

EFFECT OF TOMATO CULTIVARS ON INSECT DAMAGE
AND CHEMICAL CONTROL¹

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ABSTRACT

'Pennorange E160A' and 'Pearson' tomatoes had fewer fruit damaged by *Keiferia lycopersicella* (Wals.), the tomato pinworm, and armyworms, primarily *Spodoptera eridania* (Cramer), the southern armyworm, in 2 tests than on 'Walter.' When measured by the number of damaged fruit, the degree of control of the tomato pinworm and southern armyworm with Dipel WP® and chlordimeform was significantly affected by tomato cultivar. The number of *Liriomyza sativae* Blanchard leafmines/10 trifoliates (3 terminal leaflets) was significantly less on UF-763292 (a pubescent mutant breeding line), 'Earliana,' 'Pennorange E160A' (a cherry tomato), 'Pearson,' and 'Pritchard' tomato cultivars in 2 tests. Despite significantly more insect damage, 'Walter' yielded more than other cultivars, primarily because of less loss from graywall. No large fruited cultivar offered much potential as a replacement for 'Walter' in areas where populations of tomato pinworm, armyworms, and leafminers occur annually. 'Pennorange E160A' may offer an alternative for home garden use and large, fresh market tomatoes in areas where insects are damaging in most seasons. The multiple resistance of 'Pennorange E160A' and 'Pearson' to the tomato pinworm, armyworms and the vegetable leafminer may be of benefit in a breeding program.

Since about 1972 the tomato pinworm, *Keiferia lycopersicella* (Walsingham), has been very damaging to tomatoes in Florida. Poe et al. (1976) indicated that 5 indeterminate tomato cultivars were more heavily infested with tomato pinworm larvae than 5 determinate cultivars.

The vegetable leafminer, *Liriomyza sativae* Blanchard, is considered an important pest of tomatoes, *Lycopersicon esculentum* Mill, but reports of its damaging effects on yield have not been consistent (Wolfenbarger and Wolfenbarger 1966, Levins et al. 1975, Schuster et al. 1977). Tomato cultivars (Webb and Smith 1969, Wolfenbarger 1966), breeding material, and *Lycopersicon* spp. (Kelsheimer 1963, Webb et al. 1971) have exhibited differences in leafminer damage to foliage.

The purpose of this investigation was to evaluate the effect of tomato cultivars on damage and control of the tomato pinworm, armyworms, primarily *Spodoptera eridania* (Cramer), and the southern green stink bug, *Nezara viridula* (L.), on fruit, and of the vegetable leafminer on foliage.

MATERIALS AND METHODS

Two experiments (Tests 1 and 2) were conducted from 2 September to 30 December, 1975, and 1 (Test 3) from 9 February to 3 June, 1976, at the Agricultural Research and Education Center, Bradenton, Florida.

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Plants were staked and grown on 6-8 in. high x 30-34 in. wide beds of Myakka fine sand. The soil was fumigated (broadcast basis) with either 350 lb/acre of Dowfume MC-33® (Tests 1 and 2) or 5 gal/acre of Dowfume W-85® (Test 3). Chlordane 1.5% + toxaphene 2.0% was applied at 30 lb product/acre in a 12 in. band in the planting row to control mole crickets and cutworms. Beds were covered with either tan polyethylene coated paper mulch (Tests 1 and 2) or black polyethylene plastic (Test 3). Each plot had 7 (Test 1) or 10 (Tests 2 and 3) transplants 10-12 in. apart in single rows spaced 4.5 ft. Each test consisted of 4 replicates of each cultivar in a randomized complete block design with 'Walter' used as a check in all tests. In Tests 1 and 2 the cultivars 'Bonny Best,' 'Earliana,' 'Floralou,' 'Homestead 24,' 'Homestead 61,' 'Indian River,' 'Manalucie,' 'Marglobe,' 'Pearson,' 'Pritchard,' 'Supermarket,' 'Purdue Crimson,' and 'Tropi-Red' were old cultivars included because they had shown differences in tomato pinworm damage in preliminary field and greenhouse trials. UF-71057 was included to evaluate insect damage to a breeding line which may be released for machine harvest. UF-763292 is a pubescent mutant which had exhibited leafminer resistance. 'Tiny Tim,' 'Pennorange E160A,' and 'Watanabes' had shown resistance to the tomato fruitworm, *Heliothis zea* (Boddie) (Fery and Cuthbert 1974). 'Florida MH-1,' 'Floramerica,' and 'Flora-Dade' are new or recent cultivars. Entries included in Test 3 were selected from among the entries in Tests 1 and 2. Plants received weekly (Tests 1 and 2) or twice weekly (Test 3) alternating applications of Manzate 200® and Bravo 6F®. Tests 2 and 3 were treated weekly with Dipel WP® (0.125 lb product/100 gal) and chlordimeform 4EC (0.125 lb ai/100 gal) to determine the effect of cultivar on control of the tomato pinworm and armyworms.

Leafmines were counted every other week on 10 trifoliates (3 terminal leaflets) randomly selected from lower foliage. Mature fruit were harvested either 2 (Tests 1 and 2) or 3 (Test 3) times and the number of fruit damaged by tomato pinworms, armyworms and southern green stinkbugs recorded. During the second harvest of Test 3, fruit that was damaged by insects, or cracked, misshapen, etc. (culls), or affected with graywall, a disease of unknown etiology (Jones 1969), were separated and the remaining good fruit were sized (small, medium, and large). Fruit in all lots were counted and weighed. Because yields varied among cultivars, the number of damaged fruit was converted to a percent of the total.

RESULTS AND DISCUSSION

In Test 1, no differences among either number or percent of fruit damaged by tomato pinworms were significant although values for 'Pennorange E160A' and 'Pearson' were very low (Table 1). Significantly fewer fruit of 'Tropi-Red,' 'Marglobe,' 'Pritchard,' and UF-71057 were damaged in Test 2. The percent of damaged fruit on these cultivars was also significantly lower with the exception of 'Pritchard.' 'Pennorange E160A,' 'Pearson,' and 'Tiny Tim' in Test 3 were significantly less damaged (both number and percent). The degree of control of the tomato pinworm (as indicated by the number and percent of fruit damaged) with Dipel WP® and chlordimeform was significantly affected by tomato cultivar in Tests 2 and 3. When the population level was low (Test 2), many cultivars sustained significantly less damage. When the population was high, however, (Test 3), fewer cultivars were less damaged. Only on 'Pearson' was control significantly better in both Tests 2 and 3.

TABLE 1. FRUIT OF TOMATO CULTIVARS DAMAGED BY THE TOMATO PINWORM AND ARMYWORMS IN 3 TESTS.

Cultivar	Pinworm						Armyworm*					
	No.			%**			No.			%**		
	Test 1	Test 2	Test 3	Test 1	Test 2	Test 3	Test 1	Test 2	Test 3	Test 1	Test 2	Test 3
Pearson	0.2 N.S.	0.7a-d†	17.5ab	0.3 N.S.	0.8a-d	5.2c	2.7a	7.5a	3.0ab	5.4a	8.9a	0.9c-e
Pennorange												
E160A	0.5	-	16.0a	0.5	-	1.7b	10.5a-c	-	0.0a	13.9a-c	-	0.0a
Tiny Tim	1.2	-	4.8a	0.8	-	0.4a	10.5a-c	-	3.5ab	9.8ab	-	0.3a-c
UF-763292	1.7	-	117.0h	4.6	-	32.4h	6.5ab	-	9.5cd	11.4a-c	-	2.5 ^c
Floralou	2.0	1.2a-e	-	2.1	2.7d	-	17.0a-e	25.0a-d	-	16.7a-c	26.9bc	-
Earliana	2.2	1.7b-e	64.0d-f	1.6	1.4a-d	13.8ef	27.0c-g	16.5a-c	1.5ab	20.4bc	15.7a-c	0.3a-c
Pritchard	2.2	0.2ab	47.0cd	1.7	0.3ab	7.9d	33.5d-h	13.5a-c	1.8ab	27.6c	25.0a-c	0.3a-c
Florida												
Beefsteak	2.2	-	-	1.8	-	-	16.0a-d	-	-	14.2a-c	-	-
Manalucie	2.2	0.5a-e	30.0bc	1.9	0.8a-d	10.6de	26.7b-g	9.0ab	4.8ab	16.7a-c	12.7ab	1.6d-f
Marglobe	2.5	0.0a	52.5cd	3.7	0.0a	11.4de	14.2a-d	9.0ab	3.5ab	18.5a-c	25.1a-c	0.8b-d
Homestead 61	2.7	1.5b-e	-	1.2	1.1a-d	-	32.7d-h	26.8b-d	-	17.4a-c	18.4a-c	-
Purdue												
Crimson	3.0	-	-	1.8	-	-	26.2b-g	-	-	16.3a-c	-	-
Bonny Best	3.0	0.5a-c	52.0cd	3.2	0.4a-c	11.0de	11.0a-c	14.2a-c	4.5ab	11.2a-c	11.6ab	0.9b-d
Indian River	3.2	1.0a-d	-	4.1	1.1a-d	-	14.2a-d	19.2a-c	-	11.8a-c	25.8a-c	-
Supermarket	3.5	2.2de	64.2d-f	1.2	1.6b-d	12.1d-f	21.5a-f	37.2d	1.5ab	13.0a-c	30.0c	0.3a-c
Walter	3.5	2.5de	54.0de	1.2	1.8b-d	10.9de	36.2e-h	19.8a-d	3.0ab	21.1bc	16.4a-c	0.6a-c
Homestead 24	3.5	3.7e	-	2.5	2.1cd	-	32.7d-h	27.5cd	-	17.4a-c	18.3a-c	-
Florida MH-1	3.7	-	-	1.9	-	-	43.2gh	-	-	32.2c	-	-
Watanabes	4.5	-	-	2.4	-	-	10.7a-c	-	-	5.8a	-	-
Tropi-Red	4.7	0.0a	77.2e-g	2.6	0.0a	13.6ef	47.5h	16.2a-c	11.2d	27.2c	24.5a-c	2.0ef
Floramerica	5.0	-	98.8gh	2.6	-	25.5g	40.2f-h	-	3.5ab	22.0bc	-	0.9c-e
Golden 908	5.2	-	-	4.9	-	-	12.5a-c	-	-	13.4a-c	-	-
Flora-Dade	7.5	-	-	3.5	-	-	22.5a-g	-	-	14.5a-c	-	-
UF-71057	-	0.0a	85.5fg	-	0.0a	16.6f	-	23.0a-d	5.5bc	-	17.9a-c	1.1c-e

*Primarily *Spodoptera eridania* (Cramer).**Percent of fruit damaged transformed $\arcsin \sqrt{X + 1}$ for statistical analysis.

†Means in the same column not followed by the same letter are significantly different at the 0.05 level by Duncan's Multiple Range Test.

'Tiny Tim,' 'Pennorange E160A,' 'Florida Beefsteak,' 'Marglobe,' 'Bonny Best,' 'Golden 908,' UF-763292, 'Pearson,' and 'Watanabes' had significantly fewer fruit damaged by armyworms in Test 1 (Table 1). The latter 2 cultivars also had significantly lower percentages of fruit damaged indicating a higher level of resistance. Fruit damage in Test 2 was not significantly less on any cultivar although the number and percent of damaged fruit were less on 'Pearson.' 'Pennorange E160A' had no fruit damaged in Test 3 although no significant differences occurred. Control of armyworms with Dipel WP® and chlordimeform was not significantly better on any cultivar (Tests 2 and 3).

No cultivar had significantly less fruit damaged by the southern green stinkbug in Tests 1 and 3 although damage on 'Tiny Tim' in Test 1 was very low (Table 2).

TABLE 2. FRUIT DAMAGED BY THE SOUTHERN GREEN STINKBUG IN 2 TESTS AND LEAFLET DAMAGED BY THE VEGETABLE LEAFMINER IN 3 TESTS ON TOMATO CULTIVARS.

	Stinkbug				Leafminer		
	No.		%*		Mine/10 trifoliolate**		
	Test 1	Test 3	Test 1	Test 3	Test 1	Test 2	Test 3
Tiny Tim	0.5a†	10.0a	0.3a	0.7a	57.5a	---	112.5ef
Tropi-Red	2.2a	8.5a	1.1a	1.4ab	170.5c-e	137.0a-c	120.7fg
Earliana	2.2a	7.8a	1.7a	1.7ab	124.0bc	104.2a	46.7a
Purdue Crimson	2.5a	---	4.5ab	---	179.0c-f	---	---
Bonny Best	3.7a	29.2ab	3.9ab	6.3a-c	169.0c-e	154.5a-c	92.7de
Marglobe	3.7a	9.8a	5.1a-c	2.0ab	163.5c-e	143.5a-c	104.5d-f
UF-763292	3.7a	21.5ab	6.3a-c	6.0a-c	90.2ab	---	60.7ab
Flora-Dade	4.2a	---	2.1ab	---	258.0g	---	---
Homestead 61	4.5a	---	2.3ab	---	196.5d-g	205.0c	---
Pritchard	4.5a	71.8c	3.6ab	12.1c	148.7b-d	175.5a-c	97.7de
Pearson	4.5a	17.5ab	9.4a-c	5.6a-c	138.7b-d	129.2ab	88.0cd
Florida MH-1	5.2ab	---	3.3ab	---	192.0c-g	---	---
Supermarket	5.5ab	43.8a-c	3.4ab	7.9bc	158.2c-e	131.2a-c	123.5fg
Pennorange							
E160A	6.5ab	54.2bc	8.7a-c	6.0a-c	125.5bc	---	71.7bc
Golden 908	7.7ab	---	4.9a-c	---	246.0fg	---	---
Floralou	8.0ab	---	6.9a-c	---	199.5d-g	129.5a-c	---
Indian River	8.0ab	---	10.2a-c	---	218.0e-g	171.7a-c	---
Watanabes	9.0ab	---	5.8a-c	---	136.0b-d	---	---
Homestead 24	9.2ab	---	6.3a-c	---	257.2g	184.2bc	---
Walter	9.5ab	11.2a	5.6a-c	2.3ab	226.5e-g	145.0a-c	120.2fg
Florida Beefsteak	10.2ab	---	9.3a-c	---	158.0c-e	---	---
Manalucie	16.7a-c	127.8ab	14.6c	7.5bc	196.2d-g	135.0a-c	139.7g
Floramerica	22.2c	8.8a	11.8bc	2.2ab	164.7c-e	---	91.0cd
UF-71057	---	22.2ab	---	4.6a-c	---	183.0bc	134.5g

*Percent of fruit damaged transformed $\arcsin \sqrt{x+1}$ for statistical analysis.

**Averaged over 3 (Tests 1 and 3) or 4 (Test 2) biweekly samples. A trifoliolate is 3 terminal leaflets.

†Means in the same column not followed by the same letter are significantly different at the 0.05 level by Duncan's Multiple Range Test.

In Test 1 'Tiny Tim,' 'Earliana,' 'Pennorange E160A,' 'Pritchard,' UF-763292, 'Watanabes,' and 'Pearson' had significantly fewer leafmines (Table 2). No cultivars in Test 2 had statistically fewer leafmines although counts/10 trifoliates were lowest on 'Earliana.' 'Earliana,' UF-763292, 'Pennorange E160A,' 'Pearson,' 'Floramerica,' 'Bonny Best,' and 'Pritchard' had significantly less leafminer damage in Test 3.

Only 'Floramerica,' 'Tropi-Red,' and UF-71057 in one harvest in Test 3 (Table 3) produced more large fruit than 'Walter.' However, 'Walter' had more medium sized fruit than the first 2 cultivars. Only 'Tiny Tim' and 'Manalucie' had fewer fruit discarded due to cracks, shape, etc. (culls) or incidence of graywall. 'Manalucie,' however, yielded very poorly in this test.

TABLE 3. AVERAGE GRADE (SIZE), CULLS AND INCIDENCE OF GRAYWALL OF FRUIT OF TOMATO CULTIVARS HARVESTED 26 MAY 1976 (TEST III).

Cultivar	Grade (size)* of good fruit									
	Large		Medium		Small		Culls**		Graywall	
	No.	Wt. (lb.)	No.	Wt. (lb.)	No.	Wt. (lb.)	No.	Wt. (lb.)	No.	Wt. (lb.)
Floramerica	41.7	15.7	10.0	3.8	4.7	1.1	22.0	7.5	23.2	7.5
Tropi-Red	35.2	11.9	23.2	6.0	34.2	5.1	50.7	11.1	42.5	8.2
UF-71057	32.9	12.8	30.5	7.3	18.2	3.9	14.5	4.0	47.7	10.5
Walter	26.2	9.3	27.2	6.7	25.9	4.5	17.5	5.4	18.2	4.6
Marglobe	20.7	6.8	26.7	6.4	31.9	4.9	21.0	4.5	60.0	11.2
Supermarket	14.7	4.7	34.2	8.2	49.7	7.4	37.7	8.1	61.2	10.9
Bonny Best	10.5	3.6	17.0	4.1	59.9	8.2	46.7	7.9	42.5	6.9
Pearson	7.9	3.8	7.2	4.0	7.5	1.8	7.0	2.3	30.5	8.9
Pritchard	6.0	2.0	27.7	6.1	83.4	12.2	30.5	5.8	42.2	7.0
Manalucie	5.0	2.3	1.2	0.2	0.7	0.3	4.7	1.8	17.5	5.1
Earliana	3.2	0.9	5.0	1.4	23.9	3.7	87.0	14.9	23.5	4.3
UF-763292	1.0	0.4	5.0	1.5	3.7	1.1	5.2	0.8	45.7	9.2
Pennorange										
E160A	0.0	0.0	0.0	0.0	184.2	13.2	145.2	10.3	63.0	4.4
Tiny Tim	0.0	0.0	0.0	0.0	122.5	1.7	38.2	0.4	12.7	0.3

*Commercial sizes were assigned as follows: large-combination, 6 × 5; medium-6 × 6; and small-6 × 7, 7 × 7.

**Cracked, misshapen, etc.

Compared to 'Walter,' some cultivars had less insect damage in at least 2 tests: 'Pearson' and 'Pennorange E160A' for tomato pinworm and armyworm damaged fruit; and 'Pennorange E160A,' 'Pearson,' 'Pritchard,' UF-763292 and 'Earliana' for leafmines on foliage.

'Walter,' while sustaining significant insect damage, still yielded more large fruit than other cultivars which were consistently less damaged. 'Walter' fruit also had a low incidence of graywall. On this basis none of the tested cultivars with large fruit for fresh market offers potential as an alternative for 'Walter' in areas where populations of leafminers, pin-

worms and armyworms are damaging annually. However, 'Floramerica' yielded more large fruit than 'Walter' despite yielding significantly more fruit damaged by the tomato pinworm. 'Pennorange E160A,' a cherry tomato type, may offer an alternative to large, fresh market tomatoes where insects are damaging in most seasons. Some cultivars and UF-763292 may also have a potential in a breeding program for resistance to these pests.

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