valencia’ orange trees at Ft. Pierce, FL.—1994.

|                     | Amount per 250 gallons |       | Mean mite population per lensfield at indicated days before and after spraying 24 June: <sup>z</sup> |       |       |      |       |       |       |       |       |       |        |       |
|---------------------|------------------------|-------|------------------------------------------------------------------------------------------------------|-------|-------|------|-------|-------|-------|-------|-------|-------|--------|-------|
|                     | 1b AI                  | fl oz | -7                                                                                                   | +7    | +21   | +28  | +35   | +42   | +49   | +56   | +63   | +70   | +77    | +84   |
| Alert 2SC           | 0.1                    | 6.4   |                                                                                                      |       |       |      |       |       |       |       |       |       |        |       |
| + 0.5% oil emulsion |                        | 84    | 0.2                                                                                                  | 0.1a  | 0.1 a | 0.1a | 0.1a  | 0.2 a | 0.3 a | 0.8 a | 3.0 a | 4.8 b | 9.6 b  | 8.7 a |
| Alert 2SC           | 0.15                   | 9.6   |                                                                                                      |       |       |      |       |       |       |       |       |       |        |       |
| + 0.5% oil emulsion |                        | 84    | 0.1                                                                                                  | 0 a   | 0.1 a | 0 a  | 0.1 a | 0.1 a | 0.1 a | 0.3 a | 0.4 a | 1.4 a | 4.1 ab | 5.7 a |
| Alert 2SC           | 0.2                    | 12.8  |                                                                                                      |       |       |      |       |       |       |       |       |       |        |       |
| + 0.5% oil emulsion |                        | 84    | 1.2                                                                                                  | 0 a   | 0.1   | 0 a  | 0 a   | 0 a   | 0.1 a | 0.1 a | 0.5 a | 0.8 a | 3.1 ab | 6.4 a |
| Alert 2SC           | 0.3                    | 19.2  |                                                                                                      |       |       |      |       |       |       |       |       |       |        |       |
| + 0.5% oil emulsion |                        | 84    | 0.3                                                                                                  | 0.1 a | 0 a   | 0 a  | 0.1 a | 0 a   | 0.1 a | 0.1 a | 0.2 a | 0.4 a | 1.0 a  | 2.2 a |
| Agrimek 0.15%EC     |                        | 10    |                                                                                                      |       |       |      |       |       |       |       |       |       |        |       |

<sup>z</sup>Means within columns separated by Duncan’s Multiple Range Test, 5% level. NS = no significance.

Table 7. Efficacy of several rates of American Cyanamid's Alert 2SC as oil emulsion sprays vs. citrus rust mite on 'Valencia' orange trees at Ft. Pierce, FL.—1994.

|         | Amount per 250 gallons |       | Mean mite population per lensfield at indicated days before and after spraying 24 June: <sup>z</sup> |       |       |       |       |       |       |       |        |        |        |        |
|---------|------------------------|-------|------------------------------------------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|
|         | 1b AI                  | fl oz | -7                                                                                                   | +7    | +21   | +28   | +35   | +42   | +49   | +56   | +63    | +70    | +77    | +84    |
|         | +0.25% oil emulsion    | 42    | 0.2                                                                                                  | 0.1 a | 0.1 a | 0 a   | 0.1 a | 0.1 a | 0.1 a | 0.1 a | 0.2 a  | 1.9 a  | 2.1 a  | 5.1 a  |
| Control |                        | —     | 0.1                                                                                                  | 0.3 b | 0.6 b | 1.1 b | 2.6 b | 4.6 b | 5.8 b | 6.9 b | 12.4 b | 20.9 b | 26.0 c | 25.0 b |
|         |                        |       | NS                                                                                                   |       |       |       |       |       |       |       |        |        |        |        |

<sup>z</sup>Means within columns separated by Duncan's Multiple Range Test, 5% level. NS = no significance.

hanced its value as a component of a multi-purpose spray

Table 8. Efficacy of AC303,630 2SC applied with an airblast sprayer vs. citrus rust mite on 'March' grapefruit and 'Pineapple' orange trees at Ft. Pierce, FL.—1995.

|                      | Amount per 250 GPA |       | Mean mite population per lensfield at indicated days before and after spraying 15 June: <sup>z</sup> |     |     |       |       |       |        |        |       |         |        |
|----------------------|--------------------|-------|------------------------------------------------------------------------------------------------------|-----|-----|-------|-------|-------|--------|--------|-------|---------|--------|
|                      | 1b AI              | fl oz | -2                                                                                                   | +7  | +14 | +21   | +28   | +35   | +42    | +49    | +56   | +63     | +77    |
| AC 303,630 2SC       | 0.15               | 9.6   |                                                                                                      |     |     |       |       |       |        |        |       |         |        |
| + 0.5 oil emulsion   |                    | 84    | 2.0                                                                                                  | 0.1 | 0.1 | 0.1a  | 0.7 a | 0.4 a | 2.4 ab | 1.9 ab | 1.3 a | 4.3 abc | 9.3 c  |
| AC 303,630 2SC       | 0.20               | 12.8  |                                                                                                      |     |     |       |       |       |        |        |       |         |        |
| + 0.5 oil emulsion   |                    | 84    | 2.6                                                                                                  | 0.4 | 0.4 | 0 a   | 0.2 a | 0.3 a | 1.4 a  | 1.2 ab | 0.9 a | 5.7 bc  | 13.2 c |
| AC 303,630 2SC       | 0.30               | 19.2  |                                                                                                      |     |     |       |       |       |        |        |       |         |        |
| + 0.5 oil emulsion   |                    | 84    | 1.8                                                                                                  | 0   | 0.1 | 0.1 a | 0.1 a | 0.1 a | 0.7 a  | 0.1 a  | 0.1 a | 0.9 a   | 2.9 ab |
| Agrimek 0.15%EC      |                    | 10    |                                                                                                      |     |     |       |       |       |        |        |       |         |        |
| + 0.25% oil emulsion |                    | 42    | 1.8                                                                                                  | 0.1 | 0.3 | 0.1 a | 0.2 a | 0.4 a | 0.4 a  | 0.2 a  | 0.6 a | 2.2 ab  | 2.7 ab |
| Agrimek 0.15EC       |                    | 5     |                                                                                                      |     |     |       |       |       |        |        |       |         |        |
| + 0.25% oil emulsion |                    | 42    | 1.8                                                                                                  | 0.1 | 0.1 | 0.1 a | 0.3 a | 0.4 a | 0.8 a  | 0.9 ab | 1.0 a | 1.4 a   | 2.4 a  |
| Control              |                    | —     | 2.1                                                                                                  | 0.4 | 1.2 | 1.3 b | 2.1 b | 1.4 b | 4.6 b  | 3.1 b  | 4.2 b | 7.6 c   | 8.2 bc |
|                      |                    |       | NS                                                                                                   | NS  | NS  |       |       |       |        |        |       |         |        |

<sup>z</sup>Means within columns separated by Duncan's Multiple Range Test, 5% level. NS = no significance.

directed at disease control and nutritional supplementation. The same rates were tested on both oranges and grapefruit and Alert was not phytotoxic at any rate or tank mix.

The development of novel insecticide classes with new biochemical mechanisms may help to overcome any resistance problems resulting from overuse of a single insecticide. The chemistry of Alert and its performance

Table 9. Efficacy of Alert 2SC vs. citrus rust mite on 'Valencia' orange trees at Ft. Pierce, FL.—1996.

|                      | Amount per 200 gallons |       | Mean mite population per lensfield at indicated days before and after spraying 25 June: <sup>z</sup> |     |     |       |        |        |        |        |       |
|----------------------|------------------------|-------|------------------------------------------------------------------------------------------------------|-----|-----|-------|--------|--------|--------|--------|-------|
|                      | 1b AI                  | fl oz | -6                                                                                                   | +7  | +14 | +21   | +28    | +35    | +42    | +49    | +56   |
| Alert 2SC            | 0.1                    | 6.4   | 0.8                                                                                                  | 0.1 | 0.2 | 0.1 a | 0.4 a  | 0.9 a  | 1.6 a  | 4.9 a  | 4.6 b |
| Alert 2SC            | 0.3                    | 19.2  | 0.3                                                                                                  | 0.1 | 0   | 0 a   | 0.1 a  | 0.3 a  | 0.3 a  | 0.6 a  | 1.2 a |
| Agrimek 0.15%EC      |                        | 10    |                                                                                                      |     |     |       |        |        |        |        |       |
| + 0.25% oil emulsion |                        | 42    | 1.1                                                                                                  |     | 0   | 0.1 a | 0.1 a  | 0.1 a  | 0.4 a  | 0.4 a  | 0.6 a |
| Control              |                        | —     | 1.6                                                                                                  | 1.1 | 1.7 | 6.0 b | 18.6 b | 17.3 b | 25.0 b | 16.1 b | 6.0 b |
|                      |                        |       | NS                                                                                                   | NS  | NS  |       |        |        |        |        |       |

<sup>z</sup>Means within columns separated by Duncan's Multiple Range Test, 5% level. NS = no significance.

qualifies it as representative of this philosophy and would provide an additional choice for the Florida citrus grower in a rust mite management program that featured a policy of rotating miticide classes.

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### Literature Cited

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