Crop Profile for South Florida Tomatoes

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This crop profile covers fresh market tomato crops produced south of Lake Okeechobee during the 1997-98 growing season. This area has a nine-month production cycle, intense pest pressure and significantly contributes to the winter supply of this important vegetable. This profile is the result of interviews conducted with growers throughout the area consisting of Collier, Dade, Hendry, Lee and Manatee counties.

Crop Production

During the 1997-98 season south Florida counties produced 22,320 acres of tomatoes with a value of $254,815,610 (Table 1). This represents 25% of U.S. production and 60% of Florida's acreage (FASS, 1997, 1998). This survey covers 9293 acres from 20 farms ranging in size from 50 to 2200 acres, having an average size of 465 acres (Table 2). This represents 40% of the south Florida acreage. Average yield from the survey was 36,827 lb per acre, with an average value of $0.40 per lb, giving a gross return of $13,752 per acre (Table 3). Production costs and the cost of picking and packing were estimated to be $5,424 and $5,266, respectively, leaving a net return to the farm of $3,116 per acre.

Pest management costs represent a significant outlay for south Florida tomato growers totaling $855 per acre, or 16.0% of the total production costs (Table 4).

Cultural Practices

Tomatoes in Dade County are produced on a rocky limestone soil (Table 5) and in other counties on sandy soils. Irrigation of two thirds of the acreage is through seep irrigation (Table 6), which uses a perched water table 18-24 inches below the bed surface. The water table is maintained by pumping water into a series of lateral ditches, either from an open "rim" ditch or from buried pipes with outlets at each lateral ditch (semi-closed). Most of the remaining acreage is drip irrigated from tubes laid under the plastic mulch. A small acreage receives overhead irrigation. Seepage and drip irrigation have the added benefit of avoiding extended periods of wet foliage for improved disease control.

The irrigation system serves the dual purpose of providing **and** removing water from the field. Open ditch seep irrigated fields are laser leveled without a slope. Water removal from these fields is accomplished using large pumps spaced around the rim ditch. Where semi-closed seep and drip irrigation are used, the fields are sloped to allow runoff into swales, which direct the water to the rim ditch. The slope in such fields is maintained with laser leveling. The usual interval between leveling operations is about 2 years (Table 7). Drainage is enhanced with drain tile on a small acreage.

In preparation for planting, fields are disked several times. Disking is often interrupted during the rainy summer months, when about 60% of the acreage is naturally flooded for an average of four and one-half weeks. Approximately 40% of the surveyed acreage was maintained weed free through the off season by mechanical or chemical fallowing. An additional 22% was planted in cover crops, which provide weed suppression and improve soil organic content. The most common cover crops are grasses, especially sorghum, although legumes are also planted (Table 8).

Fresh market tomato production is labor and resource intensive. The crop is grown on 6-8 inch high plastic-mulched beds (Table 9). The plastic mulch is white for plantings during the high temperature months of August through October. During the cooler weather of late fall and winter, black plastic mulch is used to raise the soil temperature during plant establishment. With few exceptions, the beds are fumigated and granular fertilizer is applied just before the mulch is applied. The mulch functions to retain the fumigant, reduce fertilizer leaching, and provide a physical barrier to weed growth.

The crop is established from 5 to 6-week-old transplants, which are grown in greenhouses, and then manually set into the mulched beds. About 4 weeks later, 2-4 lateral branches are pruned from the plant base. Pruning promotes fruit production and sizing, while reducing excessive vegetative growth. When bacterial spot disease occurs early in the crop, the pruning step is sometimes avoided to prevent spreading the disease mechanically. Following pruning, 4-foot wooden stakes are driven into the beds between plants. The crop is supported by a series of 3-4 strings, which are tied to the stakes every 10 inches. While these hand labor operations are expensive, growers recognize their value, both for the horticultural reasons and for the additional advantages of improved disease and insect management, through avoiding plant contact with bare soil and improved spray penetration.

The time from transplanting to first harvest averages 12 weeks for early (August-September) plantings and 14 weeks for late (November-December) plantings. Planting dates and breaks are detailed in Table 10. The purpose of the November planting break or reduced planting size is to reduce the amount of crop at risk during peak periods of frost or freezing risk (mid-December through January).

Harvesting begins in late November and continues through late April in south Florida. Fields are harvested 2 or 3 times depending on market conditions. Crops are destroyed with herbicide, strings are removed using tractor drawn burners, and the stakes are removed. Field sanitation practices before and after the crop are important parts of the pest management program, especially for control of bacterial spot and several destructive virus diseases.

Pest Management

Pests and their Impact: Survey participants were asked to list those pests that had a significant impact on their tomato crops. All growers described levels of pest activity, and these pests, the frequency with which they occur and the damage they produce are listed in Table 11. The acreage affected and the potential yield lost to each pest are detailed in Table 12. Primary preventive or suppressive control practices are listed in Table 13. Active ingredients identified for regulatory action under the Food Quality Protection Act (FQPA) appear in **boldface**.

Plant Diseases: Diseases threaten the crop throughout the growing season. Bacterial spot disease, caused by *Xanthomonas campestris* pv *vesicatoria*, is currently the most destructive causing defoliation, fruit damage and reduced fruit set if flower parts become infected. The disease is spread rapidly by splashing rainfall and mechanically, such as during pruning or other hand-labor operations. The estimated loss to this disease was

8.7% of potential yield, with 97.2% of the acreage affected. The crop is closely monitored from transplant through the end of the crop. Control practices include prompt crop destruction after harvesting is completed, attention to field sanitation, control of volunteer tomatoes, sanitation for hand laborers and the application of tank mixes of copper and mancozeb. The pathogen's tolerance to copper-based fungicides hampers chemical control of bacterial spot. The addition of mancozeb to copper in the spray tank improves the efficacy of the copper fungicide, but the results are often inadequate. Alternatives to this fungicide standard include a viral pathogen of the bacterial spot pathogen, Agriphage (Agri-phi, Logan, Utah) and systemic acquired resistance chemistry currently under development (Messenger, Eden Biosciences; Actigard, Novartis). Bacteriaphage treatment is widely used successfully in transplant houses but acceptance in the field has been slow primarily due to special requirements for efficacy to apply while dew is on the plant and while temperatures are cool. Such applications require spraying before sunrise, which is difficult.

Fungal diseases affecting foliage and fruit, early blight (*Alternaria solani*) and target spot (*Corynespora cassiicola*), rank next in importance to bacterial spot. Target spot is more severe in the fall (69.4% of acreage affected with yield losses of 3.7%), when extended periods of leaf wetness, required for disease development, are more likely. Early blight is more severe during cooler, drier conditions in the winter and early spring affecting 26.8% of the acreage and causing 1.8% lost yield. Early blight and other Alternaria diseases are controlled with copper and mancozeb, while target spot control requires well timed applications of chlorothalonil. The only alternative fungicides are the strobilurin fungicides, azoxystrobin (Quadris, Zeneca) and trifloxystrobin (Flint, Novartis). This new, reduced risk fungicide family is effective against early blight, but provides inadequate control of target spot.

Late blight (*Phytophthora infestans*) occurs sporadically during the cool winter and spring months and can cause rapid and severe defoliation and fruit damage if improperly treated. Several biotypes of the pathogen occur. Due to differential susceptibility to fungicides among these biotypes, control practices may need to be tailored to the situation. The US 17 biotype, which has most recently attacked tomatoes in south Florida, is best controlled using chlorothalonil. Alternative fungicides, such as the strobilurins and propamocarb hydrochloride (Tattoo, AgrEvo) have not provided the same level of disease control. Losses to late blight were low during the 1997-98 season, but long-term growers estimate 9.6% of acreage affected and 1.1% yield lost.

Fusarium crown rot (*Fusarium oxysporum* f sp *radicis-lycopersici*) affects 40% of the surveyed acreage, causing an average yield loss of 2.6%. This disease reduces crop vigor and causes plant loss throughout the crop cycle. Most destruction occurs in the final weeks of production when fruit sizing and harvesting stress the plant's root system. Control of Fusarium crown rot relies on several practices, beginning with proper soil fumigation (67:33 methyl bromide:chloropicrin is preferred) followed by avoiding root damage through close attention to water and fertilizer management. The use of crown rot resistant varieties is increasing, but is currently not widely accepted due to horticultural characteristics that make these varieties less competitive than standard varieties.

Virus diseases, especially the geminiviruses, Tomato Mottle Virus and Tomato Yellow Leaf Curl Virus, both transmitted by the silverleaf whitefly, *Bemisia argentifolii*, could potentially eliminate Florida's tomato crop. The vector is controlled adequately with chemical insecticides. The primary one is imidacloprid (Admire, Provado, Bayer), a major cost to the grower. Growers estimated that 32.2% of their acreage was affected by some level of virus disease, with a yield loss of about 1%. Alternative practices for virus disease management include prompt crop destruction, field selection and crop scheduling. High land values and marketing demands make the latter two practices difficult to implement. However, most growers conscientiously destroy fields shortly after harvesting is completed. Chemical alternatives to imidacloprid are used 6 to 8 weeks after transplanting, when the efficacy of the initial imidacloprid application declines. These include endosulfan, several pyrethroids, such as esfenvalerate (Asana, DuPont) and permethrin (Ambush, Zeneca; Pounce, FMC), which may be tank-mixed with methamidophos (Monitor, Bayer), and the biorational soap or detergent. Soap is especially favored when adult whiteflies increase during the harvest. Although they were not available during the period covered by this survey, use of the reduced risk insect growth regulators, buprofezin (Applaud, AgrEvo) and pyriproxyfen (Knack, Valent) should greatly reduce the use of methamidophos tank-mixes for whitefly control.

Other diseases cited by survey respondents caused less than 1% yield loss, and are not discussed here. They have been included in Tables 11 and 12.

Insect Pests: The silverleaf whitefly ranked highest for both acreage infested (90.9%) and lost yield (2.3%), with the loss attributed to 1) lost plant vigor and Tomato Irregular Ripening, a malady caused exclusively by the feeding of immature silverleaf whiteflies and 2) vectoring the two geminiviruses. Control practices were presented in the discussion of virus diseases.

Several species of lepidopterous larvae are common tomato pests in south Florida and include the beet armyworm, *Spodoptera exigua*, and the southern armyworm, *S. eridania*. The tomato pinworm, *Kieferia lycopersicella*, has, through improved management methods, declined in importance in south Florida in recent years. These three species infest up to 77.2% of the surveyed acreage, and cause losses of 1.2%. Fruit feeding is important, although defoliation by the southern armyworm can reduce crop vigor. Control relies heavily on *Bacillus thuringiensis* based products, often applied every 3-4 days during peak populations. Traditionally, methomyl (Lannate, DuPont) or chlorpyrifos (Lorsban, Dow AgroSciences) were applied to eliminate mature larvae, which are less susceptible to B.t., but with the recent introduction of the reduced risk spinosad (Spintor, Dow AgroSciences), these materials are used less. This trend will increase as more reduced risk alternatives, such as emamectin benzoate (Proclaim, Novartis) and tebufenozide (Confirm, Rohm and Haas) come into use. Tomato pinworm control has been greatly enhanced in recent years by pheromones, used in traps for monitoring populations and for mating disruption when thresholds have been exceeded.
Leafminer (*Liriomyza* spp.) larvae feeding inside the leaf tissue cause reduced leaf surface and predispose the plant to attack by disease pathogens. Growers estimate losses to leafminers at over 1% with 89.5% of their acreage infested. Although losses are relatively low, control costs are significant. Current resistant management practice includes rotation of avermectin (Agrimek, Novartis), cyromazine (Trigard, Novartis) and spinosad. An average of 2 applications is needed to maintain control for an average planting. Applications are more frequent during the critical spring crop establishment period, when high numbers of leafminer adults invade newly planted fields from the

adjacent fall crop. An encouraging development in alternatives for leafminer control has resulted from the high level of control of whiteflies and worms by the "soft" chemistries of imidacloprid and *B.t.*, respectively, resulting in increased activity of parasitic wasps, *Diglyphus* sp, which parasitize the larvae and thus help control leafminers. Because of the parasitic activity of the wasps, leafminer control sprays are needed less often and later in the crop than in the past.

Other insect pests listed in Tables 11 and 12 caused less than 1% yield loss, and are not discussed here.

Nematodes: The major nematode pest is the root knot nematode, *Meloidogyne* spp., which is controlled by methyl bromide fumigation. The most promising alternative to methyl bromide at present is dichloropropene (Telone, Dow AgroSciences). Field testing is under way throughout south Florida and Telone is expected to become widely used when methyl bromide is phased out. Nematode infestation affected less than 1% of the surveyed acreage and yield losses were negligible.

Weeds: The most important weeds in south Florida are black nightshade, *Solanum nigrum*, and Nutsedge, *Cyperus* spp., followed by grasses (75.9%, 49.1% and 42.8% of surveyed acreage infested, respectively). Losses to weeds come primarily through competition for resources, which results in reduced crop vigor. Generally methyl bromide fumigation provides adequate control of nutsedge. Directed sprays of paraquat dichloride (Gramoxone Extra, Zeneca) and metribuzin (Sencor, Bayer) generally provide adequate control of nightshades, grasses and other weeds. Alternatives to these herbicides are available. Perhaps the most promising is glyphosate (Roundup, Monsanto) used as a chemical fallowing material during the off season.

The impact of key pests on the tomato production system in particular and the entire south Florida vegetable industry is significant. Considering the major pests discussed above and the minor pests together, growers' estimates of lost potential yield total 24.6% (Table 12). A 25% loss over the long term not only strains the economic well being of the farming industry, but puts pressure on south Florida's fragile environment. One expression of this is the greater acreage that therefore must be farmed to meet marketing demands, as well as the additional inputs needed to keep losses from going higher.

The economic impact of these pest losses is outlined in Table 14. >From these figures, losses due to pests cost growers 9056 pounds of tomatoes per acre, or over 4½ tons, which at the 1997-98 prices is $3,382 per acre in lost revenue. Of the surveyed growers' 9293 acres the revenue loss to pests totals over $31 million annually. Clearly the growers are justified in their pest management efforts, given the magnitude of these losses.

Integrated Pest Management in South Florida Tomatoes

Survey participants were queried about pest management practices. The results are presented in Table 15. The practices were categorized according to the PAMS system put forth by the USDA (NASS, 1998). The acronym, PAMS, stands for Prevention, Avoidance, Monitoring and Suppression. Pest managers are encouraged to incorporate as many prevention and avoidance practices as possible in order to avoid having pest problems in the first place. When pest problems arise, they are monitored, and when thresholds are exceeded, they are suppressed using the best techniques available. The results of the pest management survey clearly show that south Florida tomato growers employ a wide range of practices to manage pests. Foremost among these are those that fall into the categories of prevention, monitoring and suppression. Avoidance practices, which involve crop scheduling and field location are difficult to implement because of high land values and marketing demands. Pest monitoring or scouting was practiced on all the tomato acreage. The scouts included several independent consulting companies, fully trained farm staff or the growers themselves.

Pest suppression, the final step in the PAMS system, was carried out in a thoughtful, well-planned manner. Pesticide applications to fall and spring plantings are detailed in Tables 16 and 17, respectively. Active ingredients identified for regulatory action under the Food Quality Protection Act (FQPA) appear in **boldface**.

The most widely used pesticides include the fumigants, methyl bromide and chloropicrin, the fungicides, mancozeb, chlorothalonil and copper hydroxide, and imidacloprid and paraquat dichloride, insecticide and herbicide, respectively. These 7 active ingredients were applied to over 90% of all acreage.

The fungicides as a group were applied most often with up to 21 and 28 applications of mancozeb to fall and spring crops, respectively. Although the winter and spring seasons normally are less favorable for plant disease development than the summer and fall seasons, 1997-98 was an especially rainy El Niño season. Higher than usual rainfall coupled with slower crop maturity due to lower temperatures, resulted in the increased number of applications of the critical fungicide, mancozeb, and a higher average amount of active ingredient applied per acre. Chlorothalonil was applied less than half as often to either crop. Positive fungicide trends include increased use of azoxystrobin, with over 30% of the acreage treated at least once, and the use of bacteriaphage for biological control of bacterial spot. The acreage treated with bacteriaphage, however, was small.

Mancozeb and its sister compound, maneb, and chlorothalonil appear on the FQPA list as B2 carcinogens. A fourth fungicide, benomyl, which was used on a limited basis, appears on the FQPA list as a carbamate.

In addition to imidacloprid, formulations of *B.t.* were widely used. Tables 16 and 17 list separately the different subspecies of *B.t.* Together the *B.t.*'s were applied to over 90% of the acreage. Several reduced risk insecticides were also widely used, including avermectin, cyromazine, crop oil and esfenvalerate (Asana, DuPont). Insecticides appearing on the FQPA lists included carbaryl, chlorpyrifos, dimethoate, methamidophos, methomyl and oxamyl, which were applied to less than half the acreage. None of the herbicides applied to the surveyed acreage appear on the FQPA lists. Glyphosate is being field tested as a part of methyl bromide replacement strategies, while MCDS (Enquick, Unocal) is highly effective against several weeds that have developed resistance to paraquat dichloride, especially black nightshade.

Although fumigation with methyl bromide and chloropicrin is the current standard bed preparation treatment, a few acres were treated with metam sodium. Metam sodium appears as a B2 carcinogen on the FQPA list. It is sometimes applied through drip irrigation systems to kill a crop and associated weeds and nematodes in preparation for a subsequent crop thus reusing the plastic mulch. This treatment was used prior to planting 25 acres of the spring crop. Dichloropropene, currently being field tested as a methyl bromide replacement, is also listed as a B2 carcinogen.

Table 1
Tomato production and value for the 1997-98 south Florida growing season

	Acreage Planted	Harvested	Yield Per Acre (lb)	Value per lb	Total Value
US Total	88700				
Florida Total	37500	37300	36700	$0.32	$442,431,712
Regional Total	22320	22320	31330	$0.36	$254,815,610
Included in survey	9293	9293	36827	$0.40	$135,577,073
US Total	10.5%				
Florida Total	24.8%	24.9%	100.4%	122.6%	30.6%
Regional Total	41.6%	41.6%	117.6%	108.7%	53.2%
Included in survey	100.0%	100.0%	100.0%	100.0%	100.0%

Table 2
Tomato production acreage planted and harvested on surveyed farms during 1997-98 growing season in south Florida.
All planted acreage was harvested for the fresh market

Farm code	Acres planted	Production area
~C	50	Southwest Florida
~G	445	Southwest Florida
~K	210	Southwest Florida
~P	300	Southeast Florida
~Q	60	Southeast Florida
~R	550	Southwest Florida
~S	410	Southwest Florida
~U	330	Southwest Florida
~W	183	Southwest Florida
~X	63	Southwest Florida
~Z	405	Southwest Florida
1A	1000	Southwest Florida
1B	274	Southwest Florida
1C	300	Southwest Florida
1E	125	Southeast Florida
DE	2200	Southwest Florida
EA	425	Southwest Florida
IO	1500	Southwest Florida
OI	68	Southwest Florida
QM	395	Southwest Florida
Total acreage	9293	
Average farm size	465	

Table 3
South Florida tomato yields and returns for the 1997-98 season

Farm code [z]	Acres harvested	Yield (lb/A)	Estimated market price ($/lb)	Gross return per acre	Estimated annual production cost ($/A)	Estimated picking and packing costs (at $0.143/lb) [y]	Estimated net return per acre
~C	50	12000	$1.00	$12,000	$6,000	$1,716	$4,284
~G	445	30000	$0.36	$10,800	$5,500	$4,290	$1,010
~K	210	37500	$0.32	$12,000	NA [x]	$5,363	NA
~P	300	30000	$0.32	$9,600	$4,500	$4,290	$810
~Q	60	35000	$0.69	$24,000	$5,000	$5,005	$13,995
~Rf	275	37500	$0.40	$15,000	$5,400	$5,363	$4,238
~Rs	275	30000	$0.36	$10,800	$5,400	$4,290	$1,110
~Sf	210	25000	$0.32	$8,000	$5,000	$3,575	($575)
~Ss	200	42500	$0.40	$17,000	$5,000	$6,078	$5,923
~U	330	42000	NA	NA	$6,000	$6,006	NA
~W	183	37500	$0.32	$12,000	$4,500	$5,363	$2,138
~Xf	38	37500	$0.40	$15,000	$5,393	$5,363	$4,245
~Xs	25	37500	$0.36	$13,500	$4,420	$5,363	$3,718
~Zf	202	44375	$0.35	$15,531	$5,500	$6,346	$3,686
~Zs	203	52500	$0.30	$15,960	$6,250	$7,508	$2,203
1Af	600	37500	$0.36	$13,500	$6,000	$5,363	$2,138
1As	400	37500	$0.30	$11,250	$6,000	$5,363	($113)
1Bf	161	31300	$0.37	$11,531	$7,000	$4,476	$55
1Bs	113	40325	$0.35	$14,243	$7,000	$5,766	$1,476
1C	300	30000	$0.32	$9,600	$4,210	$4,290	$1,100
1E	125	50000	$0.25	$12,500	$5,800	$7,150	($450)
DE	2200	42500	$0.36	$15,300	$6,000	$6,078	$3,223
EA	425	37500	NA	NA	$3,400	$5,363	NA
IO	1500	40000	$0.34	$13,600	$5,500	$5,720	$2,380
OI	68	36250	$0.60	$21,750	$7,200	$5,184	$9,366
QM	395	43750	$0.36	$15,593	$3,621	$6,256	$5,715
Average		36827	$0.40	$13,752	$5,424	$5,266	$3,116

[z] Farm codes containing a lower case “f” or “s” represent fall and spring crops respectively.

[y] Based on an average picking and packing cost of $3.58/25 lb box.

[x] NA = Not available.

Table 4
Cost of pest management in south Florida tomatoes (1997-98)

Farm code [z]	Estimated annual production cost ($/A)	Average estimated pesticide cost ($/A)	Average estimated cost ($/A) for other IPM inputs: Crop consultants	Average estimated cost ($/A) for other IPM inputs: Pheromone trapping	Total pest management cost ($/A)	Pest management share of total production costs
~C	$6,000	$500	$50	$0	$550	9.2%
~G	$5,500	$1,000	$40	$0	$1,040	18.9%
~K	NA [y]	NA	NA	NA	NA	NA
~P	$4,500	$275	$40	$0	$315	7.0%
~Q	$5,000	$1,500	$40	$0	$1,540	30.8%
~Rf	$5,400	$700	$35	$0	$735	13.6%
~Rs	$5,400	$700	$35	$0	$735	13.6%
~Sf	$5,000	$425	$32	$0	$457	9.1%
~Ss	$5,000	$425	$32	$0	$457	9.1%
~U	$6,000	$2,000	$40	$0	$2,040	34.0%
~W	$4,500	$1,000	$0	$0	$1,000	22.2%
~Xf	$5,393	$1,251	$0	$0	$1,251	23.2%
~Xs	$4,420	$1,251	$0	$0	$1,251	28.3%
~Zf	$5,500	$1,250	$35	$1	$1,286	23.4%
~Zs	$6,250	$1,000	$35	$1	$1,036	16.6%
1Af	$6,000	$700	$35	$0	$735	12.3%
1As	$6,000	$700	$35	$0	$735	12.3%
1Bf	$7,000	$640	$50	$0	$690	9.9%
1Bs	$7,000	$640	$50	$0	$690	9.9%
1C	$4,210	$900	$0	$0	$900	21.4%
1E	$5,800	$400	$45	$0	$445	7.7%
DE	$6,000	$600	$43	$0	$643	10.7%
EA	$3,400	$500	$40	$0	$540	15.9%
IO	$5,500	$625	$25	$1	$651	11.8%
OI	$7,200	$1,150	$0	$0	$1,150	16.0%
QM	$3,621	$511	$0	$0	$511	14.1%
Average	$5,424	$826	$29	$0	$855	16.0%

[z] Farm codes containing a lower case “f” or “s” represent fall and spring crops respectively.

[y] NA = Not available.

Table 5
Soil types where tomatoes are grown in south Florida (1997-98 season)

Soil type	Acreage	Percent of total
Sand	8808	94.8%
Rock	485	5.2%
Total	9293	100.0%

Table 6
Irrigation practices used in growing south Florida tomato crops (1997-98 season)

Irrigation type	Acreage	Percent of total
Perched water table open	3196	34.4%
Perched water table semi-closed	3175	34.2%
Drip	2893	31.1%
Overhead volume gun	30	0.3%
Total	9293	100.0%
Special drainage practices used in growing south Florida tomatoes.		
Drain tile	14	0.2%

Table 7
Land preparation practices used between growing seasons in south Florida tomato crops (1997-98 season)

Land preparation practice	Acreage	Percent of total
Disking (Following crop residue turn-in)	8894	95.7%
Mechanical fallow	3543	38.1%
Herbicide fallow	125	1.4%
Flooding	5917	63.7%
Average duration of flooding (4.4 weeks)		
Cover crop	2029	21.8%
Laser level	8508	91.6%
Average period between laser leveling events (1.9 years)		

Table 8
Cover crops planted in south Florida tomato production areas (1997-98 season)

Cover crop type	Acreage planted	Percent of total cover crop acreage
Mixed grasses (millet, sorghum and/or rye)	203	10.0%
Legumes (clay pea or cow pea)	311	15.3%
Sorghum	1515	74.7%
Total cover crop acreage	2029	100.0%

Table 9
Cultural practices used in south Florida tomato production (1997-98 season)

Cultural practice	Acreage	Percent of total
Plastic mulch	9293	100.0%
Pruning	8668	93.3%
Staking	9293	100.0%
Tying	9293	100.0%
Hand cultivation for weed control	50	0.5%

Table 10
Planting date details for south Florida tomato crops (1997-98 season)

		Acreage
Average beginning fall planting date	08/26/97	
Duration of fall planting where planting break is observed (weeks) [z]	7.3	6185
Average end of fall planting where planting break is observed	10/16/97	
Average beginning spring planting date	12/09/97	
Duration of spring planting where planting break is observed (weeks)	7.4	
Average end of spring planting where planting break is observed	01/30/98	
Average length of planting break where planting break is observed	7.6	
Duration of planting where planting break is not observed	20.7	3108
Average end of planting where planting break is not observed	01/18/98	
Total		9293

[z] Includes farms where only fall crops are planted (788.0 acres)

Table 11. South Florida tomato pests: Frequency of occurrence and type of damage produced.

		Type of damage				
	Frequency of occurrence	**Defoliation.**	**Fruit damage**	**Reduced fruit set**	**Plant loss**	**Loss of vigor**
Diseases:						
Bacterial Spot	Annual	+	+	+		+
Early Blight	Annual (Winter, Spring)	+	+		+	
Fusarium Crown Rot	Annual (Winter, Spring)				+	+
Late Blight	Sporadic (Winter, Spring)	+	+		+	
Pythium	Annual (Summer, Fall)				+	
Southern Blight	Annual (Summer, Fall)				+	
Target Spot	Annual (Fall, Winter)	+	+	+		
Verticillium Wilt	Annual (Winter, Spring)				+	+
Virus Diseases	Annual		+	+		+
White Mold	Annual (Winter, Spring)				+	+
Insects:						
Aphids	Annual (Winter, Spring)					+
Beet Armyworms	Annual (Summer, Fall, Spring)	+	+			
Leafminers	Annual (Winter, Spring)	+				
Silverleaf Whiteflies	Annual		+			+
Southern Armyworms	Annual (Summer, Fall, Spring)	+	+			
Stinkbugs	Annual (Winter, Spring)		+			
Thrips	Annual (Winter, Spring)		+	+		
Tomato Pinworms	Annual (Winter, Spring)	+	+			
Nematodes:						
Root Knot Nematodes	Annual					+
Weeds:						
Eclipta	Annual					+
Goose Grass	Annual					+
Grasses, General	Annual					+
Nightshade	Annual					+
Nutsedge	Annual					+
Parthenium	Annual					+
Pigweed	Annual					+
Pusley	Annual					+
Ragweed	Annual					+
Sesbania	Spring					+
Smart Weed	Spring					+

Table 12. Pest problems occurring in south Florida tomato crops. Estimates of long-term (5 year) acreage affected and yield losses.

Pest	Acreage of control problems	Percent of total acreage	Average grower's estimate of lost potential yield
Diseases:			
Bacterial Spot	9031	97.2%	8.7%
Early Blight	2488	26.8%	1.8%
Fusarium Crown Rot	3688	39.7%	2.6%
Late Blight	892	9.6%	1.1%
Pythium	402	4.3%	0.0%
Southern Blight	555	6.0%	0.1%
Target Spot	6448	69.4%	3.7%
Verticillium Wilt	137	1.5%	0.8%
Virus Diseases	2992	32.2%	0.9%
White Mold	33	0.4%	0.1%
Insects:			
Aphids	1150	12.4%	0.1%
Beet Armyworms	3300	35.5%	0.3%
Leafminers	8318	89.5%	1.0%
Silverleaf Whiteflies	8443	90.9%	2.3%
Southern Armyworms	7172	77.2%	0.8%
Stinkbugs	560	6.0%	0.2%
Thrips	334	3.6%	0.0%
Tomato Pinworms	795	8.6%	0.1%
Nematodes:			
Root Knot Nematodes	34	0.4%	0.1%
Weeds			
Eclipta	1783	19.2%	0.0%
Goose Grass	2200	23.7%	0.0%
Grasses	1058	11.4%	0.0%
Nightshade	7053	75.9%	0.1%
Nutsedge	4559	49.1%	0.1%
Parthenium	360	3.9%	0.0%
Pigweed	550	5.9%	0.0%
Pusley	210	2.3%	0.0%
Ragweed	360	3.9%	0.0%
Sesbania	1100	11.8%	0.0%
Smart Weed	1100	11.8%	0.0%
Total % loss per acre			**24.6%**

Table 13
Primary chemical control practices employed against tomato pests in south Florida, 1997-98.
Boldface indicates active ingredients on the FQPA target list.

Pest	Primary control practice (Chemical name)	Trade name	Formulation	% of crop treated	Type of application	Average application rate (lb AI/A)	Average # of applications	Typical pre-harvest interval (days)
Diseases:								
Bacterial Spot	**Mancozeb**	**Dithane DF**	**75% DF**	**95.18**	**Foliar Spray**	**0.77**	**20.83**	**5**
	Copper Hydroxide	Kocide 101	77% WP	97.91	Foliar Spray	1.06	19.87	1
Early Blight	**Mancozeb**	**Dithane DF**	**75% DF**	**95.18**	**Foliar Spray**	**0.77**	**20.83**	**5**
	Copper Hydroxide	Kocide 101	77% WP	97.91	Foliar Spray	1.06	19.87	1
Fusarium Crown Rot	Methyl Bromide			99.58	Fumigation Injection	169.55	1.00	98
	Chloropicrin			99.58	Fumigation Injection	38.95	1.00	98
Late Blight	**Chlorothalonil**	**Bravo 720**	**6 lb AI/gal EC**	**96.52**	**Foliar Spray**	**1.19**	**8.28**	**2**
Pythium	Mefenoxam	Ridomil Gold EC	4 lb AI/ gal EC	59.29	Pre-plant Banded Spray, Post plant Injection or Spray	0.14	1.22	84
Southern Blight	Methyl Bromide			99.58	Fumigation Injection	169.55	1.00	98
	Chloropicrin			99.58	Fumigation Injection	38.95	1.00	98
Target Spot	**Chlorothalonil**	**Bravo 720**	**6 lb AI/gal EC**	**96.52**	**Foliar Spray**	**1.19**	**8.28**	**2**
Verticillium Wilt	Methyl Bromide			99.58	Fumigation Injection	169.55	1.00	98
	Chloropicrin			99.58	Fumigation Injection	38.95	1.00	98
Virus Diseases	Imidacloprid	Admire 2E	2 lb AI/gal EC	99.58	Transplant Drench or Foliar Spray	0.22	1.28	84
White Mold	Methyl Bromide			99.58	Fumigation Injection	169.55	1.00	98
	Chloropicrin			99.58	Fumigation Injection	38.95	1.00	98
Insects:								
Aphids	Imidacloprid	Admire 2E	2 lb AI/gal EC	99.58	Transplant Drench or Foliar Spray	0.22	1.28	84
Armyworms	Bacillus thuringiensis	Dipel, Agree	Several	93.24	Foliar Spray	0.09	7.12	1
Leafminers	Avermectin	Agrimek	0.15 lb AI/gal EC	61.95	Foliar Spray	0.01	1.75	7
Silverleaf Whiteflies	Imidacloprid	Admire 2E	2 lb AI/gal EC	99.58	Transplant Drench or Foliar Spray	0.22	1.28	84
Stinkbugs	Endosulfan	Thiodan 3EC	6 lb AI/gal EC3	28.58	Foliar Spray	0.79	3.15	2
Thrips	Spinosad	SpinTor 2SC	2 lb AI/gal EC	40.05	Foliar Spray	0.09	1.92	1
Tomato Pinworms	Bacillus thuringiensis	Dipel, Agree	Several	93.24	Foliar Spray	0.09	7.12	1
Root Knot Nematode	Methyl Bromide			99.58	Fumigation Injection	169.55	1.00	98
	Chloropicrin			99.58	Fumigation Injection	38.95	1.00	98

Table 13 ***(Continued)***
Primary chemical control practices employed against tomato pests in south Florida, 1997-98.
Boldface indicates active ingredients on the FQPA target list.

Weeds:								
Eclipta	Paraquat dichloride	Gramoxone	2.5 lb AI/gal EC	95.87	Directed Spray	0.71	1.53	72
	Metribuzin	Sencor	75% DF	81.72	Directed Spray	0.54	1.13	72
Grasses	Paraquat dichloride	Gramoxone	2.5 lb AI/gal EC	95.87	Directed Spray	0.71	1.53	72
	Metribuzin	Sencor	75% DF	81.72	Directed Spray	0.54	1.13	72
Nightshade	Paraquat dichloride	Gramoxone	2.5 lb AI/gal EC	95.87	Directed Spray	0.71	1.53	72
	Metribuzin	Sencor	75% DF	81.72	Directed Spray	0.54	1.13	72
Nutsedge	Methyl Bromide			99.58	Fumigation Injection	169.55	1.00	98
	Chloropicrin			99.58	Fumigation Injection	38.95	1.00	98
Parthenium	Paraquat dichloride	Gramoxone	2.5 lb AI/gal EC	95.87	Directed Spray	0.71	1.53	72
	Metribuzin	Sencor	75% DF	81.72	Directed Spray	0.54	1.13	72
Pigweed	Paraquat dichloride	Gramoxone	2.5 lb AI/gal EC	95.87	Directed Spray	0.71	1.53	72
	Metribuzin	Sencor	75% DF	81.72	Directed Spray	0.54	1.13	72
Pusley	Paraquat dichloride	Gramoxone	2.5 lb AI/gal EC	95.87	Directed Spray	0.71	1.53	72
	Metribuzin	Sencor	75% DF	81.72	Directed Spray	0.54	1.13	72
Ragweed	Paraquat dichloride	Gramoxone	2.5 lb AI/gal EC	95.87	Directed Spray	0.71	1.53	72
	Metribuzin	Sencor	75% DF	81.72	Directed Spray	0.54	1.13	72
Sesbania	Paraquat dichloride	Gramoxone	2.5 lb AI/gal EC	95.87	Directed Spray	0.71	1.53	72
	Metribuzin	Sencor	75% DF	81.72	Directed Spray	0.54	1.13	72
Smart Weed	Paraquat dichloride	Gramoxone	2.5 lb AI/gal EC	95.87	Directed Spray	0.71	1.53	72
	Metribuzin	Sencor	75% DF	81.72	Directed Spray	0.54	1.13	72

Table 14

Estimated economic impact of pest activity in south Florida tomatoes.

Total % loss per acre	24.6%
Average marketable yield per acre from Table 3	36,827
Potential yield (Avg. yield*(1+Total % loss))	45,884
Difference (lost yield in lb/A)	(9,057)
Average gross return per acre from Table 3	$13,752
Potential gross return per acre (Avg. gross return*(1+Total % loss))	$17,134
Difference (lost return in $/A)	($3,382)
Total $$ loss in survey area (lost return*9293 acres)	($31,429,205)

Table 15

Frequency of use of selected tomato IPM practices by south Florida tomato growers.

Percentages in **boldface** represent the numbers of growers who responded that each practice was used "sometimes", "usually" or "always".

75-100%				
IPM practice category				
Prevention	Avoidance	Monitoring	Suppression	
X		X		Managing and scouting crop margins
X				Field sanitation (disking)
X				Crop destruction
X				Water table management for disease control
	X			Sanitation for hand laborers
		X		Disease scouting (field and transplants)
		X		Proper disease identification
		X		Maintain written or electronic scouting records
			X	Maintain pesticide application records
			X	Equipment calibration and maintenance
			X	Soil fumigation
			X	Preventive fungicide practices
			X	Pesticides chosen for efficacy rather than cost
			X	Applicator training and licensing
			X	Worker protection standards
			X	Imidacloprid treatments at planting
			X	Adjusting insecticide and fungicide spray intervals according to pest pressure

Table 15 *(Continued)*

Frequency of use of selected tomato IPM practices by south Florida tomato growers.

Percentages in **boldface** represent the numbers of growers who responded that each practice was used “sometimes”, “usually” or “always”.

75-100% *(Continued)*				
			X	Protecting transplants from insects and diseases
			X	Resistance management
			X	Choice of biologically friendly pesticides when available
			X	Roguing young plants with disease symptoms
50-75%				
	X			Interrupt sequential plantings
	X			Use resistant varieties
	X			Crop rotation (double cropping)
		X		Scouting for beneficial insects
		X	X	Herbicides chosen based on weed identification
			X	Insecticides and herbicides applied only according to scouting reports
			X	Adjust insecticide and fungicide application rates
			X	Using adjuvants to improve safety and efficacy of applications
			X	B.t. Applied only on demand
			X	Herbicide spot treatments
Percentage of respondents using this practice at least half the time				
25-50%				
IPM practice category				
Prevention	Avoidance	Monitoring	Suppression	
X				Adjusting soil pH and nitrogen sources for Fusarium management
	X			Cleaning field equipment to prevent disease spread
		X		Using tomato pinworm pheromones
			X	Destroy and replant young fields with disease problems
			X	Adjust herbicide application intervals
			X	Spot treatments for diseases
			X	Delaying insecticide applications if beneficial insects are adequate for control
			X	Adjusting herbicide application rates

Table 15 *(Continued)*

Frequency of use of selected tomato IPM practices by south Florida tomato growers.

Percentages in **boldface** represent the numbers of growers who responded that each practice was used “sometimes”, “usually” or “always”.

0-25%				
X				Cover cropping
	X			Field selection based on past pest incidence
	X			Intercropping
	X			Manage planting schedule to avoid pest incidence
	X			Reflective mulch
	X		X	Mycorrhizal seed treatments or amendments to field or transplant soil
		X		Precision agriculture (GPS, grid sampling)
		X		Insect and disease pest mapping
			X	Tomato pinworm mating disruption
			X	Mechanical weed control
			X	Unsprayed refuges for beneficial insects
			X	Rotate herbicides
			X	Beneficial insect releases

Table 16
Pesticide active ingredients applied to fall tomato crops and to tomato farms where no planting break was observed. 1997-98.
Boldface indicates active ingredients on the FQPA target list.

Pesticide type	FQPA List [z]	Active ingredient	Acres treated at least once	% of crop treated at least once	Average lb AI used per treated acre	Average number of applications	Average application rate (lb AI/A)	Application rate range(lb AI/A) Low	Application rate range(lb AI/A) High
Fumigant		Chloropicrin	5954	99.6%	39.0	1	39.0	4.0	79.2
Fumigant		Methyl Bromide	5954	99.6%	169.6	1	169.6	100.5	220.5
Fungicide		Copper Hydroxide	5854	97.9%	19.5	20	1.1	0.2	2.3
Fungicide	**b**	**Chlorothalonil**	**5771**	**96.5%**	**9.6**	**8**	**1.2**	**0.2**	**2.3**
Fungicide	**b**	**Mancozeb**	**5691**	**95.2%**	**13.9**	**21**	**0.8**	**0.1**	**1.5**
Fungicide		Mefenoxam	3545	59.3%	0.1	1	0.14	0.02	0.50
Fungicide		Azoxystrobin	2210	37.0%	0.2	2	0.1	0.1	0.1
Fungicide		Fosetyl Al	1273	21.3%	3.6	2	2.2	1.4	4.0
Fungicide		Copper Sulfate	404	6.8%	13.0	13	0.9	0.8	1.1
Fungicide	**c**	**Benomyl**	**349**	**5.8%**	**0.3**	**1**	**0.2**	**0.1**	**0.3**
Fungicide	**b**	**Maneb**	**338**	**5.7%**	**16.0**	**13**	**1.0**	**0.7**	**1.5**
Fungicide		Copper Oxychloride	275	4.6%	8.0	7	1.1	1.1	1.1
Fungicide		Copper Ammonium Carbonate	210	3.5%	0.2	2	0.1	0.1	0.1
Fungicide		Sulfur	210	3.5%	19.5	7	2.5	0.2	5.0
Fungicide		Propamocarb Hydrochloride	165	2.8%	0.8	1	0.8	0.8	0.8
Fungicide		Bacteriaphage	24	0.4%	8.00E+10	4	2.00E+10	2.00E+10	2.00E+10
Herbicide		Paraquat Dichloride	5732	95.9%	1.0	2	0.7	0.3	0.9
Herbicide		Metribuzin	4886	81.7%	0.6	1	0.5	0.3	1.0
Herbicide		MCDS	1495	25.0%	33.7	1	33.7	32.6	34.9
Herbicide		Glyphosate	1393	23.3%	1.3	1	1.3	1.0	2.0
Herbicide		Diquat Dibromide	586	9.8%	0.4	1	0.3	0.3	0.4
Herbicide		Sethoxydim	118	2.0%	0.2	1	0.2	0.2	0.3
Insecticide		Imidacloprid	5954	99.6%	0.3	1	0.2	0.1	0.4
Insecticide		Bt engineered	4610	77.1%	1.4	8	0.1	0.0	0.5
Insecticide		Avermectin	3704	62.0%	0.0	2	0.01	0.01	0.01
Insecticide		Bt kurstaki	3526	59.0%	0.3	7	0.1	0.0	0.1
Insecticide		Cyromazine	2729	45.6%	0.2	1	0.1	0.1	0.1
Insecticide	**c**	**Methomyl**	**2618**	**43.8%**	**0.7**	**2**	**0.5**	**0.2**	**0.9**
Insecticide		Spinosad	2395	40.1%	0.2	2	0.1	0.1	0.1
Insecticide		Cyhalothrin	1833	30.7%	0.1	4	0.03	0.02	0.05

[z] b = B2 Carcinogen, c = Carbamate, o = Organophosphate

Table 16 (Continued)

Pesticide active ingredients applied to fall tomato crops and to tomato farms where no planting break was observed. 1997-98.

Boldface indicates active ingredients on the FQPA target list.

Pesticide type	FQPA List [z]	Active ingredient	Acres treated at least once	% of crop treated at least once	Average lb AI used per treated acre	Average number of applications	Average application rate (lb AI/A)	Application rate range(lb AI/A) Low	High
Insecticide		Crop Oil	1806	30.2%	2.1	1	1.4	0.6	1.8
Insecticide		Endosulfan	1709	28.6%	2.4	3	0.8	0.5	1.0
Insecticide		Detergent	1375	23.0%	1.9	4	0.7	0.5	0.9
Insecticide		Permethrin	1145	19.1%	0.9	10	0.1	0.1	0.1
Insecticide	**o**	**Chlorpyrifos**	**1035**	**17.3%**	**0.4**	**1**	**0.4**	**0.3**	**0.5**
Insecticide		Esfenvalerate	909	15.2%	0.2	5	0.04	0.03	0.05
Insecticide		Bt aizawi	900	15.1%	0.5	6	0.1	0.1	0.1
Insecticide	**c**	**Oxamyl**	**600**	**10.0%**	**1.5**	**3**	**0.5**	**0.5**	**0.5**
Insecticide		Cyfluthrin	521	8.7%	0.1	3	0.1	0.0	0.1
Insecticide	**o**	**Methamidophos**	**443**	**7.4%**	**1.3**	**1**	**1.3**	**1.0**	**2.0**
Insecticide		Piperonyl Butoxide	202	3.4%	3.0	12	0.3	0.3	0.3
Insecticide	**c**	**Carbaryl**	**125**	**2.1%**	**3.0**	**3**	**1.0**	**1.0**	**1.0**
Insecticide	**o**	**Dimethoate**	**38**	**0.6%**	**2.50**	**5**	**0.5**	**0.5**	**0.5**
Insecticide		Garlic/Sugar/Capsaici n	25	0.4%	9.7	2	4.9	4.9	4.9
Insecticide		Neem oil	8	0.1%	8.2	3	2.7	2.7	2.7
Nematicide		Chitin	25	0.4%	132	1	132.0	132.0	132.0

[z] b = B2 Carcinogen, c = Carbamate, o = Organophosphate

Table 17
Pesticide active ingredients applied to spring tomato crops. 1997-98.
Boldface indicates active ingredients on the FQPA target list.

Pesticide type	FQPA List [z]	Active ingredient	Acres treated at least once	% of crop treated at least once	Average lb AI used per treated acre	Average number of applications	Average application rate (lb AI/A)	Application rate range(lb AI/A) Low	Application rate range(lb AI/A) High
Fumigant		Chloropicrin	3289	99.3%	28.4	1	28.4	4.0	66.0
Fumigant		Methyl Bromide	3289	99.3%	181.0	1	181.0	134.0	220.5
Fumigant	**b**	**Metam Sodium**	**25**	**0.8%**	**95.4**	**1**	**95.4**	**95.4**	**95.4**
Fungicide		Copper Hydroxide	3289	99.3%	24.4	26	1.1	0.2	2.3
Fungicide	**b**	**Mancozeb**	**3264**	**98.5%**	**15.4**	**29**	**0.6**	**0.1**	**1.4**
Fungicide	**b**	**Chlorothalonil**	**3189**	**96.2%**	**11.1**	**12**	**1.0**	**0.2**	**2.3**
Fungicide		Mefenoxam	2203	66.5%	0.2	1	0.12	0.02	0.50
Fungicide		Azoxystrobin	1100	33.2%	0.4	4	0.1	0.1	0.1
Fungicide	**c**	**Benomyl**	**888**	**26.8%**	**0.7**	**2**	**0.3**	**0.1**	**0.5**
Fungicide		Fosetyl Al	425	12.8%	5.4	2	2.7	1.4	4.0
Fungicide		Propamocarb Hydrochloride	302	9.1%	1.4	2	0.9	0.8	0.9
Fungicide		Dimethomorph	223	6.7%	0.2	1	0.2	0.2	0.2
Fungicide		Copper Sulfate	203	6.1%	13.0	13	0.9	0.8	1.1
Fungicide		Bacteriaphage	25	0.8%	5.62E+10	10	5.62E+10	5.62E+10	5.62E+10
Fungicide	**b**	**Maneb**	**25**	**0.8%**	**16.6**	**6**	**1.1**	**0.8**	**0.8**
Fungicide		Sulfur	25	0.8%	33.0	15	2.2	2.2	2.2
Herbicide		Metribuzin	3189	96.2%	0.5	1	0.5	0.3	0.8
Herbicide		Paraquat Dichloride	3066	92.5%	1.3	2	1.0	0.5	3.8
Herbicide		MCDS	1100	33.2%	34.9	1	34.9	34.9	34.9
Herbicide		Glyphosate	400	12.1%	1.0	1	1.0	1.0	1.0
Herbicide		Permethrin	316	9.5%	1.6	17	0.1	0.1	0.1
Herbicide		Diquat Dibromide	113	3.4%	0.4	1	0.4	0.4	0.4
Herbicide		Sethoxydim	102	3.1%	0.3	1	0.3	0.3	0.3
Insecticide		Imidacloprid	3289	99.3%	0.3	2	0.19	0.03	0.36
Insecticide		Bt engineered	2976	89.8%	1.0	8	0.14	0.02	0.45
Insecticide		Avermectin	2948	89.0%	0.0	3	0.01	0.00	0.01
Insecticide		Crop Oil	1998	60.3%	4.1	2	1.8	0.9	2.6
Insecticide		Esfenvalerate	1826	55.1%	0.2	4	0.04	0.03	0.05
Insecticide		Bt kurstaki	1814	54.7%	0.3	6	0.05	0.03	0.08

[z] b = B2 Carcinogen, c = Carbamate, o = Organophosphate

Table 17 *(Continued)*
Pesticide active ingredients applied to spring tomato crops. 1997-98.
Boldface indicates active ingredients on the FQPA target list.

Pesticide type	FQPA List [z]	Active ingredient	Acres treated at least once	% of crop treated at least once	Average lb AI used per treated acre	Average number of applications	Average application rate (lb AI/A)	Application rate range(lb AI/A)	
								Low	High
Insecticide		Cyromazine	1566	47.3%	0.3	2	0.1	0.1	0.1
Insecticide		Detergent	1375	41.5%	1.9	4	0.7	0.5	0.9
Insecticide	**o**	**Methamidophos**	**1337**	**40.3%**	**0.8**	**1**	**0.8**	**0.5**	**1.0**
Insecticide	**c**	**Methomyl**	**1325**	**40.0%**	**0.7**	**2**	**0.4**	**0.2**	**0.5**
Insecticide		Cyhalothrin	1030	31.1%	0.1	3	0.03	0.02	0.05
Insecticide		Bt aizawi	775	23.4%	0.5	5	0.1	0.1	0.1
Insecticide		Endosulfan	710	21.4%	2.7	3	0.9	0.8	1.0
Insecticide		Spinosad	340	10.2%	0.1	2	0.1	0.1	0.1
Insecticide		Piperonyl Butoxide	203	6.1%	4.0	16	0.3	0.3	0.3
Insecticide	**o**	**Chlorpyrifos**	**200**	**6.0%**	**0.5**	**1**	**0.5**	**0.5**	**0.5**
Insecticide		Cymoxanil	35	1.1%	0.2	2	0.1	0.1	0.1
Insecticide	**o**	**Dimethoate**	**25**	**0.8%**	**2.5**	**5**	**0.5**	**0.5**	**0.5**
Insecticide		Garlic/Sugar/Capsaicin	25	0.8%	9.7	2	4.9	4.9	4.9
Insecticide		TPW Pheromone	25	0.8%	0.04	1	0.04	0.04	0.04
Insecticide		Neem oil	8	0.2%	8.2	3	2.7	2.7	2.7
Nematicide		Chitin	25	0.8%	132.0	1	132.0	132.0	132.0

[z] b = B2 Carcinogen, c = Carbamate, o = Organophosphate

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