Insect Pests and Impact on Late-Season Tomato in Arkansas[1]

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ABSTRACT The recent release of heat-tolerant tomato cultivars has resulted in increased interest in expanding fresh market tomato from historically early production to late summer and fall in Arkansas. Although insects are generally of minor importance in early production, much concern exists with the greater numbers of insects occurring later during the season. Insect frequency and impact on tomato were determined in studies conducted in northwestern and southern Arkansas in 1993 and 1994. The corn earworm, *Helicoverpa zea* (Boddie), was the most damaging insect in both locations during both years. Corn earworm larvae were detected throughout the study and caused extensive fruit damage. At the northwestern location, 81.6% of all harvested fruit was damaged by corn earworm larvae in 1993. Although thrips were present at both locations throughout the season, no plants infected with tomato spotted wilt virus were detected. Other potential insect threats, i.e., stink bugs, flea beetles and tomato pinworms, had no apparent effect on late-season production. Corn earworm management is well developed for early tomato production and should be easily adapted to late-season production. This should insure the success of late-season tomato production in Arkansas.

KEY WORDS Tomato, *Helicoverpa zea*, insect, flea beetle, thrips, whitefly, hornworm

Commercial tomato production in Arkansas has historically been located in southern Arkansas during early season. Market conditions dictate that plants be transplanted in early spring just after the frost-free date for early summer harvest. Production practices including weed and disease management, fertilization, and irrigation are well established and are usually successful for insuring quality tomato yields. Insect management for early-season tomato production also is very effective. The principal tomato insect pest during this period in Arkansas is the corn earworm or tomato fruitworm, *Helicoverpa zea* (Boddie) (Roltsch and Mayse 1984), but numerous other insects may cause economic losses and are of concern in Arkansas (Lange and Bronson 1981). The potato flea beetle, *Epitrix cucumeris* (Harris), and tobacco flea beetle, *E. hirtipennis* (Melsheimer), may attack tomato seedlings shortly after

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transplanting, resulting in severe leaf damage and defoliation (Snodderly and Lambdin 1981, Gentile and Stoner 1968). Tomato foliage also may be damaged by the Colorado potato beetle, *Leptinotarsa decemlineata* (Say) (Cantelo and Cantwell 1983, Schalk and Stoner 1979), and the vegetable leafminer, *Liriomyza sativae* Blanchard (Johnson et al. 1980, Levins et al. 1975). In addition to *H. zea*, tomato fruit may be directly attacked by tomato pinworm, *Keiferia lycopersicella* (Walsingham) (Wofenbarger et al. 1975). Aphids, thrips and whiteflies not only affect tomato directly but may transmit viruses or mycoplasmas (Lange and Bronson 1981).

Late-season tomato production was somewhat successful in Arkansas during the early 1970's. However, late-season production ceased due primarily to inconsistent supply. Recently, the development of heat-tolerant cultivars, favorable market conditions, and a need for more diversified cropping systems have resulted in an increased interest in late-season tomato production in Arkansas. Acreage is increasing and will likely continue to increase in the immediate future. Most production practices including weed and disease management, fertilization, and irrigation, currently used during early-season production also are easily adapted to late-season tomato production. However, insects that are normally a minor problem on early-season tomato may pose a serious threat to tomato harvested during the late summer and fall.

No information on the impact of insects on late-season tomato production in Arkansas is available. The objective of the research reported herein was to determine the occurrence and impact of insect pests on late-season tomato production in Arkansas.

Materials and Methods

The study was conducted in northwestern and southern Arkansas in 1993 and 1994. The northwestern Arkansas study was located at the University of Arkansas Main Experiment Station at Fayetteville. Production practices followed current University of Arkansas recommendations each year. 'Sunmaster' tomato seed was planted in May in 6 × 6 cm peat cups containing Redi-earth (Scotts-Sierra Horticulture Products Co., Marysville, OH) and plants were maintained under greenhouse conditions. Seedlings were transplanted in the field 21 June 1993 and 13 June 1994. The soil type in the field plot was Captina silt loam and received 336 kg 10:20:10 commercial fertilizer per ha before transplanting. Rows were drip irrigated and covered with black plastic mulch following current recommendations. Seedlings were transplanted directly through the plastic and staked. As plants grew, they were hand pruned and pulled up between nylon twine that had been strung between the stakes. A fungicide, chlorothalonil (Bravo 720, ISK Biotech Corp., Mentor, OH), was applied at 1.68 kg a.i./ha with a backpack sprayer at weekly intervals to prevent early blight. No insecticides were applied during the study. Plot size was 10 rows 75 m long. Rows were separated by 2 m bare ground, and plants within each row were separated by 0.6 m. In 1994, the field plot consisted of 6 rows 75 m long.

The southern Arkansas study was located at the University of Arkansas Experiment Station at Pine Bluff. Production practices were similar to those for the northwestern site with the following exceptions. In 1993 tomato cv 'Mountain Delight' was transplanted 1 July to a plot with 4 rows 73 m long. Plants were set 0.9 m apart. In 1994, tomato cv 'Sunmaster' was transplanted 27 June to a plot with 12 rows 39 m long. Plants were separated by 0.6 m. Soil type was Calloway silt loam.

Insect sampling on tomato plants. Each week from transplanting to final harvest during 1993, 40 plants (4 per row) were randomly selected at the Fayetteville location and tagged with colored flagging. Plants were sampled with the use of a portable, gasoline-powered vacuum fitted with 3.8-liter nylon paint strainers. After each plant was vacuumed, strainers were closed and transferred to a laboratory freezer for later insect identification under stereo microscopy. The flagging prevented plants from being resampled during the 4-wk period following the initial sample date. In 1994, a total of 24 plants (4 per row) were sampled per week as previously described. At Pine Bluff, 40 plants (10 per row) were sampled weekly in 1993, and 48 (8 from each alternate row) were sampled weekly in 1994. Frequently encountered insects were counted, and data were plotted. Notes on less frequently encountered insects also were made.

Insect sampling on yellow sticky flags. Yellow sticky flags (McLeod 1986) were used to obtain data on insects that may not have colonized tomato yet posed the threat of vectoring disease. Each week at Fayetteville in 1993 and 1994 and at Pine Bluff in 1993, ten yellow sticky flags were placed in each plot. Two flags were placed just above the plant canopy in each of the plot corners and center. After 7 days flags were wrapped in clear plastic and refrigerated for later examination. Potential disease vectors, including aphids, thrips, and whiteflies, were counted and plotted as described above. Plant disease incidence was assessed weekly by visually inspecting each vacuumed plant for foliar and fruit disease symptoms.

Insect damage to tomato foliage. Damage to tomato foliage by leaf miners, flea beetles, and caterpillars was assessed at weekly intervals at both locations in 1993 and 1994. Each week three leaves, one each from the lower, middle and upper canopy, were visually searched on each plant that was vacuumed. Sampling included a count of the number of mines per leaf and a damage index for flea beetle and caterpillar damage. The index ranged from 0 for no visible damage to 5 for severe damage.

Insect damage to tomato fruit. Each week fruit that was damaged by caterpillars and fruit that showed any sign of ripening, i.e., pink color, were picked from each plant in the plots. Counts of non-damaged and insect-damaged fruit were taken for each plant that was vacuumed. The Mountain Delight plants grown at Pine Bluff initially did not set fruit due to high nocturnal temperatures that occurred during late summer 1993. Fruit that finally developed were approaching maturity when a freeze occurred 30 October. Due to plant mortality, all fruit greater than 6 cm in diam were harvested 1 November and assessed for insect damage. Data were analyzed and plotted as previously described.

Results

Corn earworm larvae were first detected at Fayetteville by plant vacuuming 22 July 1993 (J203)[2] and 30 June 1994 (J181) (Fig 1 and 2). Larval numbers declined through 8 August 1993 (J220) and 18 August 1994 (J230). These periods corresponded with initial flowering of tomato. As fruit developed, corn earworm larvae entered the enlarging fruit and were unable to be removed by vacuuming. Thus, larval numbers in vacuum samples declined and remained low throughout the remainder of the study.

Corn earworm impact on the initial harvest at Fayetteville was great and continued throughout the study (Fig. 3 and 4). Damage by the corn earworm was observed on all fruit at the initial harvest in both years. Throughout the 1993 study, the mean number of corn earworm damaged-fruit per plant was 27.2, or 81.6% of all fruit harvested. In 1994, an average of 15.1 (69.1%) fruit per plant were damaged by corn earworm. With the occasional exception of a fruit damaged by the tobacco hornworm, *Manduca sexta* (L.), and the tomato hornworm, *M. quinquemaculata* (Haworth), no other insects were observed to directly damage fruit.

Corn earworm larvae were first detected at the Pine Bluff plot 15 July 1993 (J196) and 20 July 1994 (J201) (Fig. 5 and 6). Larvae were observed in vacuum samples on each sample date in both years. The greatest number of corn earworm larvae in the Pine Bluff samples occurred 18 August 1993 (J230) at peak bloom. Although fruit damage from corn earworm feeding was less at Pine Bluff than at Fayetteville, losses were excessive. Throughout the 1993 and 1994 studies, the mean number of corn earworm damaged fruit per plant was 6.4 (34.3%) and 7.1 (35.1%), respectively (Fig. 7 and 8). Although stink bug damage on tomato in Arkansas is occasionally reported, no fruit damage resulting from stink bugs was observed during the study.

Frequencies of other insects that occurred in vacuum samples during the study are shown in Fig. 1 and 2 (Fayetteville) and Fig. 5 and 6 (Pine Bluff). The cabbage looper, *Trichoplusia ni* (Hübner), was seldom collected except during July 1993 at Fayetteville, and only minor foliar damage by cabbage looper was observed. Although whiteflies were detected throughout the sampling periods during both years, collections were low except for Fayetteville samples from early September 1993. Aphids, primarily the potato aphid, *Macrosiphum euphorbiae* (Thomas), and the green peach aphid, *Myzus persicae* (Sulzer), also were collected throughout the study in low numbers. Brief exceptions occurred at Fayetteville in 1994 on 21 July (J202) and 25 August (J237) when the mean number of aphids per sample was 38.3 and 44.8, respectively. Flea beetles also were collected throughout the study at both locations. Concern with high levels of flea beetle damage just after tomato transplanting was not warranted because flea beetle numbers were generally lowest in collections at this time. Numbers of thrips also were low throughout the study. Numerous other insect species were collected in the vacuum samples, but because of low numbers they are not reported.

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[2] Julian date.

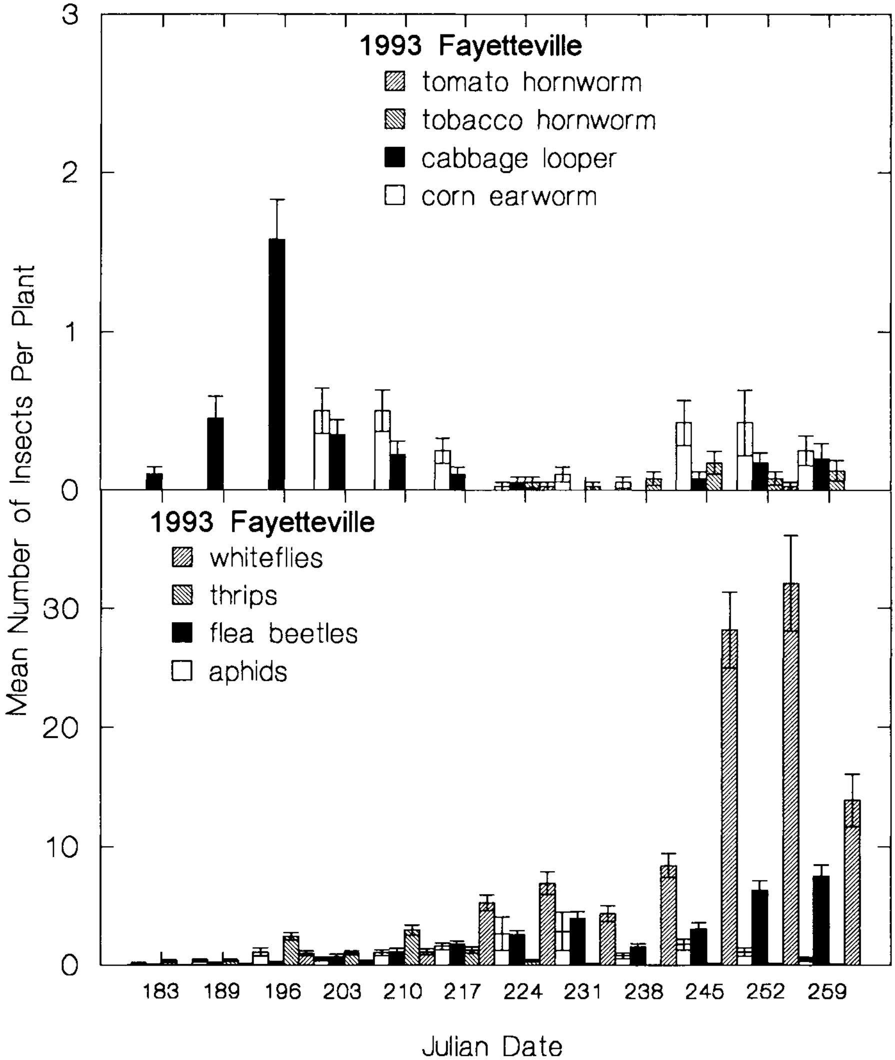

Fig. 1. Insects collected in vacuum samples from tomato at Fayetteville during 1993. Bars reflect mean +/- SEM.

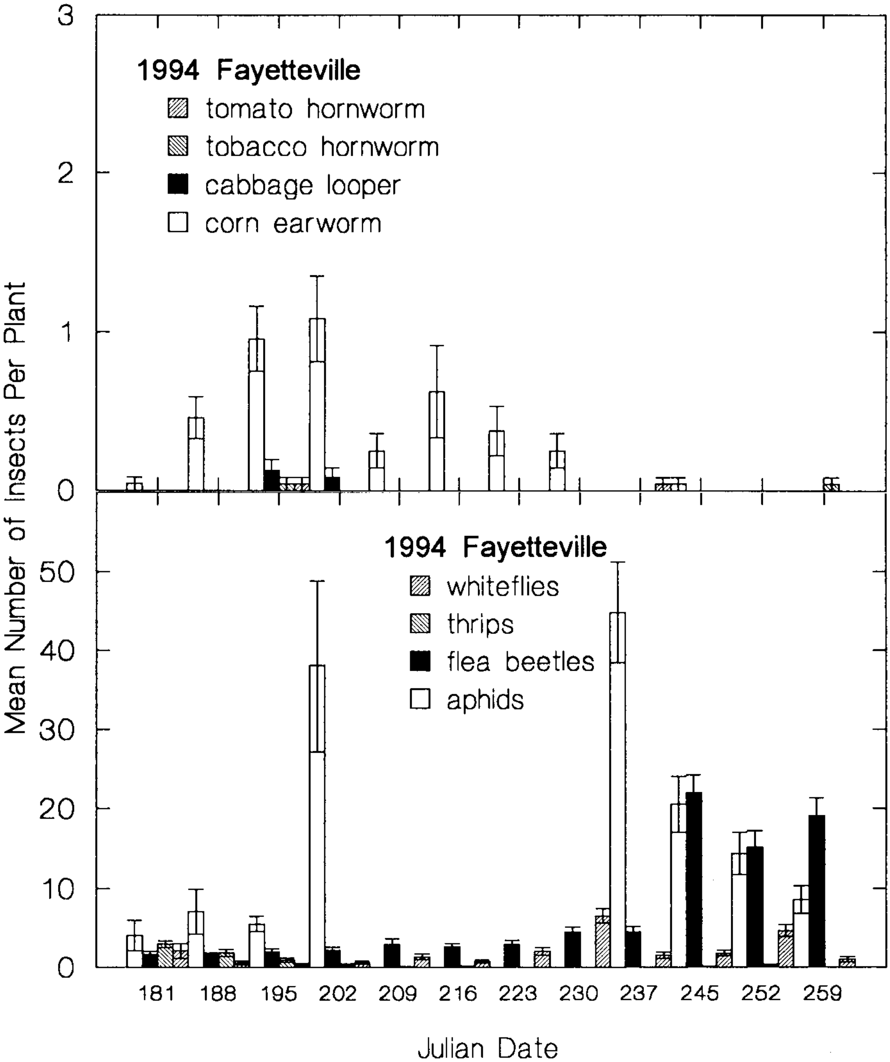

Fig. 2. Insects collected in vacuum samples from tomato at Fayetteville during 1994. Bars reflect mean +/- SEM.

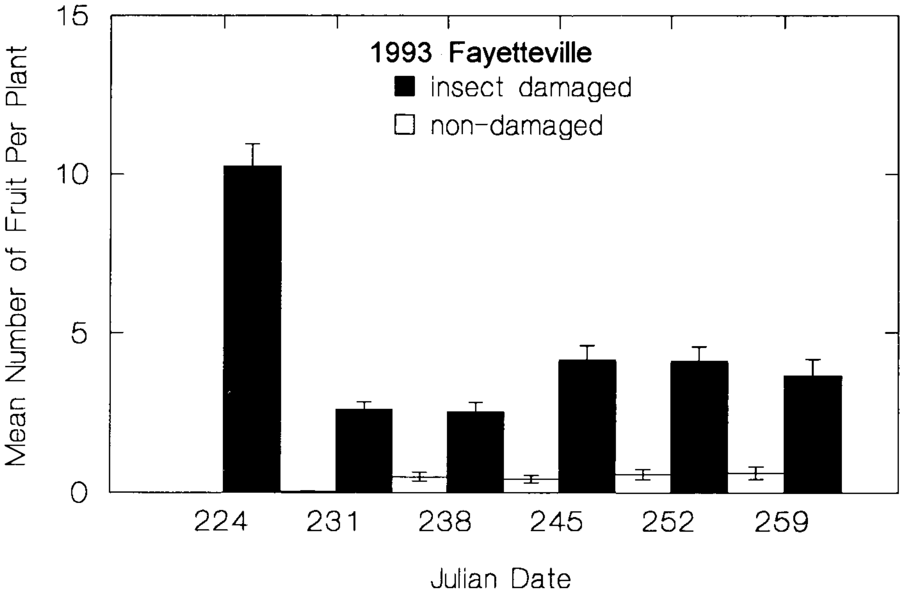

Fig. 3. Insect damaged and non-damaged tomato fruit at Fayetteville during 1993. Bars reflect mean +/- SEM.

Aphids, thrips, and whiteflies were trapped on sticky flags throughout the study in Fayetteville both years (Fig. 9). Of these insect groups, thrips were the most frequently trapped and generally peaked in numbers during mid-July in 1993 and early August in 1994. These peaks may have been related to tomato flowering. Aphids were the next most frequently trapped group. Common aphid species were the potato aphid and the green peach aphid. Although aphids were trapped throughout the study, aphid colonies on tomato plants were rare and brief in existence. Whiteflies also were trapped throughout the study but were generally low in numbers. Thrips and whiteflies also were abundant on sticky flags throughout the 1993 season at Pine Bluff (Fig. 10). Although whiteflies reached a high of 938.7 per flag on 25 August (J237), numbers on plants were relatively low and appeared to have no effect.

Foliage feeding was minimal at both locations during both years of the study. Although the mean number of mines per leaf at Fayetteville reached 7.9 per leaf on 8 July 1993 (J189), almost all mines were confined to the lower tomato leaves. The number of leaf mines declined later in 1993 samples and was less than 1 per leaf throughout 1994. Flea beetle damage was most common on the lower leaves. The highest level of damage occurred in the last 1993 sample from the Fayetteville plot when the flea beetle damage index reached a mean of 2.3 on the lowest leaves. Just after transplanting, when

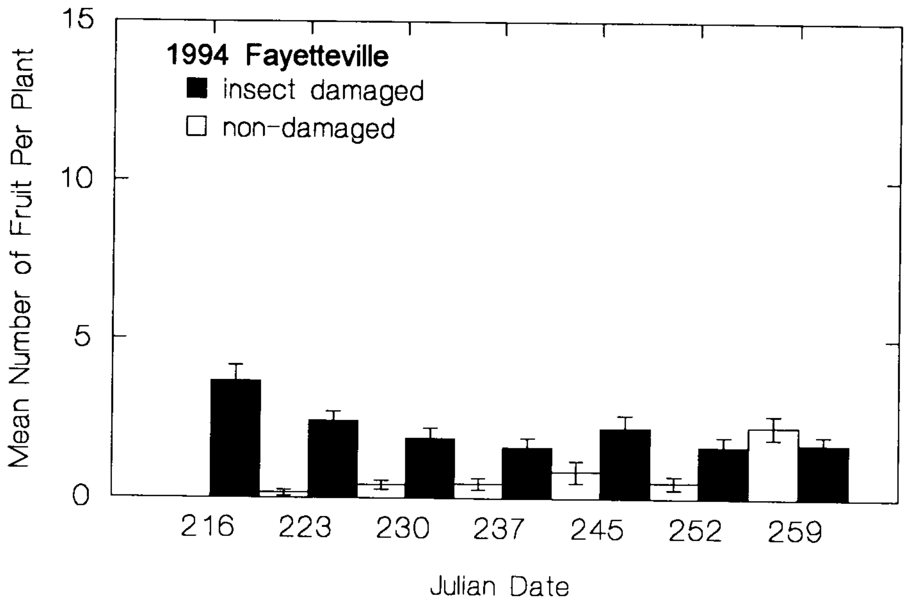

Fig. 4. Insect damaged and non-damaged tomato fruit at Fayetteville during 1994. Bars reflect mean +/- SEM.

tomato is most susceptible to flea beetle attack, damage indices averaged less than 1 each year at both locations. Foliage damage from caterpillars was almost entirely caused by cabbage looper and tomato and tobacco hornworm larvae. Although damage was observed at all canopy levels sampled and gradually increased throughout the study each year, it appeared to have little effect on the yield.

Discussion

Late-season tomato production has been limited in Arkansas primarily because of a lack of cultivars capable of setting fruit during warm summer nights. The recent release of heat-tolerant cultivars has generated much interest in expanding the tomato growing season. Although most production practices are well suited for production during this period, management of insects is of increased concern. Unlike many tomato diseases that depend on damp spring weather, many insect pests of agronomic importance experience population increase through the growing season and develop high numbers during late summer and early fall. Late-season producers in Arkansas are currently very concerned with the corn earworm, which usually increases in population density through the season, thrips-vectored tomato spotted wilt,

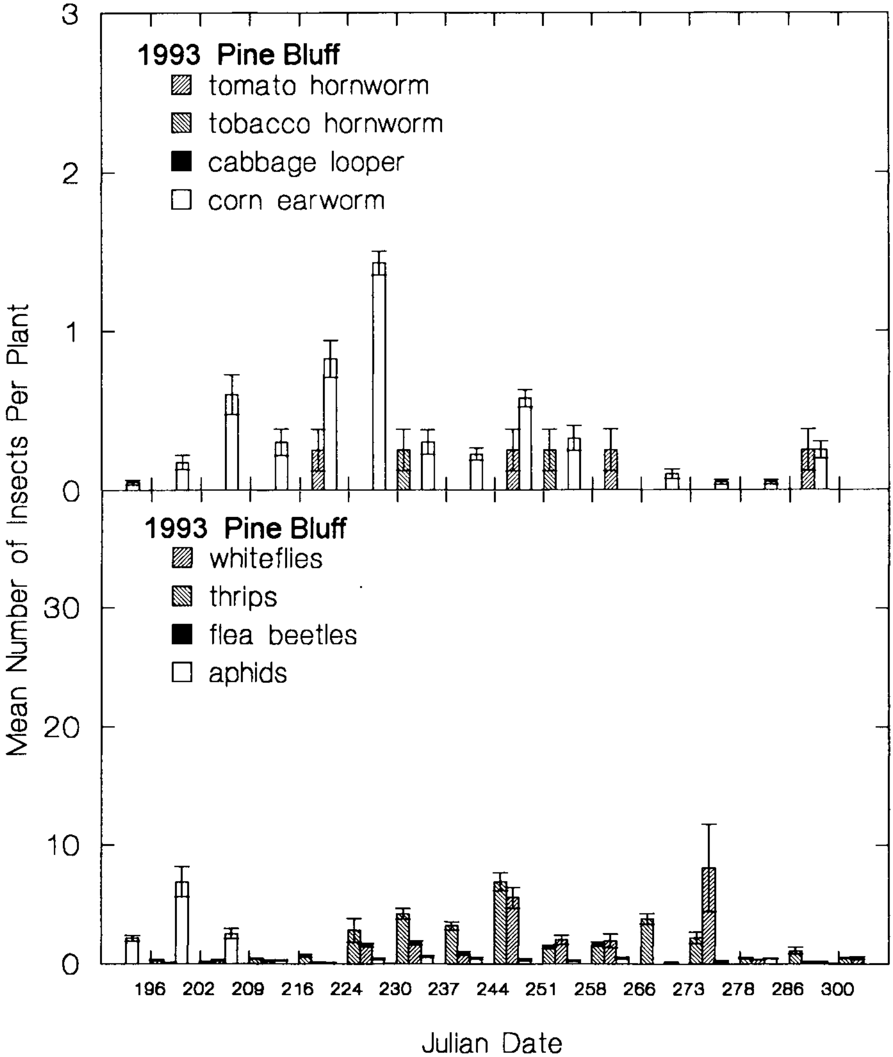

Fig. 5. Insects collected in vacuum samples from tomato at Pine Bluff during 1993. Bars reflect mean +/- SEM.

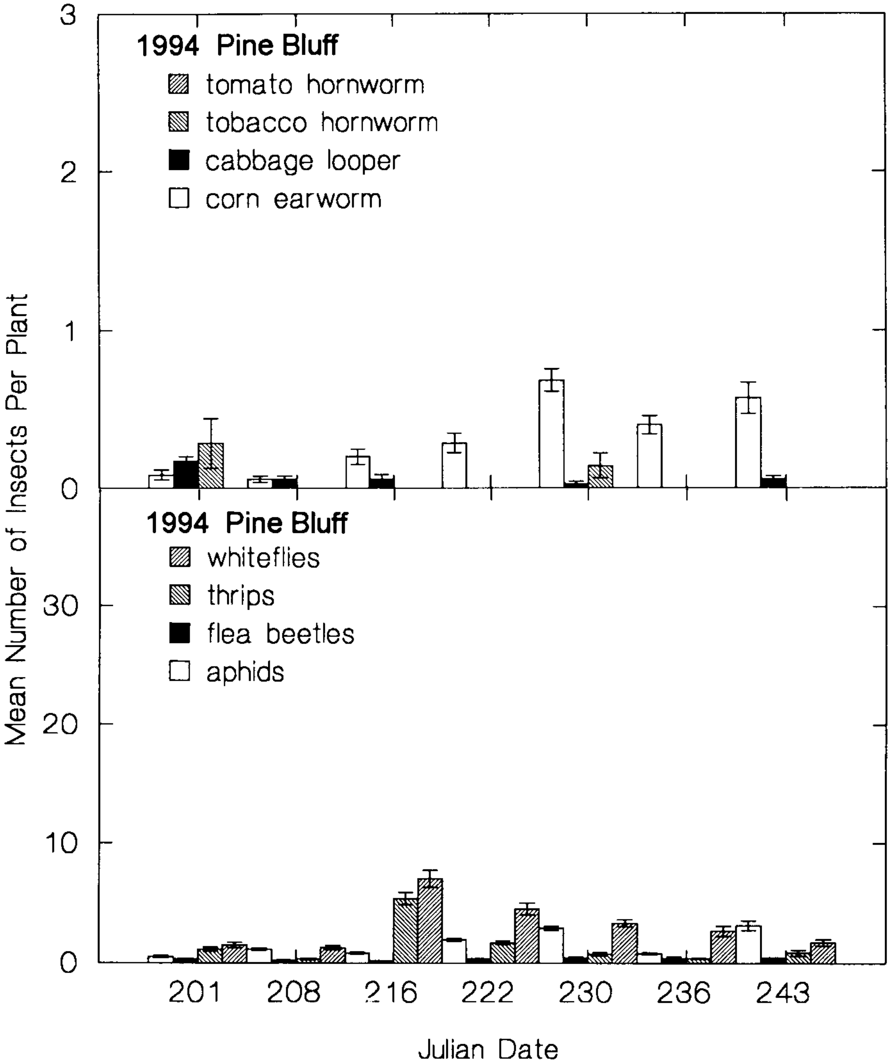

Fig. 6. Insects collected in vacuum samples from tomato at Pine Bluff during 1994. Bars reflect mean +/- SEM.

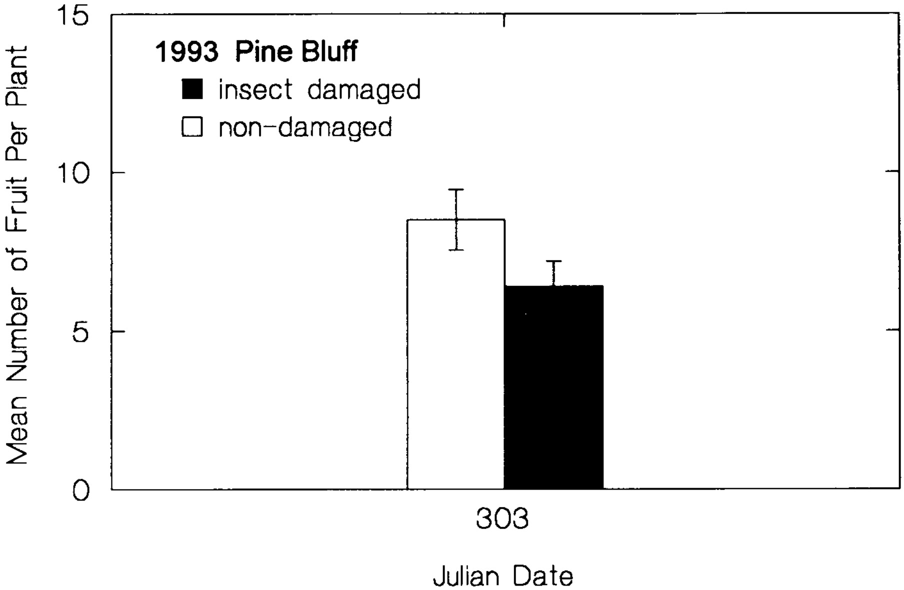

Fig. 7. Insect damaged and non-damaged tomato fruit at Pine Bluff during 1993. Bars reflect mean +/- SEM.

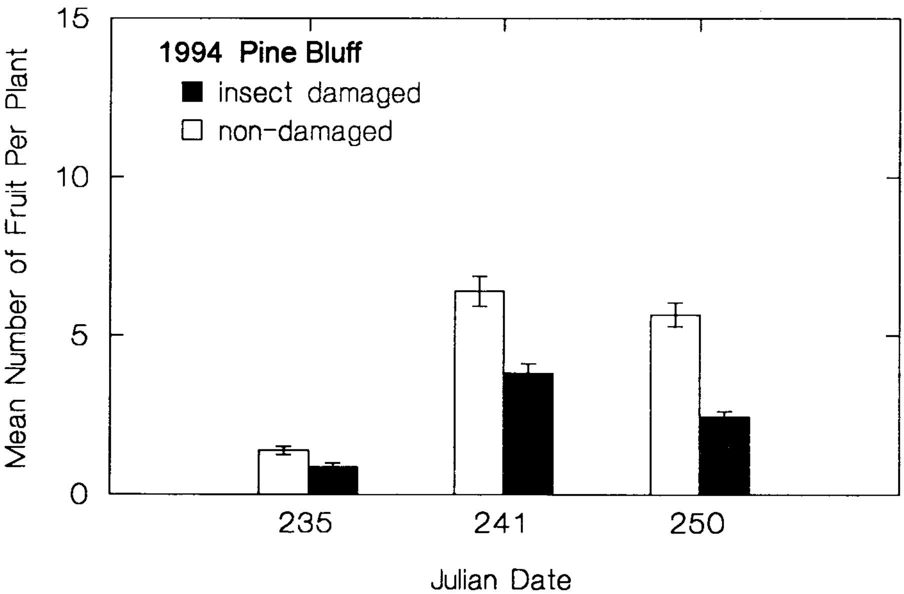

Fig. 8. Insect damaged and non-damaged tomato fruit at Pine Bluff during 1994. Bars reflect mean +/- SEM.

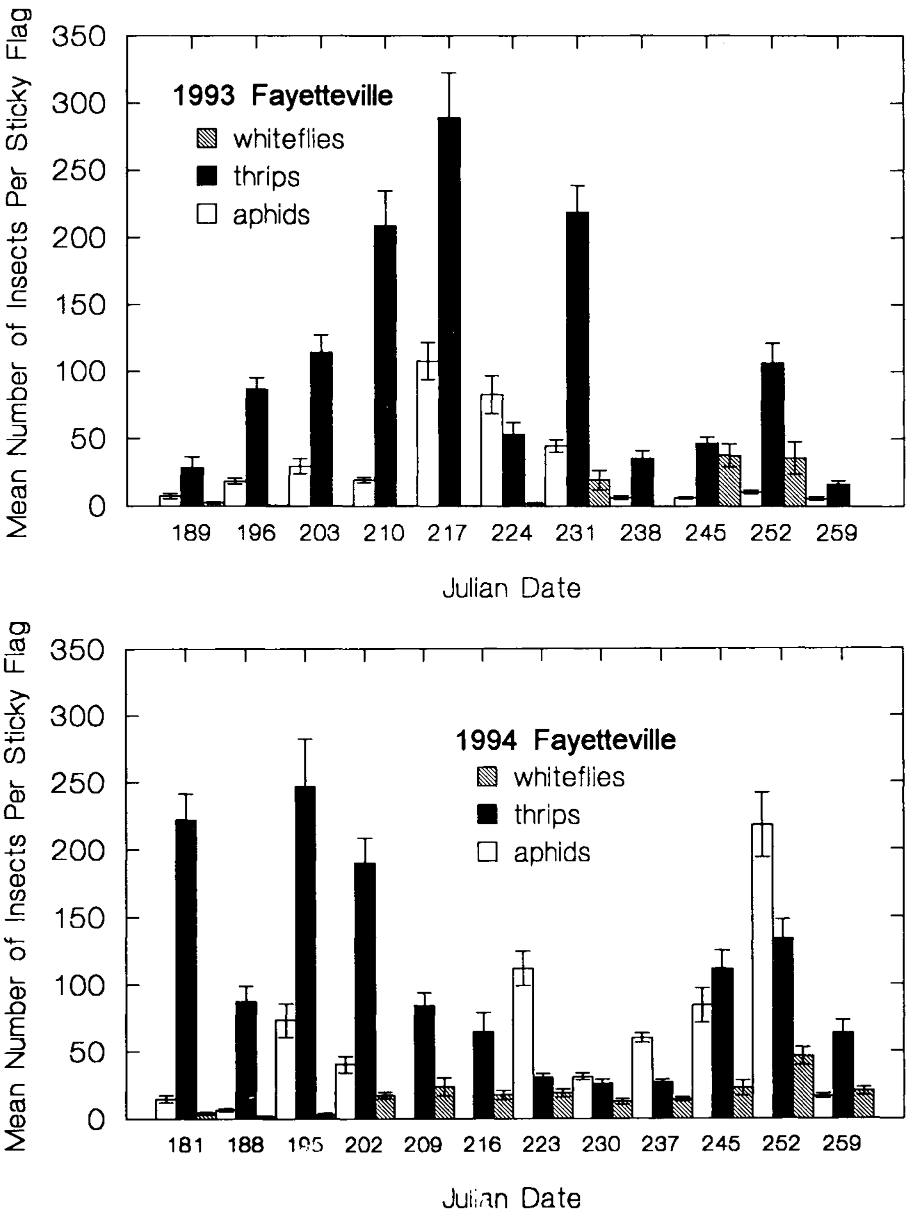

Fig. 9. Insects collected on yellow sticky flags at Fayetteville during 1993 and 1994. Bars reflect mean +/- SEM.

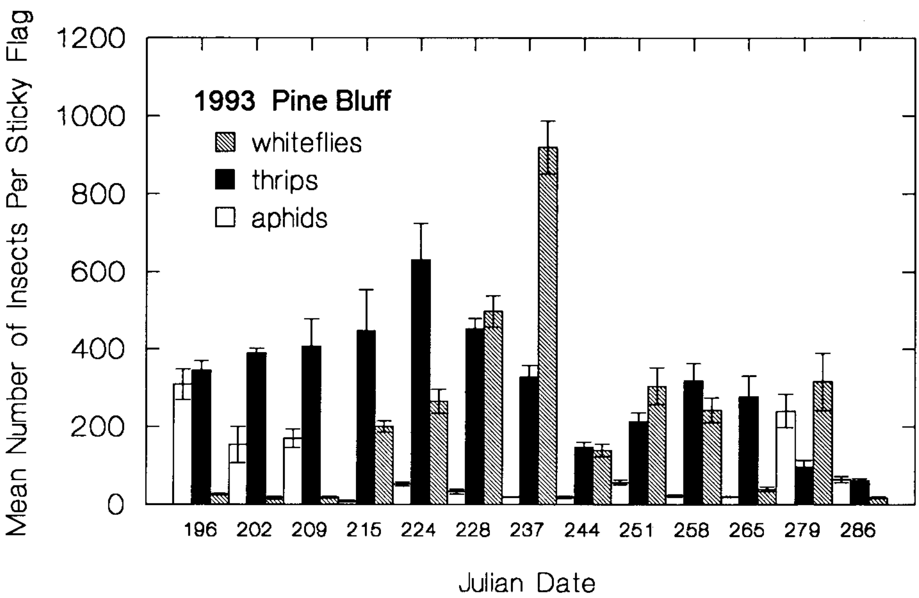

Fig. 10. Insects collected on yellow sticky flags at Pine Bluff during 1993. Bars reflect mean +/- SEM.

which occasionally affects tomato in Arkansas, flea beetles that may be present in large numbers at transplanting, stink bugs, and many other insect pests and disease vectors. In our study, no plants infected with tomato spotted wilt virus were detected at either location in either year. Flea beetle feeding on newly-transplanted tomato seedlings was very low, and no fruit damage from stink bug feeding was observed. The corn earworm was the only insect pest of economic importance in either location. Damage from corn earworm larvae was excessive at both locations, greatly reducing yields. However, the corn earworm on tomato can usually be effectively managed. Several IPM programs for managing corn earworm on tomato have been developed (Mayse et al. 1982, Oatman et al. 1983). Refinements in these programs should enable successful management of corn earworm on late season tomato and should expand tomato production in Arkansas.

Acknowledgments

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References Cited

Cantelo, W. W. and G. E. Cantwell. 1983. Tomato yield loss as a result of simulated Colorado potato beetle (Coleoptera: Chrysomelidae) feeding. Environ. Entomol. 12; 1646-1651.

Gentile, A. G. and A. K. Stoner. 1968. Damage by larvae of the tobacco flea beetle to tomato seedlings. J. Econ. Entomol. 61: 152-154.

Johnson, M. W., E. R. Oatman, J. A. Wyman, and R. A. van Steenwyk. 1980. A technique for monitoring *Liriomyza sativae* in fresh market tomatoes. J. Econ. Entomol. 73: 552-555.

Lange, W. H. and L. Bronson. 1981. Insect pests of tomatoes. Annu. Rev. Entomol. 26: 345-371.

Levins, R. A., S. L. Poe, R. C. Littell, and J. P. Jones. 1975. Effectiveness of a leafminer control program for Florida tomato production. J. Econ. Entomol. 68: 772-774.

Mayse, M. A., B. A. Dumas and M. E. Peerson. 1982. Chemical control of tomato fruitworm. Arkansas Farm Res. 31:7.

McLeod, P. 1986. Wire stake flags: an alternate sticky trap. J. Entomol. Sci. 21: 219-221.

Oatman, E. R., J. A. Wyman, R. A. van Steenwyk and M. W. Johnson. 1983. Integrated control of the tomato fruitworm and other lepidopterous pests on fresh-market tomatoes in southern California. J. Econ. Entomol. 76: 1363-1369.

Roltsch, W. J. and M. A. Mayse. 1984. Population studies of *Heliothis* spp. (Lepidoptera: Noctuidae) on tomato and corn in southeast Arkansas. Environ. Entomol. 13: 292-299.

Schalk, J. M. and A. K. Stoner. 1979. Tomato production in Maryland: effect of different densities of larvae and adults of the Colorado potato beetle. J. Econ. Entomol. 72: 826-829.

Snodderly, L. J. and P. L. Lambdin. 1981. Control of flea beetles on tomatoes with foliar-applied insecticides. Tenn. Farm & Home Sci. 117: 27-28.

Wolfenbarger, D. O., J. A. Cornell, S. D. Walker, and D. A. Wolfenbarger. 1975. Control and sequential sampling for damage by the tomato pinworm. J. Econ. Entomol. 68: 458-460.