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# Control of Tomato Irregular Ripening with Imidacloprid

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***Abstract.*** **The utilization of imidacloprid in controlling silverleaf whitefly (SLWF) (*Bemisia argentifolii* Bellows and Perrin) and its associated disorder tomato (*Lycopersicon esculentum* Mill.) irregular ripening (TIR) was investigated under field conditions. Tomato seedlings were transplanted into the field and drenched with 0.0, 14.5, 24.0, or 43.5 mg a.i./plant of imidacloprid during Fall 1995 and Spring 1996. Adult SLWF populations were reduced in plots drenched with imidacloprid as compared with the untreated control plots during both growing seasons. In the fall, the low, medium, and high rates of imidacloprid reduced the percentage of tomato fruit with external tomato irregular ripening symptoms from 33.4 in the untreated control to 1.4, 0.3, and 0.7, respectively. The percentage of fruit with internal symptoms was reduced from 83.8 in the untreated control plot to 14.2, 4.0, and 6.1 for the low, medium, and high rates of imidacloprid, respectively. In the spring experiment, the incidence of external TIR symptoms in all plots was minimal (<1%), but the higher rates of imidacloprid reduced the incidence of internal symptoms relative to the untreated control. Chemical name used: 1-[(6-chloro-3-pyridinyl) methyl]-*N*-nitro-2-imidazolidinimine (imidacloprid).**

Tomato irregular ripening (TIR) is a disorder associated with feeding of the silverleaf whitefly (SLWF) (Maynard and Cantliffe, 1989). The symptoms consist of either green, white, or pink streaks or blotches on the exterior and/or white or yellow discoloration of the fruit pericarp. The external symptoms may disappear as the fruit matures from pink to fully red (Powell and Stoffella, 1995). The internal pericarp symptoms do not dissipate upon ripening (Powell et al., in press). Both the external and internal symptoms make the fruit less desirable for fresh market.

Control of TIR has focused on reducing the incidence of feeding by the SLWF. One insecticide, hexachlorohexahydromethano-2, 4, 3-benzodioxathiepin 3-oxide (endosulfan), reportedly reduced TIR incidence from 52% to 22% (Powell and Stoffella, 1993). Recently, Polston et al. (1995) reported that imidacloprid reduced SLWF populations in tomatoes to very low levels and that this reduced infection and losses due to tomato mottle geminivirus. These results led us to evaluate imidacloprid for reducing TIR incidence in field-grown tomatoes.

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## Materials and Methods

Five-week-old 'Sunny' tomato seedlings were transplanted on 20 Sept. 1995 and 27 Mar. 1996 (fall and spring, respectively) at the Indian River Research and Education Center, Fort Pierce, Fla. Soil-type classification, bed preparation, disease control, and fertilization practices were as previously described (Powell and Stoffella, 1993).

The experimental area consisted of polyethylene-covered raised beds, spaced 2.1 m apart (center to center). Seedlings were spaced 61 cm apart with a population equivalent of 7689 plants/ha.

Treatments consisted of a single application of imidacloprid at 0.0, 14.5, 29.0, or 43.5 mg a.i./plant, applied as a root drench (118 mL/plant) 2 d after transplanting. Individual plots consisted of 12 consecutive plants in a row with each plot separated by eight within-row border plants. A randomized complete block experimental design was used, with each treatment replicated four times. No additional insecticides were applied to the experimental area. Adult SLWF populations were monitored weekly using 7.5 × 7.5-cm yellow, sticky boards (Great Lakes IPM, Vestaburg, Mich.) (Powell and Stoffella, 1993) that were attached to stakes and placed in the center of each plot. Each sticky board was placed between plants at a height of ≈60 cm.

Tomato fruit were harvested on 26 Dec. 1995 and 2 and 9 Jan. 1996 for the fall experiment and on 3, 10, and 17 June 1996 for the spring experiment. Fruit in the pink to red-ripe stage were harvested from the center eight plants of each plot and graded into marketable and cull fruit (those with insect and/or pathogen damage). Tomato irregular ripening symptoms were not considered when assigning marketable grade. During each harvest the marketable fruit were counted, weighed, sized, evaluated for external TIR symptoms, cut in half equatorially, and evaluated for internal TIR symptoms. A fruit was considered positive for external TIR if it contained at least one longitudinal yellow or white streak, and positive for internal TIR if at least half of the internal tissue was clearly white when compared with nonaffected fruit. Fruit with external or internal TIR symptoms were expressed as a percentage of the total fruit harvested. The data (percentage of the total fruit harvested with external or internal TIR symptoms) were combined for the three fall harvests and the three spring harvests and subjected to analysis of variance. Treatment means were separated by Duncan's multiple range test (5% level) for each experiment.

## Results and Discussion

*Fall 1995 experiment.* Imidacloprid reduced SLWF populations (Fig. 1A), especially during the 52-day period after transplanting, and reduced external and internal TIR symptoms (Table 1) relative to the untreated plots. Marketable fruit yields were ($t \cdot ha^{-1}$) 37.603, 42.014, 39.591, and 36.378 and mean fruit size (g/fruit) was 161, 154, 159, and 152 for plots treated with 0.0, 14.5, 29.0, or 43.5 mg imidacloprid/plant, respectively; no differences were significant at $P \leq 0.05$.

*Spring 1996 experiment.* Imidacloprid again reduced SLWF populations (Fig. 1B). Medium and high rates of imidacloprid reduced the percentage of internal TIR relative to untreated controls (Table 1). External symptoms were minimal (<1%) in this experiment, and differences among treatments were nonsignificant at $P \leq 0.05$. Marketable fruit yields ($t \cdot ha^{-1}$) were 11.545, 8.795, 11.218, and 10.646, and mean fruit size (g/fruit) was 124, 122, 120, and 118 for plots treated with 0.0, 14.5, 29.0, or 43.5 mg imidacloprid/plant, respectively, and treatment differences were again not significant.

The reduction in TIR by a single drench application of imidacloprid was much greater in the fall than in the spring experiment. In the fall, the incidence of TIR in tomatoes from untreated plots was higher than typically observed, while in the spring experiment TIR was lower than that normally observed (Powell and Stoffella, 1993; Powell and Stoffella, 1995). This correlated with observed SLWF populations. In the fall experiment, SLWF populations were higher and population increase in the control plots occurred earlier. The SLWF populations in Spring 1995 were lower than observed in other years (Powell and Stoffella, 1993). The data indicate that a single application of imidacloprid can reduce and maintain SLWF populations at a level that is low enough to reduce TIR incidence in field-grown tomatoes. Thus, control practices being used by most growers in Florida not only protect the tomato crop from whitefly-transmitted viruses, but also increase fruit quality by reducing TIR.

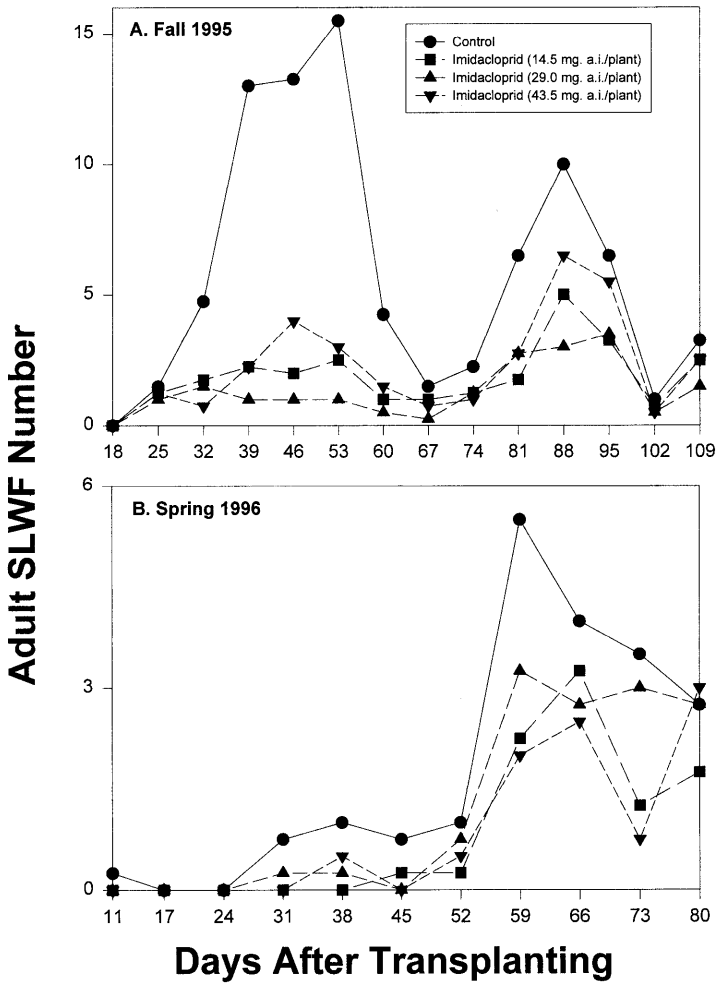


Fig. 1. Adult silverleaf whitefly trapped on yellow sticky boards in tomato plots treated with imidacloprid during Fall 1995 (A) and Spring 1996 (B).

Table 1. Effects of imidacloprid drench application on tomato irregular ripening.

| Rate (mg a.i./plant) | Tomato irregular ripening (%) Fall 1995 External | Fall 1995 Internal | Tomato irregular ripening (%) Spring 1996 External | Spring 1996 Internal |
|---|---|---|---|---|
| 0.0 | 33.4 a[z] | 83.8 a | 0.0 | 19.8 a |
| 14.5 | 1.4 b | 14.2 b | 0.4 | 12.8 ab |
| 29.0 | 0.3 b | 4.0 b | 0.0 | 6.8 b |
| 43.5 | 0.7 b | 6.1 b | 0.3 | 0.8 b |

[z]Mean separation within columns by Duncan's multiple range test at $P \leq 0.05$.

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