4. Pohronezny, K. L. and V. Waddill. 1978. Integrated pest management—development of an alternative approach to control of tomato pests in Florida. Univ. Fla. Ext. Plant Pathol. Rpt. No. 22.
5. Rabb, R. L. 1970. Introduction to the conference, p. 1-5. In: R. L. Rabb and F. E. Guthrie, (eds.). Concepts of pest management. N. Carolina State Univ., Raleigh.
6. Schuster, D. J. 1978. Vegetable leafminer control on tomato, 1977. Insecticide and Acaricide Tests. 3:108.
7. Schuster, D. J. 1979. Vegetable leafminer control on tomato, 1977-78. Insecticide and Acaricide Tests. 4:110.
8. Schuster, D. J., R. T. Montgomery, D. L. Gibbs, G. A. Marlowe, Jr., J. P. Jones, and A. J. Overman. 1980. The tomato pest management program in Manatee and Hillsborough Counties, 1978-1980. Proc. Fla. State Hort. Soc. 93:235-239.
9. Trumble, J. T. and N. C. Toscano. 1983. Impact of methamidophos and methomyl on populations of *Liriomyza* species (Diptera: Agromyzidae) and associated parasites in celery. Can. Ent. 115:1415-1420.
10. Trumble, J. T. 1985. Integrated pest management of *Liriomyza trifolii*: influence of avermectin, cyromazine, and methomyl on leafminer ecology in celery. Agr. Ecosystems and Env. 12:181-188.
11. Waddill, V. H. 1978. Contact toxicity of four synthetic pyrethroids and methomyl to some adult insect parasites. Fla. Ent. 61:27-30.

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INFLUENCE OF POSTHARVEST CULTURAL PRACTICES ON TOMATO PINWORM POPULATION IN SOUTHERN FLORIDA

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Abstract. **The effect of tomato (*Lycopersicon esculentum* Mill.) planting time and postharvest practices on tomato pinworm (TPW), *Keiferia lycopersicella* Walsingham, was observed in Homestead, Florida. Field plots were planted on 5 different dates (Oct., Nov., Dec., Jan., and Feb. 1980 and Jan. and Feb. 1981). The Feb. 1981 planting had 25 times more fruit damaged per plant than earlier plantings. The lowest infestation occurred in the Oct. planting. Postharvested southern Florida tomato fields fall into different categories (e.g. abandoned, mowed, disced) according to the cultural practice performed. Fields disced, mowed, or abandoned immediately after main harvest had more (83%) ($P = 0.05$) injuries/m² than fields in which these practices are performed 2-3 months after harvest. Planting time and a combination of post-harvest practices may account for a higher or lower TPW infestation.**

Tomato pinworm (TPW), *Keiferia lycopersicella,* is one of the most important pests of tomato (*Lycopersicon esculentum* (10,2,4,5). This insect feeds in the mesophyll of the leaves causing a serpentine-type mine or they tie leaves together. The larvae also bore into fruit, providing an entrance for plant pathogens which cause major damage to fruit (3). The effect of cultural practices on this pest has been discussed by Elmore and Howland (1), Swank (9), Poe et al. (6), and Price and Poe (7). These authors recommended the use of non-infested seedlings, destruction of plant debris, burning of crop residues and discing of abandoned tomato fields to reduce TPW populations. Nevertheless, the effect of planting time and post-harvest practices on survival of TPW is not entirely understood. Cultural practices are important aspects in a pest management program for TPW in southern Florida, since TPW is more serious during spring when populations build up as the crop matures or become abandoned. Reported here are investigations on the effects of planting time and cultural practices on populations of TPW.

Materials and Methods

Study 1. To determine the effect of planting time on damage to tomato fruit by TPW larvae, natural TPW infestations were studied on 5 nonstaked 'Flora-Dade' tomato plantings (30 Oct., 25 Nov. and 30 Dec. 1980 and 30 Jan. and 28 Feb. 1981) at the Agricultural Research and Education Center, University of Florida, Homestead, Florida. Each planting consisted of 4 blocks (112 plants each), direct-seeded in polyethylene-mulched raised beds spaced 1.8 m apart (ca. 45 m long) of Rockdale soil. Plants were spaced 38 cm apart in the rows. To evaluate TPW infestation build-up on each planting, 20 plants were randomly selected per week per planting. Then, TPW larval injury evaluations on plant leaves were made, from 27 Jan. through 27 May 1981. At harvest, TPW damage to fruits and leaves was evaluated on each planting by selection of fruits and leaves, 20 plants in each block. The experiment was replicated 4 times on each planting. The harvest was performed 4 months after plant germination. Average number of damaged fruits were compared between plantings. Analysis of variance and Duncan's Multiple Range Test were used to compare treatments.

Study 2. Survival of TPW in fields after the last commercial harvest was investigated in Homestead, Dade Co., Florida. The study was conducted during 1980 in 16 fall-winter planted commercial fields.

A tomato field in southern Florida can be classified after the main harvest as either 1) "U-pick" field, 2) abandoned field, or 3) disced and mowed. The "U-pick" fields refers to those plantings in which the crop is harvested directly by the consumer. Generally, the field is not sprayed with insecticides after commercial harvest. The second category corresponds to those fields which are left without any supervision for at least 1-2 months. The third category is a field which is mowed, burned, and finally disced after the main harvest. Several strategies (mowed, disced, and new crop planted) may be applied sequentially to the same fields. A total of 10 m² of area was selected in

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2 tomato fields to monitor the presence of volunteer tomato plants and TPW injuries, after main harvest or after performance of any horticultural practices. TPW injuries per m^2 corresponded to those found on plants sampled per m^2. The injuries selected for this survey were non-necrosed blotches, folded-necrosed and not necrosed leaves. It has been previously demonstrated (3) that TPW injuries with these characteristics show 72-96% larval occurrence. Necrosed blotches were not used as larval estimates. This survey was carried over 4 months, depending on the cultural activities practiced.

Study 3. During 1981 an experiment was established to determine which cultural practices increased TPW population. The experiment was done at the Agricultural Research and Education Center, in Homestead, Florida. Experimental fields were planted 30 Oct., 25 Nov. or 30 Dec. 1980. Each planting was set in raised beds and mulched with light colored plastic. Plants were spaced 38 cm apart. Each planting was split into 3 treatments (108 m^2 each). The treatments were replicated 4 times. Therefore, plots were disced (treatment 1), mowed (treatment 2), or left abandoned (treatment 3) 1 week (December planting), 5 weeks (November planting), or 9 weeks (October planting) after harvest. Three weeks after the treatments were set, the number of tomato plants and TPW injuries on 5 m^2 randomly selected were monitored on each subplot. The survey was continued for 1.5 months. Counts were done every 2 weeks. Data were subjected to a nested analysis of variance (8). Mean number of plants and number of injuries per m^2 were separated by use of Duncan Multiple Range Test.

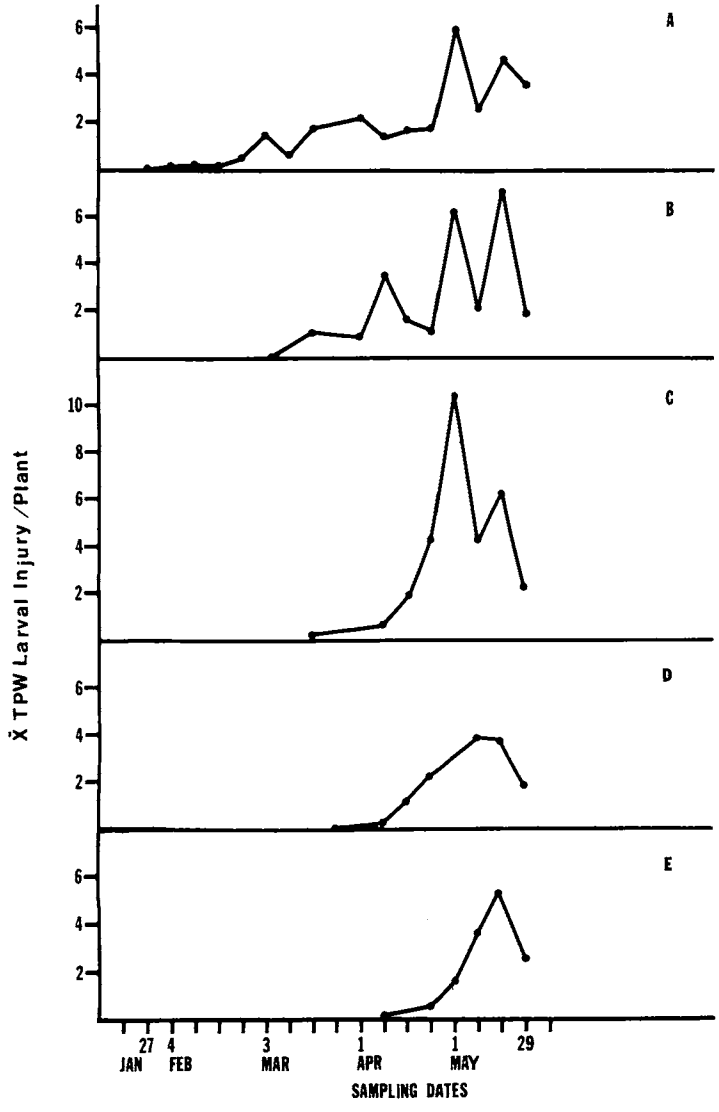

Fig. 1. Mean number of tomato pinworm (TPW) injuries per plant on 5 different tomato plantings. A = 30 Oct. 1980, B = 25 Nov. 1980, C = 30 Dec. 1980, D = 30 Jan. 1981, E = 28 Feb. 1981.

Results and Discussion

Study 1. The amount of damage depends in large part on the growth-stage of the plants as well as on the infestation level. The trend observed in Fig. 1 shows that when population increased from low levels (0.75 leaf per plant) during January-February to high levels (5-10 leaf injuries per plant) (Apr.-June), earlier plantings were already harvested (Feb.-Apr.) compared to late plantings which were in reproductive stages and support higher infestations before harvest (May-June). Therefore, at harvest, earliest plantings (Oct. 1980) had the lowest TPW fruit damage (Table 1). Significant differences in number of fruit damaged per plant were found between those crops planted during October-December and crops planted during January-February. Therefore, the amount of TPW damage in southern Florida depends on planting dates with the greatest threat to the later winter-spring planted crops. These crops had 13-17 total fruits damaged per plant. Therefore, planting time should be a viable component of an integrated control program for TPW.

Study 2. The survey demonstrated that 7 (41%) of the fields inspected during 1980 were disced and mowed immediately after harvest. From the 10 remaining fields, 7 became "U-pick" fields and 2 (17.64%) were considered abandoned. Two fields from category 1 were planted again with a summer crop (bean or squash). The other fields (5) had tomato plant emerging and regrowing during a 2-month period. Four of the 7 "U-pick" fields were disced and mowed in a 2-month period; the remaining ones (2) were abandoned. During the new fall tomato growing season, 47% of the 16 inspected fields in the previous season were planted to tomato again.

In Fig. 2 are shown the mean number of plants and foliar injury per m^2 in 2 fields. Both fields showed a steady number of tomato plants and TPW injuries/m^2, when left abandoned (Field 1) or used as "U-pick" field (Field 2). The major difference between the 2 fields was the length of time between discing and planting a new crop. For instance, the number of tomato plants and TPW injuries

Table 1. Effect of planting time on fruit injured by *K. lycopersicella* larvae to 'Flora-Dade' tomatoes during 1981.

Planting time	Total fruit damaged/plant[z]
30 Oct. 1980	0.67 b[y]
25 Nov. 1980	3.15 b
30 Dec. 1980	5.11 b
30 Jan. 1981	13.35 a
28 Feb. 1981	16.95 a

[z]Plantings without insecticide protection 20 days after emergence; Plant sprayed once with fenvalerate 2.4 EC (0.045 kg a.i./ha).
[y]Mean separation in columns by Duncan's Multiple Range Test, 5% level.

increased in Field 1 when the field was disced and planted again (1 week later) with beans (*Phaseolus vulgaris*). The germination of volunteer tomato plants was possibly related to the irrigation and type of herbicide used in the new crop. Opposite to this, the number of tomato plants/m² remained steady in Field 2 for about 7 months after the field was disced. There was a slight increase in number of TPW injuries/m² from Apr. through Aug. 1980.

In general, it was observed that when beans or other vegetables were planted immediately after tomatoes, the volunteer tomato plants and TPW larval levels were more numerous than when the field was disced or left abandoned.

Study 3. Tomato crops planted earlier (Oct.-Nov., 1980) had less volunteer plants than the one planted later (Dec. 1980) (Table 2). There were more TPW injuries in the younger planting than in the others. Effects of planting time on the treatments were obvious (Table 2). The older planting had a higher number of injuries per plant when abandoned than when the planting was mowed or disced. The second planting (Nov. 1980) had more injuries per m² if abandoned compared to the other treatments. In contrast, the younger planting had a higher number of injuries when disced and mowed than when abandoned. Older fields had fewer viable seeds that will germinate than those from younger fields in which seeds are immediately incorporated into the soil, assuring better seed germination.

Table 2. Effect of planting age and cultural practices on volunteer tomato plants and number of TPW injuries.

1980 Planting[y] Date	Treatment[x]	No. plants/m²	No. injuries/m²
30 Oct.	disced	0.00 b[z]	0.00 a
	mowed	0.08 b	0.13 a
	abandoned	0.32 a	0.28 a
25 Nov.	disced	0.02 c	0.16 b
	mowed	0.28 b	0.16 b
	abandoned	1.07 a	1.51 a
30 Dec.	disced	2.33 b	4.23 a
	mowed	2.17 a	4.55 a
	abandoned	1.33 a	3.23 a

[z]Mean separation in columns by Duncan's Multiple Range Test (P = 0.05).
[y]Time span between harvest and observations was 3, 2, and 1 month for the October, November, and December planting, respectively.
[x]Fields were treated (disced, mowed, or abandoned) once and then left alone throughout.

Effects from secondary host plants as oversummering sites have been suggested for TPW. The availability of off-season tomatoes helps to maintain the TPW population but also helps in buildup of natural enemies. Use of abandoned or "U-pick" fields for pest management of TPW by constant release of parasitoids would be a practice to reduce pinworm populations for the next season, without interfering with the farmer interests and environmental concerns.

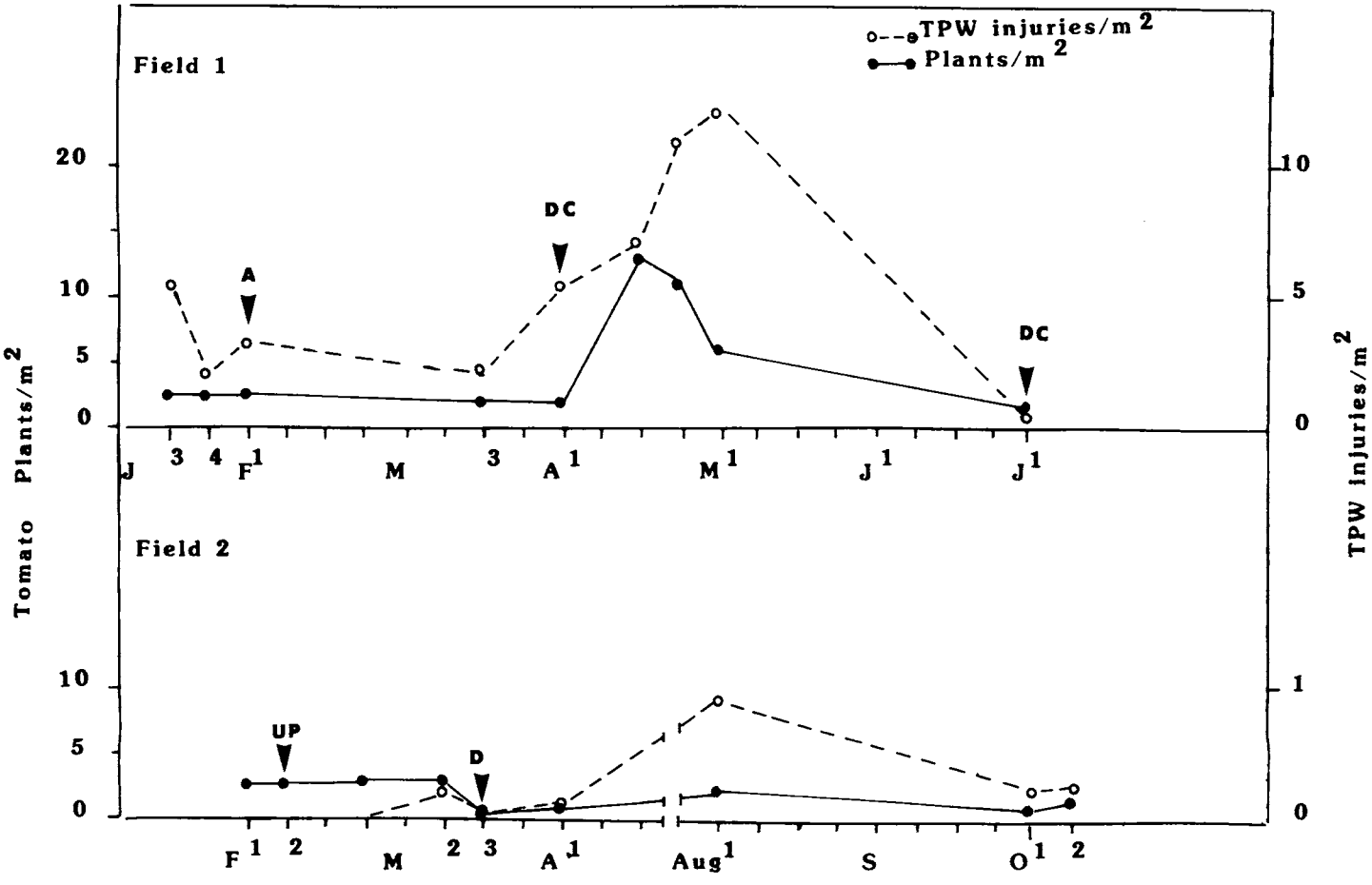

Fig. 2. Number of tomato plants and tomato pinworm (TPW) injuries per m² in harvested tomato fields; Homestead, Florida 1980. A = field abandoned after main harvest; DC = D = field disced and left alone. Abscissa is a time in weeks from February (F) through April (A) and August (Aug) through October (O).

Consequently, effects of cultural practices in tomatoes against the TPW can be focused in 2 ways: 1) these practices may be considered in relation to the pest density or 2) in relation to the impact on natural control agents. In southern Florida, the widespread cultural practices could account for part of the insect reduction during the past 10 years.

Literature Cited

1. Elmore, J. C. and A. F. Howland. 1943. Life history and control of the tomato pinworm. U.S. Dept. Agr. Tech. Bul. No. 841.
2. Oatman, E. R. 1970. Ecological studies of the tomato pinworm on tomato in southern California. J. Econ. Ent. 63:1531-4.
3. Pena, J. E. 1983. Tomato pinworm, *Keiferia lycopersicella* (Walsingham): population dynamics and assessment of plant injury in southern Florida. PhD Diss. Univ Fla., Gainesville.
4. Poe, S. L. 1973. The tomato pinworm in Florida. Univ Fla., Inst. Food Agr. Sci., Bradenton AREC Res. Rpt. GC73-2.
5. Poe, S. L. and P. H. Everett. 1974. Comparison of single and combined insecticides for control of tomato pinworm in Florida. J. Econ. Ent. 67:571-4.
6. Poe, S. L., J. P. Crill, and P. H. Everett. 1975. Ecology of tomato pinworm relative to production management in semi-tropical agriculture. Proc. Fla. State Hort. Soc. 8:160-5.
7. Price, J. F. and S. L. Poe. 1977. Influence of stake and mulch on lepidopterous pests of tomato. Fla. Ent. 60:173-6.
8. Sokal, R. and F. J. Rolf. 1969. Biometry: The Principles and Practice of Statistics in Biological Research. Freeman and Co., San Francisco.
9. Swank, G. R. 1937. Tomato pinworm (*Gnorimoschema lycopersicella* Busck) in Florida. Fla. Ent. 20:33-42.
10. Watson, J. R. and W. L. Thomspon. 1932. Pinworm on tomatoes. Fla. Ent. 16:14.

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COMPATIBILITY OF CHLORPYRIFOS SPRAYS WITH FERTILIZER AND FUNGICIDE AMENDMENTS ON FLORIDA PEPPERS

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Abstract. **Shortly after transplanting, weekly sprays of chlorpyrifos (Lorsban 4E) in combination with spreader-sticker (Ortho X-77) only, with soluble fertilizer (Nutri-leaf 60) + spreader-sticker and with a maneb (Manzate 4F) + copper hydroxide (Kocide 101) + spreader-sticker mix were applied to bell peppers (*Capsicum annuum* L.) on irrigated Astatula fine sand in Central Florida during the spring of 1985. Sprays were applied under a rigorous spray program using maximum rates and starting on stressed young plants. The combination of chlorpyrifos + maneb + copper hydroxide + spreader-sticker resulted in significantly fewer plants per 20-ft plot and in reduced numbers of fruit per plot. Numbers and weight of sun-scald or chemically burned peppers were significantly higher in plots treated with a combination of chlorpyrifos + soluble fertilizer + spreader-sticker. All chlorpyrifos schedules significantly reduced the numbers of marketable fruit per plot although weights of marketable fruit per plot showed no statistical differences. Weight and numbers of peppers damaged by noctuid larvae were significantly reduced in all chlorpyrifos schedules.**

It is a very common practice for Florida vegetable growers to incorporate many different materials in their spray tanks. For example, a 500 gallon spray tank may include one or more insecticides, a miticide, one or probably more fungicides, a bactericide or bacteristat, soluble fertilizer, chelated minerals or micronutrients, and finally a spray sticker or spreader adjuvant. Compatibility problems are intensified when the spray mix is applied concentrate by means of ground or aerial spray equipment. They are further compounded when material rates are maximized or spray intervals are shortened. Furthermore, spray water hardness and pH depending on water source also complicate the situation. And lastly, weather and climatic conditions can have an adverse effect on the target crop before, during, or after spraying. The purpose of this research project was to investigate the compatibility of chlorpyrifos with commonly used fertilizer and fungicide amendments on bell peppers in Florida.

Materials and Methods

The trial was conducted on the AM-MO Research Farm in Groveland. Vigorous bell pepper plants ('Jupiter') obtained from Speedling Inc. were mechanically set 19 Mar. 1985 in a single 320 ft row in an East-West orientation atop a clean bed 40 inches wide and 10 inches high. Plants were on 12 inch drills and soil was Astatula fine sand with 5.6 pH and 1.2% organic matter. Oxamyl (Vydate 2L) at 2 gallons per acre was broadcast and lightly disked in for nematode control 8 days prior to bed-shaping and planting. Irrigaton by means of fixed overhead sprinklers with a delivery rate of 0.3 inches per hour was provided as needed and always 1 to 3 days prior to each spray. No herbicide was employed; rather, beds were maintained weed-free through the season by tractor cultivation and timely hand-hoeing. A commercial fertilizer [6-1.7-6.6(N-P-K) + Mn + Zn] was side-dressed 3 times during the growing season. Plots were single rows 20 ft long with each treatment replicated 4 times in a randomized block design within the 320 ft of row.

Materials were applied in a conventional spray at 100 gallons spray per acre based on a commercial 36-inch row spacing. A one gallon stainless steel sprayer was utilized at a constant 50 psi (CO_2), simulating 3 nozzles per row with one overtop and one angled in toward each side of the plants by making 3 timed passes per rep with a full spray No. 4 disc, No. 35 swirl plate, and 50 mesh screen. Speed of travel was 0.5 mph. Frequent agitation was provided to