

# Crop Profile for Tomatoes in Kentucky

*(Lycopersicon esculentum)*



**Prepared: September, 2001**

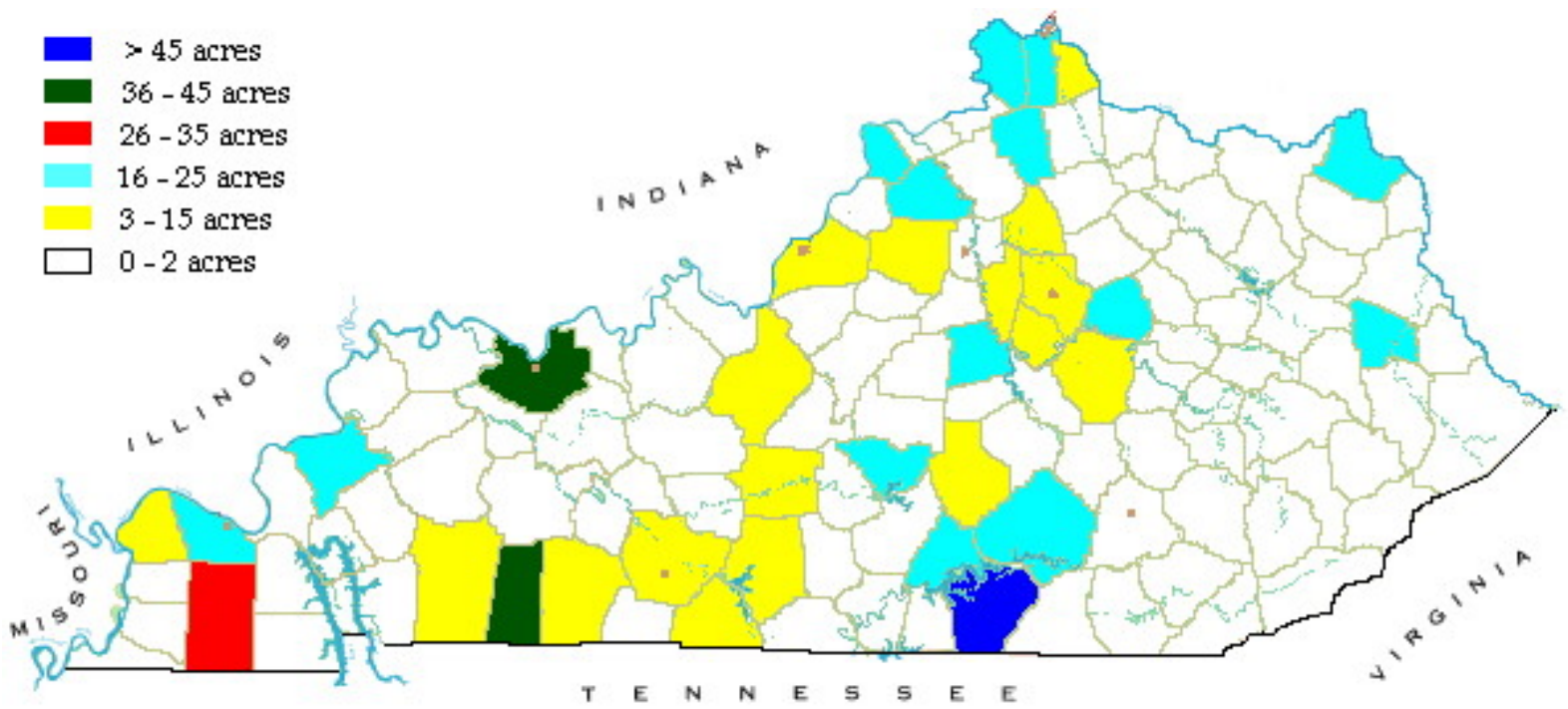
## General Production Information

### Production Statistics

The total acreage in Kentucky was estimated to be approximately 1,100 acres in 1998 with an additional 12 acres of greenhouse production. The tomato production in Kentucky during 1998 was estimated to be valued at US \$12,454,400. Tomatoes are marketed on a wholesale and retail basis.

### Production Regions

Tomato production generally occurs on small farms scattered across the state. The map below indicates the commercial tomato acreage by county reported for USDA 1997 Ag. Census and listed 1998 by the Purdue University Center for New Crops and Plant Products. Cooperatives in south central and western Kentucky have increased the concentration of fresh market pepper production in Daviess, Wayne, Graves and Todd counties.



## Cultural Practices

### Varieties Recommended for Kentucky:

#### Large Red-

Better Boy	Mountain Spring
Mountain Fresh	Mountain Supreme
Sunbeam	Solar Set
Sun Leaper	

#### Red Cherry-

Cherry Grande	Mountain Belle
Sweet Chelsea	

#### Pear/Paste-

Brigade	Milano
Spectrum 882	Plum Dandy
Roma VF	

#### Yellow Fruit-

Carolina Gold (hybrid) Lemon Boy (hybrid)

## **Pink Fruit-**

Tough Boy

Pink Girl

### **Specific Issues with Tomato Production in Kentucky**

#### **Herbicide Residue / Herbicide Drift:**

Be very careful planting in fields following corn or soybeans as common herbicides used in these crops can carryover, even from one year to the next, and be very damaging to tomatoes. In addition to carryover residues within the field, herbicide drift from neighboring fields into tomato fields continues to be a serious issue.

#### **Susceptibility to Tobacco Diseases**

Tomatoes and tobacco are in the same plant family and share similar diseases. For this reason, rotation between tomatoes and tobacco can encourage several tomato diseases. Although tobacco ground may represent some of the best land on a farm, it is advisable wait at least three years before planting tomatoes in fields used for tobacco. Relative to tomatoes, tobacco is more resistant to many of these shared diseases.

#### **Repeated Use of Fields for Tomatoes**

Disease susceptibility of tomatoes also dictates that tomatoes should not follow tomatoes on the same land for a period of three years.

## **Insect Pests**

**Aphids**  
*(Macrosiphum euphorbiae)*



Aphids or plant lice are among the smallest, most defenseless and most preyed on of all insects, yet because of their immense vitality and extraordinary fecundity resulting from a short life cycle and an ability to reproduce parthenogenetically, they affect nearly every kind of green plant, including tomatoes. On a single large tomato plant, 24,688 aphids have been counted.

Aphids, generally about 1/16 to 1/8 inch long, are usually green, although some species are brown, yellow, pink or black. They can usually be distinguished by the pair of oil- or wax-secreting tubes on the upper side of the fifth or sixth abdominal segment and by their two-segmented tarsi. They feed by thrusting sharp, hollow stylets from their beaks in among the plant cells and sucking out the sap. During the feeding process, they may inject a toxic saliva into the plant. The result is a blighting of buds, dimpling of fruits, curling of leaves and the appearance of discolored spots on the foliage.

On tomatoes, the most noticeable injury is the devitalizing of the blossom clusters so that the blossoms fall and no tomatoes set. When large numbers of aphids are present, the plants may gradually wilt, turn yellowish or brown and die. Aphids are among the most important agents in the dissemination of plant virus diseases; a brief period of feeding by a single infected aphid may infect and eventually kill a plant.

Aphids typically winter as fertilized eggs on some perennial plant (particularly roses) or on refuse from annual vegetable crops. The spring hatching nymphs, functioning as stem-mothers, become the start for a great colony of aphids over the growing season. Greenish or pinkish, winged or wingless aphids cluster in shaded places on the leaves, stems and blossoms. Winged migrants spread from field to field so that the epidemic may sweep over a district in an alarming manner. Following such an outbreak, the insect may not visit a community in conspicuous numbers again for many years.

### **Controls**

**Biological:** Aphids are preyed upon by lady beetles and green lacewing and syrphid larvae, but these cannot usually control the rapid spring increase in aphid populations. Wasp parasites are also enemies of aphids.

### **Application Alternatives Used in Kentucky:**

**Admire 2 F-** Apply as a soil application at 16 to 24 fl oz per acre to a limit of 24 fl oz per season.

**Dimethoate 400-** Apply as a foliar application at 1/2 to 1 pint per acre per season.

**Diazinon 50 WP-** Apply as a foliar application at 1/2 lb per acre per season.

**Endosulfan 3 EC (Thiodan, Phaser)-** Apply as a foliar application at 2/3 to 1-1/3 qt per acre to a limit of 6 applications or 4 qt per acre per season.

**Malathion 57 EC-** Apply as a foliar application at 1 to 3 pt per acre.

**Provado 1.6 F-** Apply as a foliar application at 3.75 fl oz per acre to a limit of 18.75 fl oz per acre per season. (Do not use following a soil application of Admire.)

### **Beet Armyworm** *(Spodoptera exigua)*



The beet armyworm is a general feeder and attacks the foliage, stems of field and vegetable crops. It is an occasional invader of vegetable crops in Kentucky.

Although it cannot overwinter here, it is a significant pest for vegetable growers because of its wide host range and resistance to most insecticides. This insect is killed by the first hard frosts in the fall. Producers of fall vegetable crops need to watch out for this pest during August and September. The beet armyworm is a light-green to black larva with four pairs of abdominal prolegs and a dark head. There are many fine, white wavy lines along the back and a broader stripe along each side. There is usually a distinctive dark spot on each side just above the second pair of true legs.

Female moths lay masses of up to 80 eggs underneath a covering of cottony-white scales, as many as 600 eggs over a 3 to 7-day period. These eggs hatch in 2 to 3 days and the larvae first feed together in a group near the egg cluster. As they grow, they gradually move away from the egg masses. Many small larvae die during this wandering stage but the behavior tends to spread out the infestation. Beet armyworm is quite mobile, one larvae may attack several plants in a row. Older larvae may feed on fruit as well as leaves. After they complete their feeding, the 1-1/4 inch larvae pupate in the soil in a loose cocoon containing soil particles and leaf fragments. The life cycle takes about a month to complete in warm weather.

### **Controls**

**Biological:** There are no effective biological control agents against beet armyworm that occur naturally in Kentucky. There is a commercially available virus, beet armyworm NPV, that is applied like as a foliar spray. This material is effective, but takes about two weeks to kill the larvae.

**Cultural:** No effective cultural controls available.

**Monitoring:** Controls are recommended when an average of one or more larvae are found on 40 plants.

#### **Application Alternatives Used in Kentucky:**

**Avaunt 30 DG** - Apply as foliar spray to control small larvae at a rate of 3.5 oz per acre. Limit 14 oz per acre. Allow 5 days between applications.

**Bt var aizawai products**- Apply as a foliar application at 1/2 to 2 lb per acre per season.

**Confirm 2 F** - Apply as a foliar spray at 6 to 16 fl oz per acre. Limit 64 fl oz per acre per season.

**Spintor 2SC**- Apply as a foliar application at 4 to 8 fl oz per acre to a limit of 0.45 lb ai per acre per season.

### **Colorado Potato Beetle** *(Leptinotarsa decemlineata)*



The Colorado potato beetle is notorious for its ability to rapidly develop resistance to insecticides that are used repeatedly for control. This has been a serious problem on the east coast for some time, and is becoming more of a problem in Kentucky. With a limited number of insecticides available, some homeowners feel they have exhausted their control options when it becomes resistant to one or more insecticides.

In tomatoes Colorado potato beetle is an infrequent pest of newly set tomato plants. The adult and larva feed on the leaves and terminal growth of tomato plants, but typically only cause serious damage to young plants. Once plants reach eight inches, adult or larval feeding, regardless of the apparent severity of damage, does not reduce fruit yield.

Colorado potato beetles overwinter in the soil as adults. They become active in the spring as temperatures

rise and begin to feed on weeds and volunteer or early planted potatoes, even entering the soil to attack emerging foliage. Female beetles lay orange-yellow eggs in batches of about two dozen or so on the underside of the leaves. Each female can lay 500 or more eggs over a four to five week period. Eggs hatch in four to nine days and the larvae begin to feed on potato foliage. The larvae are humpbacked with two rows of black spots on each side. They usually feed in groups and damage can be severe. The larval stage lasts two to three weeks.

Full grown larvae burrow in the ground to pupate. In five to 10 days, the adult beetle emerges. This insect can go from egg to adult in as little as 21 days. The newly emerged adult female feeds for a few days before egg laying begins. There are two full and occasionally a partial third generation each year. If foliar sprays are used, an effort should be made to treat just after most eggs have hatched but before serious plant damage occurs.

## Controls

**Biological:** The Colorado potato beetle has several important natural enemies in Kentucky including the pentatomids, *Perillus biocultaus* and *Podisus maculiventris*. *Bacillus thuringiensis* var *tenebrionis* (Bt) is effective against small larvae (less than 1/4 inch) and should be applied at egg hatch or when larvae are first seen. A premature treatment may lose much of its effectiveness before the eggs hatch. Larger larvae are more difficult to control with Bt.

**Monitoring:** Treat for Colorado potato beetle if an average of 1 adult larva or egg mass per plant is found and plants are less than 12 inches tall when staked.

**Chemical:** Insecticides in the same chemical class usually have the same mode of action, the same method of killing the insect. Resistance develops more rapidly to an insecticide when that insecticide is used repeatedly as the only control measure. Repeated use of one kills susceptible beetles, leaving those that are resistant. Overuse of one insecticide may favor the development of resistance to other insecticides in the same chemical class. Consequently, to delay or prevent resistance it is important to avoid repeated usage of one particular insecticide by rotating the insecticides used.

### Application Alternatives Used in Kentucky:

**Actara 25 WDG** - Apply at 2 to 3 oz per acre. Limit 8 oz per acre per season. Allow 5 days between applications.

**AgriMek 0.15 EC** - Apply as a foliar spray at 8 to 16 fl oz per acre. Limit 48 fl oz per acre per season. Allow 7 days between applications.

**Ambush 2 E**- Apply as a foliar application at 3.2 to 12.8 fl oz per acre to a limit of 76.8 fl oz per acre per season.

**Asana XL-** Apply as a foliar application at 5.8 to 9.6 fl oz per acre to a limit of 96 fl oz per acre per season.

**Baythroid 2-** Apply as a foliar application at 1.6 to 2.8 fl oz per acre to a limit of 16.8 fl oz per acre per season. Allow 7 days between applications.

**Endosulfan 3 EC -** Apply as a foliar application at 2/3 to 1-1/3 qt per acre to a limit of 4 qt per acre or 6 applications per season.

**Provado 1.6 F-** Apply as a foliar application at 3.75 fl oz per acre to a limit 18.75 fl oz per acre per season. Do not use following a soil application of Admire.

**Spintor 2SC-** Apply as a foliar application at 2.25 to 4.5 fl oz per acre to a limit of 0.45 lb ai per acre per season.

**Warrior 1EC-** Apply as a foliar application at 2.56 to 3.84 fl oz per acre to a limit of 2.88 pts per acre per season. Not for use on cherry tomatoes.

### **Cutworms (Various species)**

Several species of cutworms can occasionally be serious pests of newly set tomatoes in Kentucky. As in other crops, the seedling losses caused by cutworms result in reduced stands.

### **Controls**

**Biological:** Ground beetles and other generalist predators readily prey upon several cutworm species.

**Cultural:** Rotation of crops and summer plowing can be effective in limiting the impact of some cutworms. Eliminate weeds from field margins and plow fields at least two weeks prior to planting to destroy cutworm food sources and egg laying sites.

**Monitoring:** Often tomato producers treat for cutworms and flea beetles preventively just after the plants have been set into the field.

### **Application Alternatives Used in Kentucky:**

**Asana XL-** Apply as a foliar application at 5.8 to 9.6 fl oz per acre to a limit of 96 fl oz per acre per season.

**Sevin 80 WSP-** Apply as a foliar application at 2-1/2 lbs per acre to a limit of 7 applications per season and allow at least 7 days between sprays.



**Pounce 3.2 EC** - Apply as foliar spray at 2 to 8 fl oz per acre. Limit 48 fl oz per acre per season. Not for use on cherry tomatoes.

**Warrior 1 EC**- Apply as a foliar application at 1.92 to 3.2 fl oz per acre to a limit of 2.88 pts per acre per season.

### **Tomato Fruitworm** (*Heliothis zea*)



The tomato fruitworm is potentially the most damaging insect pest of tomato. The larvae are variable in color, ranging from pale yellow, to red, to green, to brown with pale stripes running lengthwise. The larvae have four pairs of prolegs and are densely covered with microscopic spines that makes the larvae feel rough.

The moths lay eggs at night on leaves near green fruit at the outer edges of the plant. The dome shaped eggs are white when first laid and develop a reddish brown band before hatching. After the egg hatches, the larva feed for a short period of time on the foliage before attacking the fruit. They prefer to feed on green fruit and usually do not enter ripe fruit. Damage consists of deep watery cavities frequently in the stem end of the fruit. During its development, one larva may injure several fruit.

The tomato fruitworm has a wide host range and the attractiveness of tomatoes for egg laying vary with the time of year. Early fruitworm generations attack corn, particularly when it is silking. But tomatoes are preferred for egg laying over corn when the silks turn brown and dry.

### **Controls**

**Biological:** The egg parasite, *Trichogramma* ssp., is the most important natural enemy.

**Monitoring:** Carefully monitor plants for eggs on undersides of leaves, often near flower clusters. Consider treatment only when the plants have green fruit and an average of 1 infested plants (larvae or fresh feeding damage) per 40 plants or when any eggs are present on foliage. Monitor for eggs carefully when trap catches exceed 7 moths per trap per week.

**Application Alternatives Used in Kentucky:**

**Ambush 2E**- Apply as a foliar application at 3.2 to 12.8 fl oz per acre to a limit of 76.8 fl oz per acre per season.

**Asana XL**- Apply as a foliar application at 5.8 to 9.6 fl oz per acre to a limit of 96 fl oz per acre per season.

**Avaunt 30 DG** - Apply as a foliar spray at 3.5 oz. Limit 14 oz per acre. Allow 5 days between applications per season.

**Baythroid 2**- Apply as a foliar application at 1.6 to 2.8 fl oz per acre to a limit of 16.8 fl oz per acre per season. Allow 7 days between applications.

**Danitol 2.4 EC** - Apply as foliar spray at 10-2/3 fl oz per acre. Allow 7 days between applications per season.

**Endosulfan 3 EC** - Apply as a foliar application at 1-1/3 qt per acre to a limit of 4 qt per acre per season.

**Pounce 3.2 EC** - Apply as foliar spray at 2 to 8 fl oz per acre. Limit 48 fl oz per acre per season. Not for use on cherry tomatoes.

**Sevin WSP**- Apply as a foliar application at 1-1/4 to 2-1/2 lb per acre to a limit of 7 applications per acre per season. Allow at least 7 days between sprays.

**Spintor 2SC**- Apply as a foliar application at 3 to 6 fl oz per acre to a limit of 0.45 lb ai per acre per season.

**Warrior 1 EC**- Apply as a foliar application at 2.56 to 3.84 fl oz per acre to a limit of 2.88 pts per acre per season. Do no use on cherry tomatoes.

### **Flea Beetles**

*(Epitrix cucumeris and Epitrix hirtipennis)*

As soon as the plants are set, they are vulnerable to attack by two species of flea beetles, the tobacco and potato flea beetles. The tobacco flea beetle is about the same size, but is yellowish brown with a dark band across its wings. The potato flea beetle is about 1/10 inch and brownish black in color. These beetles infest solanaceous crops such as tobacco, potato, tomato, and pepper.



Flea beetles attack the foliage leaving small round holes in the leaves, large numbers may destroy entire leaves. Potentially they can be serious pests early in the season when the plants are less than 4 to 6 inches tall. As they grow, larger plants can withstand substantial flea beetle damage without loss of yield.

### Controls

**Biological:** No effective biological controls against flea beetles on tomatoes are recognized in Kentucky.

**Cultural:** Weed control in and around the fields is often the most important method of holding these pests in check, since the adults often feed on weeds harbor flea beetles early spring and late in fall.

**Monitoring:** Monitor through flowering. Record the number of beetles per 10 plants at each location and estimate defoliation. Consider treatment only when the plants are less than 6 inches and an average of 40 beetles per 10 plants or 30% defoliation.

### Application Alternatives Used in Kentucky:

**Ambush 2 E-** Apply as a foliar application at 3.2 to 12.8 fl oz per acre to a limit of 76.8 fl oz per acre per season.

**Asana XL-** Apply as a foliar application at 2.9 to 5.8 fl oz per acre to a limit of 96 fl oz per acre per season.

**Sevin 80 WSP-** Apply as a foliar application at 1-1/4 to 2-1/2 lb per acre to a limit of 7 applications per acre per season. Allow at least 7 days between sprays.

**Pounce 3.2 EC -** Apply as foliar spray at 2 to 8 fl oz per acre. Limit 48 fl oz per acre per season. Not for use on cherry tomatoes.

**Warrior 1 EC-** Apply as a foliar application at a rate of 1.926 to 3.2 fl oz per acre to a limit of 2.88 pts per acre per season. Do not use on cherry tomatoes.

### Two Spotted Spider Mite

*(Tetranychus urticae)*



Two-spotted spider mites are occasional pests that can cause serious damage to some vegetable crops during hot dry weather. Mites can injure tomatoes, beans, muskmelons, watermelons, and sweet corn. Extended periods of hot, dry weather favors mite buildups. Infestations usually first occur at the edge of a field, typically near rank weed growth or dirt roads.

Generally mites feed on the undersides of leaves. They use their sucking mouthparts to remove sap from plants, giving the upper leaf surface a speckled or mottled appearance. Leaves of mite infested plants may turn yellow and dry up, and plants may lose vigor and die when infestations are severe. The undersides of affected leaves appear tan or yellow and have a crusty texture. Heavy infestations of the two-spotted spider mite produce fine webbing which may cover the entire plant. intervals.

### Controls

**Biological:** Natural enemies of mites are present in and around fields and can keep mite populations low. Many insecticides used for control of insect pests severely reduce numbers of beneficial insects that keep mite populations in check. Therefore, apply insecticides only as needed, rather than at regularly scheduled intervals.

**Cultural:** Destruction of weeds adjacent to and in fields should be done in the fall or early spring. Growers should manage weeds around fields carefully during the season. Grass should be mowed regularly. Spraying or mowing of weeds after growth has become rank may increase the movement of mites to cultivated plants. Use of overhead-sprinkler irrigation may provide some short-term relief of mite infestations.

**Monitoring:** Mites can be identified by shaking symptomatic leaves onto a sheet of white paper or by observing infected leaf areas with a hand lens. Mites can easily be moved to infested plants on clothing, so always examine infested last during inspections.

### Application Alternatives Used in Kentucky:

When possible, select pesticides for other pests which will have the least impact on beneficial insects.

**AgriMek 0.15 EC** - Apply as a foliar 8 to 16 fl oz per acre. Limit 48 fl oz per acre. Allow 7 days between applications.

**Danitol 2.4 EC** - Apply as a foliar spray at 10-2/3 fl oz per acre. Apply when mites first seen. Limit 42.6 oz per acre per season. Allow 7 days between applications.

**Dimethoate 400-** Apply as a foliar application at a rate of 1/2 to 1 pt per acre per season.

**Kelthane MF** - Apply as a foliar spray at 3/4 to 1-1/2 pt per acre. Limit 2 applications per season. Allow 7 days between applications.

**Malathion 57 AC-** Apply as a foliar application at a rate of 1 1/2 pt per acre per season.

### **Stink Bugs**

*(Acrosternum hilare, Euschistus servus)*



Green stink bug and brown stink bug attack vegetable crops including tomatoes. Stink bugs have a distinctive shield shape and produce an odor when handled. There are several species of stink bugs that feed on tomato fruit, but the brown stink bug is the most serious. Stink bugs feed with piercing sucking mouthparts which cause whitish-yellow corky spots underneath the skin of the fruit. This damage is serious for fresh market tomatoes and whole pack processing tomatoes because they render the fruit unmarketable.

Adult stink bugs migrate from weedy areas into tomato fields, particularly when the plants begin to decline. On green fruit, stink bug damage appears as a pin prick, surrounded by a light discolored area. This may turn yellow or remain green on ripe fruit and the tissue below these spots corky.

### **Controls**

**Biological:** There are no recognized effective natural enemies of stink bugs on tomatoes in Kentucky.

**Cultural:** Often stink bug populations buildup on weeds, pasture or hay fields near tomato plantings. Mowing or chopping of these areas may drive adult stink bugs into tomato fields. Weeds near tomato fields should not be allowed to become rank before mowing.

**Monitoring:** Treat if an average of more than one stink bug per 40 plants is found.

### **Application Alternatives Used in Kentucky:**

**Baythroid 2-** Apply as a foliar application at 1.6 to 2.8 fl oz per acre to a limit of 16.8 fl oz per acre per season. Allow 7 days between sprays.

**Endosulfan 3 EC -** Apply as a foliar application at 1 to 1-1/3 qt per acre to a limit of 4 qt per acre or 6 applications per season.

**Warrior 1 EC-** Apply as a foliar application at 2.56 to 3.84 fl oz per acre to a limit of 2.88 pts per acre per season. Do not use on cherry tomatoes.

### **Whiteflies**

**(*Bemisia tabaci* and *Trialeurodes vaporariorum*)**

The sweet potato whitefly has flat, oval, greenish nymphs which suck sap from plants, excreting copious amounts of sticky honeydew and are the vectors of a complex of virus diseases including lettuce infectious yellows and squash silver leaf. More than 420 plant species are hosts. The whitefly is a very destructive pest of vegetable crops. The adults are typical four-winged whiteflies about 1/16 inch long. In greenhouses, breeding is continuous. The greenhouse whitefly leaves plants covered, especially on the undersides, with small, snow-white, four-winged flies and very small, oval, flat, pale-green nymphs, less than 1/30 inch in length, which suck the sap. Infested plants are lacking in vigor, wilt, turn yellow and die. The leaves are covered with a coating of glazed, sticky material on which a sooty-colored fungus often grows, completely covering the foliage. Tomatoes are significantly impacted by this pest. They suck the sap from the leaves, feeding greedily on the plant juices for about 4 weeks. In the course of this time, they pass through four instars. The average duration of the nymphal periods is about 28 to 30 days. The adult whitefly is about 1/16 inch in length, very active, four-winged, with a yellowish body and has the appearance of having been thoroughly dusted with some very fine white material. Both males and females fly, and they feed, like the nymphs, on the undersides of the leaves, living from 30 to 40 days. Under greenhouse conditions, the generations overlap, and all the stages of the insect may be found on infested plants at any time.

### **Controls**

**Biological:** Release the eulophid parasite, *Encarsia formosa*, at 1 to 5 wasps per square foot of plant area

or 1 to 8 per plant to control greenhouse whitefly infestations.

**Cultural:** Because the green house and sweet potato whiteflies cannot overwinter in Kentucky, field infestation are often the result of carrying greenhouse infestations into the field. Transplants need to be inspected and whiteflies controlled before moving them to the field.

### **Application Alternatives Used In Kentucky:**

**Actara 25 WDG** - Apply as a foliar spray at 3 to 4 oz per acre. Limit 8 oz per acre per season. Allow 5 days between applications.

**Asana XL**- Apply as a foliar spray at 5.8 to 9.6 fl oz per acre to a limit of 96 fl oz per acre per season.

**Endosulfan 3 EC**- Apply as a foliar application to a rate of 2/3 qt per 100-200 gallons of water per acre to a limit of 4 qt per acre or 6 applications per season.

**Fulfill 50 DF** - Apply as a foliar spray at 2.75 oz per acre. Limit 5.5 oz per acre per season. Allow 7 days between applications.

**Knack 0.86 EC** - Apply as a foliar spray at 8 to 10 fl oz per acre. Limit 20 fl oz per acre per season. Allow 14 days between applications.

**Provado 1.6 F**- Apply as a foliar application to a rate of 3.75 fl oz per acre to a limit of 18.75 fl oz per acre per season. Do not use following a soil application of Admire.

## **Diseases**

### **Anthracnose** *(Colletotrichum spp.)*

Control of anthracnose is especially important for processing tomatoes because quality standards include mold counts. In fresh market operations it will be a serious concern only if fully ripe fruit are involved, such as with roadside markets. The recommendations for anthracnose are written for processing crops. With fresh market tomatoes the program used for early blight should be sufficient to control anthracnose. Anthracnose occurs mainly as sunken circular spots on ripe fruits with the sporulating fungus appearing as a dark mass in the center of the lesion. It is particularly troublesome on fruit that is overripe and in contact with the soil. Although infections can occur early (when fruits are green and small), this is

primarily a disease of ripe fruit.

## Controls

**Cultural:** Follow a two to four year rotation to crops not related to tomatoes with good weed control during the rotation to avoid a buildup of the pathogen. Hot water seed treatment will reduce the potential for anthracnose. Avoid overmature fruit, especially after Ethrel applications (or other fruit ripening agents) when susceptibility increases rapidly.

**Chemical:** Fungicide sprays are needed on a 7 to 10 day schedule from fruit set through harvest using any of the following:

### Application:

**Chlorothalonil-containing fungicide** - Apply as to a rate of 2 to 3 pts per acre for flowable formulations or 1.5 to 2.5 lbs per acre for dry formulations (DF, DG or WP).

**Mancozeb/Maneb** - Apply as to a rate of 1.5 to 2 lb per acre for dry formulations (WP, DF, DG) or 2 to 3 pts per acre for flowables.

**Quandris**- Apply as to a rate of 5 to 6 fl oz per acre.

**Ziram 76**- Apply as to a rate of 3 to 4 lb per acre. Ziram should be used only early in the season. A spreader sticker should improve its performance.

## Bacterial Canker

*(Clavibacter michiganensis michiganense)*

Bacterial Canker is an increasingly important disease in Kentucky which can cause serious losses during cool summers and in fall crops. It occurs in many forms as a fruit spot, leaf blight, stem canker or vascular wilt, depending on whether the pathogen is localized or systemic. Under Kentucky weather conditions, the bacterium becomes established on the foliage of healthy plants and invades the plant through wounds and natural openings. Prevention—not cure—is the only acceptable strategy for control. Prevent introduction into your crop; prevent overwintering in the field and slow buildup of the pathogen on the plant.

The canker pathogen is seed and transplant-borne; it overwinters on tomato debris (on roots and large stems) plus stakes and other field and greenhouse items. Once present, the bacterium is easily spread during wet conditions by splashing rain, irrigation water, machinery and workers.

## Controls



## **Cultural:**

Take steps to start with disease-free material. Use disease-free seed, but assume in today's marketplace that the seed may be infested, so also use proper seed treatments for bacterial diseases (see seed treatments section below). Use certified disease-free transplants. Sanitize all items contacting tomatoes with a 10% bleach solution to reduce introduction. In fresh market operations, plants detected with canker in the field should be carefully rogued out, avoided or at a minimum worked last. The canker pathogen is easily spread during pruning and staking operations, and less disease develops in fields where suckers are removed when very small or where plants are not pruned at all.

Avoid working in fields while foliage is wet, especially early in the season. Some observations strongly suggest that air blast-type sprays enhance the spread of pathogens by creating airborne mist. Sticks should be fumigated or dipped in a 10% chlorine bleach solution before reusing.

Rotating to non-host crops for 3 to 4 years is highly effective in reducing the pathogen at site, but there are many hosts, including tomatoes, peppers, potatoes, eggplant and solanaceous weeds such as black nightshade, so long term planning is important. Preliminary evidence suggests that tobacco is a symptomless host.

At the end of season for any susceptible crops, burning or properly composting the above ground residue can reduce the pathogen; the field should be plowed so that all residue is turned under the soil.

## **Application Alternatives Used in Kentucky:**

In seedbeds, spray on a 5-day schedule with Streptomycin at 1.25 teaspoons/gallon of water starting with first true leaf until transplanting is complete, but do not use streptomycin on the plants after transplanting to the field.

**Copper-** Apply as a foliar application on staked tomatoes on a weekly basis immediately after transplanting at a rate of 1 lb ai per acre. (Early spraying of copper on processing tomatoes has generally been ineffective in controlling bacterial canker early, but its use for other bacterial diseases may slow the spread of the foliar phases of canker.)

**Mancozeb 80 W-** Apply as a foliar spray on staked tomatoes on a weekly basis immediately after transplanting at a rate of 1.5 lb per acre.

**Streptomycin-** Apply as a spray to seedbeds on a 5-day schedule at a rate of 1.25 teaspoons per gallon of water beginning with the appearance of first true leaf and continuing until transplanting is complete. Do not use in the field after plants are transplanted.

## **Bacterial Speck and Bacterial Spot**

*(Pseudomonas syringae pv. tomato and Xanthomonas campestris pv. vesicatoria)*

Bacterial Spot mainly occurs on the foliage as dark, angular spotting with yellow halos and scabby lesions of the fruit. Bacterial Speck causes similar spots on the foliage but black specks on the fruit. Spot is favored by warm wet weather while bacterial speck is more likely in cool, wet conditions. The incidence and severity of spot and speck have markedly increased recently, probably due to the production of hybrid seed in tropical climates.

### **Controls**

**Cultural:** Use western-grown seed, certified as disease-free, plus assume that they are contaminated and use a hot-water or bleach seed treatment. Transplant only disease-free seedlings into rotated land. Bacterial Speck and Spot can "explode" under protracted wet conditions due to very rapid reproduction of the bacteria. Keep bacterial numbers down by instituting a spray program once first symptoms are present or advisories are issued.

**Monitoring:** Scan for any spotting or specks due to potential for extreme spreading. Where possible use a fixed copper plus mancozeb or maneb which makes copper more effective. Premixed material is now marketed.

### **Application Alternatives Used in Kentucky:**

**Fixed copper + mancozeb 80WP** - Apply as a foliar spray at 1.8 lbs. per acre fixed copper and 1.2 lbs. per acre of mancozeb. No more than 16.8 lbs active ingredient can be applied per season.

**Fixed copper + maneb 80WP** - Apply as a foliar spray at 1.8 lbs. per acre of fixed copper and 1.2 lbs. per acre of maneb. No more than 16.8 lbs active ingredient can be applied per season.

**Bravo C/M** - Apply as a foliar spray at 1.08 to 1.62 lbs. per acre of chlorthalonil and 1.83 to 2.74 lbs. per acre of copper and 0.21 to 0.32 lbs. per acre of mancozeb.

### **Blossom End Rot**

Blossom End Rot is not an infectious disease, rather a physiological disorder related to calcium movement or calcium deficiency promoted by variances in water availability and growth flushes. Blossom End Rot is aggravated by improper fertility programs (e.g. high levels of ammonium nitrogen or high levels of potassium).

**Cultural:** Steps should be taken to insure adequate calcium levels in the soil. Consider using calcium nitrate to minimize the problem. Mulching of tomatoes reduces Blossom End Rot. Maintain uniform soil moisture. Avoid sudden injury to healthy roots by avoiding close cultivation as well as sites subject to standing water or flooding.

### **Application Alternatives used in Kentucky:**

Calcium sprays are not considered effective in reducing Blossom End Rot in field plantings.

**Buckeye Fruit Rot**  
*(Phytophthora parasitica)*  
**Pythium Stem Rot and Fruit Rot**  
*(Pythium spp.)*

Buckeye Rot occurs as circular, zonate lesions on the fruits while Pythium causes a water rot of the fruit. In stake tomatoes, these are problems mainly on the lower fruits which receive soil splash. Both cause dark watery rots of the stem near the soil line, mainly of young plants.

**Controls**

**Cultural:** Avoid fields with poor drainage or heavy soils. Plant on raised beds with mulch to reduce surface moisture and stake to reduce contact with soil. Avoiding tobacco and crops related to tomatoes in the rotation will help with Buckeye Rot.

Phytophthora Stem Blight has been of minor importance in Kentucky, but is common in the Midwest. The chemical controls listed below are effective with Phytophthora Blight, but rotation of other susceptible crops would need to be seriously considered should this blight become a problem here. Growers with pumpkin, peppers or tomatoes in rotation should remain watchful and report problems promptly for accurate diagnosis. Pythium stem rot has been more common, especially with growers using the float system to produce transplants.

**Application:**

**Mefenoxam** - Apply as a soil spray at 0.5 lbs per acre no later than 28 days prior to harvest.

**Ridomil Gold Bravo/Ridomil Gold 4EC** - Apply as a foliar application at a rate of 1.5 to 2 lb per acre starting with fruit set and continuing until fruit are full size.

**Early Blight**  
*(Alternaria solani)*

**Gray Leaf Mold**  
*(Cladosporium sp.)*

**Gray Leafspot**  
*(Stemphylium sp.)*

**Septoria Leaf Spot/Blight**

## *(Septoria lycopersici)*

Early Blight (the most common foliage disease of tomatoes in Kentucky) mainly affects older foliage causing dark brown, target-like spots and general blighting of the foliage, stem cankers and fruit rot.

Gray Leaf Mold is more common in the greenhouse than field but can be severe under low light situations in the field, occurring as a yellow spot on foliage with gray fungus growth on the bottom side of the leaf.

Gray Leaf Spot is often found on transplants upon arrival from southern areas and/or from hot, humid greenhouses. Spots are irregular in shape, brown with extensive yellowing. In the field, it has been mainly a problem with late crops.

Septoria Leaf Spot/Blight occurs frequently and dominates in some seasons, as small gray/tan spots with dark borders, usually with dark fruiting bodies of the fungus evident in the center of each spot.

### **Controls**

**Cultural:** Control starts with disease-free transplants. Varieties with some resistance or tolerance will reduce fungicide needs, but will not eliminate the need for fungicides on tomatoes entirely. In general, early maturing varieties are more susceptible to early blight than are later maturing ones. Practice crop rotation away from all solanaceous crops for two or more years and control weeds during the rotation. Fall tomatoes are very prone to early blight, especially if early tomatoes or potatoes are planted nearby. Maintain rapid growth through proper fertilization to minimize disease. Crop rotations used for other diseases are an aid to control.

### **Application Alternatives Used in Kentucky:**

**Bravo C/M 78 WP-** Apply as a foliar application at a rate of 4 to 6

**Chlorothalonil-** Apply as a foliar application at a rate of 2 to 3 pts per acre for flowable formulations; 1.5 to 2.5 lb per acre for dry formulations.

**Mancozeb/Maneb 80 W -** Apply a 2 to 3 lb per acre for dry formulations.

**Quadris-** Apply as a foliar application at a rate of 5 to 6 fl oz per acre. Applied on a 7 to 14 day schedule, this is rapidly becoming the treatment of choice.

**Ridomil Gold/Bravo -** Apply at 2 to 3 lbs per acre.

**Ziram 76 W -** Apply at 4 lbs per acre.

### **Late Blight**

## *(Phytophthora infestans)*

Late blight can very quickly destroy a commercial tomato crop under cool, wet weather. This disease causes dark, irregular spots (often worse on the youngest foliage) giving a scalded appearance to the foliage. Fruit appear as if rolled on a hot plate. Late blight appears erratically in Kentucky; it is more common in the mountains and during fall plantings. The disease has been observed more frequently nation-wide in recent years with new strains and increased disease levels. Significant epidemics are much more likely in the future, so remain alert and keep controls in place when the threat of late blight exists.

The control program listed for early blight should be adequate for most cases of late blight in Kentucky. Be sure to close spray intervals, obtain good coverage, and keep the fixed coppers together with the chlorothalonil or mancozeb/maneb. Under very strong late blight pressure, expect chlorothalonil to be superior. Quadris at 6.2 fl oz/A is a new option, but make no more than two sequential applications before switching back to the other fungicides to help manage resistance. All outbreaks in Kentucky investigated since 1992 have involved the mefenoxam/metalaxylresistant (tolerant) strains of the fungus. Therefore, the days of just spraying with metalaxyl-containing material are over and these fungicides are no longer recommended for this disease.

### **Controls**

**Cultural:** Kentucky outbreaks are often connected with either potatoes or greenhouse infections.

#### **Application Alternatives Used in Kentucky:**

**Bravo C/M 78 WP-** Apply as a foliar application at a rate of 4 to 6

**Chlorothalonil-** Apply as a foliar application at a rate of 2 to 3 pts per acre for flowable formulations; 1.5 to 2.5 lb per acre for dry formulations.

**Mancozeb/Maneb 80 W** - Apply a 2 to 3 lb per acre for dry formulations.

**Quadris-** Apply as a foliar application at a rate of 5 to 6 fl oz per acre.

## **Nematodes**

Due to heavy soils, nematodes have not caused the level of crop damage often present in the south. Root knot nematode is the most common in Kentucky; it deforms the root system resulting in stunting, early

firing of foliage, and low yields.

## Controls

**Cultural:** Some root knot resistant varieties are available. Rotate tomatoes frequently; two years to tall fescue providing excellent control of root knot. Avoid most dicots in the rotation once nematodes are detected in the field.

**Monitoring:** If rotation to grass is not being used, fields need to be carefully checked every year for root knot. Carefully dig and examine the roots for symptoms on plants with symptoms at the end of harvest. Submit fresh soil samples to the diagnostic lab to determine the population if the field will be used for any vegetable crop or tobacco the next season.

### Application Alternatives Used in Kentucky:

Use preplant soil fumigation (see fumigation) if the nematode population is moderate to high.

**Vydate 2L** - Apply at 2-4 pts per acre at 7-14 day intervals after plants are established, is now labeled. Although we have no data from Kentucky, studies from other regions indicate Vydate is effective when nematode populations are low.

## Sclerotinia Stem Rot (*Sclerotinia* sp.)

## Botrytis Fruit and Stem Rot (*Botrytis cinerea*)

These diseases occur as girdling cankers on the main stems, usually resulting from transplanting infected plants or strikes that occur in the field during early May. Botrytis gray mold occurs mainly as a rot of the leaf and fruit under prolonged cool, wet conditions and is becoming more common in fall plantings of tomatoes in Kentucky. It also occurs in the spring along with Sclerotinia as stem lesions on young plants. Adding Benlate to the spray program will aid in control if the strain is sensitive to benomyl.

## Controls

**Cultural:** Avoid setting infected transplants into the field. Avoid fields with a history of Sclerotinia. Spores can move into tomato fields from adjacent weedy fields or from fields of tobacco, canola, cabbage, or beans were infected in the previous season. Take steps to improve air movement in the planting.

### Application Alternatives Used in Kentucky:

**Benlate 50 WP** - Apply at 0.5 to 1.0 lbs per acre directed to ensure stems are covered. Use this treatment only in combination with maneb or mancozeb. Benlate is not needed after mid May. Mancozeb/Maneb containing products - Used in the early blight control program greatly reduce these diseases although chlorothalonil containing products (like Bravo) do not give control of Sclerotinia.

### **Powdery Mildew** *(Oidium lycopersicum)*

Several serious cases of powdery mildew of tomatoes were diagnosed in 1998/99. This disease causes a white mildew and can lead to defoliation of the plants. Most cases have been in the greenhouse although some have been in the field. In all field outbreaks, the spray program being used for other foliar diseases was inadequate.

### **Controls**

**Cultural:** Do not set powdery mildew infected transplants into the field.

### **Application Alternatives Used in Kentucky:**

**Chlorothalonil-** Apply as a foliar application at a rate of 2 to 3 pts per acre for flowable formulations; 1.5 to 2.5 lb per acre for dry formulations.

**Quadris-** Apply as a foliar application at a rate of 5 to 6 fl oz per acre.

### **Southern Stem Blight or Southern Blight** *(Sclerotium rolfsii)*

Plants wilt and die from girdling of the roots and stem at the soil line. The white fungus and its fruiting bodies (resembling mustard seeds) are normally present at the soil line. Traditionally, this has been a southern disease, but it has been on the increase during the past decade. Avoid fields with a history of this disease on any crop. This disease is often introduced on field grown transplants from the south. The pathogen has a wide host range and can colonize almost any plant material as the tissue dies. The pathogen moves onto tomato plants from colonized debris.

### **Controls**

**Cultural:** Deep plowing sods, cover crops, and crop debris may reduce the disease potential. Preplant control of weeds and grass is very important. Some very serious cases have occurred following grass control after transplanting because the fungus "eats" the dead weeds and then moves onto tomatoes.

### **Application Alternatives Used in Kentucky:**

**Terrachlor 75 WP** - Apply at 10 lb/100 gallon using 0.5 pt/plant sprayed in the planting trench and on soil at transplanting may be warranted for serious cases. This is not a transplant water treatment although some areas report good success when using it in the setter water.

## Viruses

Virus diseases cause a range of conditions including mosaic and mottling, stunting, poor fruit quality and even plant death. Tomato spotted wilt (TSWV) is a relatively new problem which is arriving mainly on infected transplants.

## Controls

**Cultural:** Take steps to ensure that southern grown transplants are from sources specifically certified to be free of this virus. Transplants produced in greenhouses where ornamentals are also being produced will often be infected with TSWV. Produce transplants in isolation from thrips and ornamental hosts. Several other virus diseases are common or troublesome in tomatoes: Tobacco Etch (TEV) , Tobacco Mosaic (TMV), Cucumber Mosaic (CMV), Potato Virus Y (PVY), and Alfalfa Mosaic Virus (AMV) being the most common.

Use TMV resistant varieties and minimize contact with infected plants in the field. Several serious outbreaks of TMV have occurred in recent years, usually as a result of using infected transplants that had been grown in greenhouses with either heirloom tomato varieties or TMV-susceptible tobaccos.

To avoid Potato Virus X in greenhouses, do not handle potatoes before working tomatoes. Rinsing hands with milk (whole, dried, or skim) when planting can reduce spread of these viruses. Most of these viruses are weedborne and moved from weeds to tomatoes by insect vectors (mainly aphids). Control weeds around fields or plant into sites surrounded by small grains or corn. Do not plant adjacent tobacco, potatoes, or peppers; the farther away the better. Great disease reduction can be achieved by planting at least 200 yds away from these other crops. The risk of TEV, PVY, and CMV is higher for fall plantings.

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