

Crop Profile for Blueberries in Tennessee

Prepared: 2007

Production Facts

- Acreage grown in 2007 was approximately 275 acres. A late freeze occurred in April of 2007 resulting in no fruit being harvested for the season. Typical yield average ranges from 8,000 to 9,000 lbs of berries per acre in trickle irrigated systems. The value of the 2007 crop would have been approximately \$4 million dollars if total crop failure did not occur due to weather conditions.
- Acreage production cost ranges between \$3,500 to \$4,000 per acre for establishment followed by \$200 to \$300 per acre per year labor cost thereafter. The cost variation in the first year of establishment, depends on selecting rows to be hilled and if mulch is applied, which would increase cost. An additional cost of \$15 per acre during hot dry periods (June – August) for irrigation. Also, mowing areas between rows and fertilization will increase annual cost.
- Tennessee does not rank in national blue berry production as reported by NASS. However, if Tennessee was compared to Alabama, Tennessee acreage would rank equally with Alabama's harvested acreage for the previous two years of production.
- Tennessee's contribution to total US production of blueberry production was < 0.01%. The total reported US commercial production was listed at 430,000 lbs of berries for 2007.
- If 2007 was a productive year, producers may have seen a potential of \$13,840 per acre with a potential state value of 3.8 million dollars.

Production Regions

- Tennessee has relatively small amount of blueberry acreage when compared with other crops. Wilson, Rhea and Greene counties have the greatest acreage under commercial blueberry production.

Cultural Practices:

Workers Activities

- Planting usually occurs in late February to late March depending on weather conditions. If managed properly, blueberry plants have a longevity of

- approximately 10 to 20 years. Plants are planted with a population of approximately 605 plants per acre with a 12 foot row spacing and spaced 6 feet between plants. Plant begins in late February and may continue into late March.
- Pruning occurs after harvest and occasionally from January to early-March. Fall pruning has become common practice as a means to maintain proper bush height. An added benefit of this method is the reduction in leaf diseases by removal of older, infected leaves and subsequent rejuvenation. New midsummer foliage produced after topping persists well into fall without serious leaf spot problems. Annual pruning of deadwood and older canes maintains plant vigor, eliminates disease inoculum, and reduces populations of bud mites and scale insects. Generally workers wear cloth gloves when handling clippings.
 - Sanitation occurs in the fall to early winter. Old crop residue is collected by hand. Generally workers wear cloth gloves when handling debris.
 - Irrigation if used, it is installed in late spring to early summer after initial planting. Irrigation systems may be inspected periodically to check for leakage. Irrigation would occur after establishment when dry conditions persist from late May until early September. Approximately, 85% of the commercial blueberry acreage uses drip irrigation. On average approximately 1.5 inches of water is applied per week during dry weather conditions.
 - Scouting is not routine process in berry production, however if it occurs, it is usually conducted every two to three days after planting and continues on a one to two week schedule for two months until the plants become established. Scouting will continue into the spring and summer months when pests are normally observed. On the third year after planting, plants may be inspected on a weekly schedule when weather conditions are conducive for pest development. Especially during June and July.
 - Fertilization: usually begins around the first of April, followed by two additional applications, one beginning 6 weeks after the first application, then again on the 12 week. Depending on rate used may increase production cost up to \$250 per acre.
 - Mowing: If row middles are mowed, mowing would begin when weather conditions warm (March) and frequency becomes increased as rain and warm conditions continue. Mowing will slack off in November and may begin again the next spring. Mowing would increase production cost from \$400 to \$500 per acre depending on frequency of mowing. All re-entry intervals would be followed for this activity.
 - Pest control and pesticide application:
 - Weed control is usually conducted prior to planting (preemergent) in early spring by tractor as well as throughout the growing seasons (postemergence) as needed after harvest using either tractor mounted spray equipment or backpack sprayers. Weed control in young bushes often relies on hand weeding or hoeing. Hand weeding is also occasionally used in older fields to remove woody perennial or other problem weeds.
 - Insect and disease control: Insecticides and fungicides are applied as needed from early spring until late summer, primarily with airblast

orchard-type sprayers or by tractor with boom and multiple nozzles directed to each row. Smaller fields are treated using a hand held backpack type sprayer system.

Sanitation Practices

- If mummy berry disease has been a problem, areas beneath and around plants are raked. Mummified fruits remaining from the previous season's crop are then collected or buried.
- To reduce dieback diseases, dead twigs and branches are pruned out and destroyed.

Mulching

- Mulching generally occurs after planting and may be reapplied again in years 2 to 7 year cycles in January through March to aid in water / moisture retention and weed control. Mulch is usually spread manually by pitch fork on small areas or by mechanically with a mulch spreader in larger acreages.

Varieties

The majority of blueberries in production include rabbiteye types Tiffblue, Climax and Powder blue. The major variety propagated for 2007 was Tiffblue which was around 20 percent. However, some highbush (less than 1%) produced and include; Duke, Patriot, and Blue crop. Plantings generally survive 10 to 20 years depending on maintenance.

Insect Control

As a rule, blueberry plants require the least amount of pesticides of all fruit crops. Treatments can usually be made on an as-needed basis. If insects have been a problem in the planting in past years, malathion or carbaryl may be selected for occasional insect pests, but are not used during bloom. Repeated use of carbaryl can lead to mite buildup, especially during hot dry periods. The most commonly observed pests which may be observed from year to year include; Japanese beetles and blueberry maggots. Table 1, lists the estimated insecticide usage for 2007. Very little, if any loss occurred from insect infestation during the 2007 season.

Japanese Beetles (*Popillia japonica*)

The Japanese beetle occurs in most of counties of Tennessee. The beetles feed on over 275 different kinds of shade and fruit trees, shrubs, flowers, small fruits, garden crops, and weeds. Some of their favorites are roses, crape myrtle, grapes and fruit trees. Japanese beetle adults eat flowers and foliage, leaving only a lacy network of leaf veins.

The beetle grubs are pests of the roots of grasses and shrubs. Japanese beetle grubs occur in lawns, golf courses, pastures and even wooded areas. They burrow through the soil consuming roots. Areas of dead grass may appear when large numbers of grubs are present especially during dry spells in September or early October. The grubs overwinter in cells about 6 inches deep. In spring, they move almost to ground level, where they complete feeding and then pupate.

Chemical Controls

- **Carbaryl** (Sevin 80S, 80WSP):
- **Azadirachtin** (Neemix 4.5%EC, Aza-Direct):

Alternatives:

- Treat sod or grassy pasture areas surrounding field with *Bacillus popilliae* in the fall.

Cultural Control Practices:

- Pheromone traps placed approx. 50 yards away from area.

Biological Controls:

- *Bacillus popilliae*, is a bacteria which will aid in the control of grubs. Bacterial spore suspensions should be applied in the fall in grassy areas near orchards, where larvae are developing. Product would be used as a preventative.

Post Harvest Control Practices:

- None

Other issues:

- None

Blueberry maggot (*Rhagoletis mendax*)

The life cycle of the BM is almost identical to that of the Apple Maggot. The BM overwinters as a pupa 1-2" below the surface of the soil. In July, as the berries ripen, the adult emerges and within a week's time will feed and mate. Females lay their eggs singly beneath the surface of a ripening berry. The emerging larva feeds for a two-week period, during which time it molts twice. When full grown, the larva drops to the ground, if the berry has not already fallen. It pupates in the soil, where it will remain for the winter.

Chemicals:

- **Carbaryl** (Sevin 80WSP, 80S):
- **Malathion** (Malathion 57EC):
- **Diazinon** (Diazinon AG500):

Alternatives:

- **Azinphos-methyl** (Guthion 50WSP) this product is **not labeled in Tennessee** for blueberry production but would be highly effective. Extremely toxic to applicators and field laborers.
- **Phosmet** (Imidan 70W) no more than 2 applications per season. **Not labeled in Tennessee.**

Cultural Control Practices:

- Early maturing varieties may escape infestation.
- Pheromone traps hung in mid-May as indicator when adults are present.

Biological Controls:

- *Opius melleus* and *Opius ferrugineus* have been reported in the eastern US and may provide some control. No information on presence of these biologicals.

Post Harvest Control Practices:

- Remove any remaining berries.
- Weed the field, reduce overwintering sites.

Other issues:

- None

Blueberry gall midge (*Dasineura oxycoccana*)

The blueberry gall midge is a tiny fly. The larvae also known as maggots typically feed on vegetative buds, which usually destroys the flower buds, resulting in low yields. Midges also cause severe damage to vegetative growth. Plants cannot produce enough foliage to support a heavy fruit crop, resulting in smaller berries with low sugar. On most varieties, vegetative feeding does little harm. On rabbiteye cultivars, flower feeding strains of blueberry gall midge occur sporadically. If present, gall midges which feed on flower buds are a serious threat. Feeding injury destroys flower buds before bud scales open in the spring. Gall midge lay eggs on warm winter days. The variety Premier is often particularly attractive, and it is a good sentinel variety to monitor. Gall midge pesticide applications also provide a helpful degree of pre-bloom thrips suppression.

Chemical Controls:

- **Diazinon** (Diazinon AG500) apply as-needed for gall midge between flower bud stages 1 and 2, as the most mature buds first show slight separation of scales. Repeat sprays during warm periods. Should not be sprayed within 5-days of bloom. Very effective.
- **Malathion** (Malathion 57EC) very effective and has a 1-day PHI.
- **Spinosad** (SpinTor 2SC, Entrust 80%) relatively non-toxic to bees after product thoroughly dries. Fairly expensive.

Alternatives:

- None

Cultural Control Practices:

- Producers are cautioned not to institute pre-bloom insecticide control programs for blueberry gall midge until its presence as a pest has been confirmed on or near their production area.
- Orchard sanitation in the form of a herbicide program to chemically mow the entire orchard floor or light cultivation, as for mummy berry suppression, may offer helpful suppression.

Biological Controls:

- None

Post Harvest Control Practices:

- Sanitation

Other issues:

- None

Bagworm (*Thyridopteryx ephemeraeformis*)

The common bagworm, is one of the most commonly observed form of this pest. It has a spindle-shaped silk bag camouflaged with bits of foliage, bark and other debris. Completed bags range from 1-1/2 to 2-1/2 inches long. The larva within the bag is brown

or tan, mottled with black, and the bee-like adult males have clear wings and fur covered bodies. The females remain larva-like and do not emerge from the bag. The larva may stick its head and front legs out of the top of the bag to feed and move. When disturbed, the larva immediately pulls its head into the bag and holds the opening closed. Mature larvae may stay on their host plant or drag their bags some distance before firmly attaching the bag for transformation into the adult stage. Bagworm females cannot fly and local populations can build rapidly when established on preferred hosts, especially arborvitae, cedar and juniper. Crowded larvae may eat the buds infested plants causing twig dieback, forming open, dead areas.

Bagworms have a single generation per year and overwinter as eggs inside the female bag. There may be 300-1000 eggs in a bag. The eggs delay hatching until late-May or early-June. As they hatch, the small blackish larvae crawl out the bottom of the bag and spin down on a strand of silk. These larvae on a string are often picked up by the wind and ballooned to nearby plants. When a suitable host plant is found the young larva immediately begins to form a new bag over its body. This bag is only about 1/8 inch long and is soon covered with sawdust-like fecal pellets. As the larva feeds and grows it enlarges the bag and begins to incorporate bits and pieces of plant material. By mid-August, the larvae are mature and they often move to a sturdy branch or other structure where they attach the bag firmly with a strong band of silk. The larvae orient themselves with their heads down and pupate. The female pupa looks much like the larva while the male forms characteristic wing pads and other adult-like structures. Within four weeks the males emerge and actively fly about in search of females. Mature females call by releasing a sex attractant pheromone. After mating the female literally mummifies around the egg mass, which remains in place until the next spring. Bagworms are difficult to control because they are often unnoticed until mature. Mature larvae will often pupate early if pesticides have been applied on the plant foliage.

Chemical Controls:

- *Bacillus thuringiensis* subsp. *kurstaki* (Dipel DF) should be applied when eggs begin to hatch.
- Other products used for other pests will provide control when larvae are present.

Alternatives:

- Other insecticides used in blueberry production may have considerable effect on this pest.

Cultural Control Practices:

- Hand-picking and removal, then dispose of bagworm cases, some of which contain eggs, prior to April.

Biological Controls:

- Though there are a few known parasites and predators, they are often not adequate in blueberry production.

Post Harvest Control Practices:

- None

Other issues:

- None

Blueberry bud mite (*Acalitus vaccinii*)

The blueberry bud mite is an eriophyid mite, so tiny (1/125 inch long) that it cannot be seen without magnification. Blueberry bud mite is an occasional pest in blueberries in Georgia, but is a common pest on certain cultivars in Tennessee. Injury may be more visible in late spring. Infested plants are recognized by a cluster or a rosette of buds, which may be abundant. Infested buds become succulent, fleshy, closely packed, form clusters or rosettes on stems, and they may redden. Bloom on infested plants is reduced. Affected berries are small, roughened and may have small reddish pimples or blisters on the fruit surface. Blueberry bud mite numbers increase during late summer and early fall. Next year's flower and leaf buds are infested.

Chemical Controls:

- **Endosulfan** (Thionex 3EC): may only be used as a post harvest material.
- **Horticultural oil** (Golden Pest Spray) applications immediately after harvest will aid in control.

Alternatives:

- None

Cultural Control Practices:

- Sanitation by aggressive, timely pruning of infested branches can be helpful. Mechanical topping (mowing off old fruiting twigs) immediately after harvest greatly reduces bud mite incidence the following year.
- Never propagate from bushes that may be infested with blueberry bud mite.

Biological Controls:

- Tydeid predatory mites may provide some control, but no research in Tennessee has been conducted to determine the effects of this predator.

Post Harvest Control Practices:

- **Endosulfan** (Thionex 3EC) may be helpful to augment pruning out of older wood as a post harvest application.

Other issues:

- None

Imported Fire Ants (*Solenopsis invicta*, *Solenopsis richteri*)

Although fire ants are mostly a nuisance to field workers in these crops, their overall economic and ecological impact is unknown. The ants' nest building aerates the soil of the orchard floor, which is beneficial, but they will feed on the meat of cracked fruit and can damage irrigation systems. Ant mounds may interfere with some types of harvesting operations. Chemical control is warranted only if the cost of control is less than the potential economic loss ants may cause. In pick-your-own operations, customer safety also should be considered.

Ant baits employed in late winter to early-spring as a broadcast treatment should eliminate most, but seldom all, fire ant mounds within treated areas. Under high pressure treating a second time, post-harvest in the fall will provide better fire ant control. Most ant baits are slow acting; they require up to eight weeks to control active mounds. Worker ants must be attracted to baits, so they can carry the baits back to their colonies. Most ant baits interfere with reproduction, which causes a gradual die-off of colonies.

Ant baits work best when soil is moist, but not wet. Active ant foraging is essential. Ideally, temperatures should be warm and sunny. Avoid application of ant baits when conditions are expected to be cold, overcast, rainy or very hot. Individual mound treatments are most effective when used as-needed for the occasional colony that survives broadcast treatments. Mound treatments using insecticide baits should be applied in a circle, 3 to 4 feet from the mound. Do not disturb mounds or place bait directly on top of mounds.

Chemical Controls:

- **Diazinon** (Diazinon AG500): provides good control. Has a 7-day PHI. Is a Restricted Use Pesticide.
- **Malathion** (Malathion 5EC): provides only fair control. May be applied to plants to discourage foraging on plants. Usually requires post harvest treatments with other products to obtain highly effective control.
- **S-methoprene** (Extinguish) is a bait which is registered for use in crop land.
- **Pyriproxyfen** (Esteem) can be used by commercial growers in many tree fruits and nut orchards, as well as in certain vegetable and fruit crops.
- **Pyrenone** (Pyrenone crop spray): is a pyrethroid insecticide, which should be applied to the soil near plantings or areas of infestation.
- **Pyrethroid** (various):
NOTE: Optimum timing of application(s) is yet to be determined. Where used, monitor closely for secondary pest outbreaks. Fresh bait should be applied when the ground is dry and rain is not expected, preferably for the next 24 hours. Apply baits when fire ants are actively foraging, preferably when the temperatures are in the 70s and 80s. See Fire Ants in Tennessee web site, <http://fireants.utk.edu> for more information on bait applications and fire ant management. Few contact insecticide products are registered specifically for fire ant control in bearing blueberry plantings, although some products containing pyrethrins (Fairfield American pyrenone Crop Spray and others) are generally labeled for ant control in these sites. Blueberry plantings can be treated with registered products.

Alternatives:

- Other fire ants baits, such as Advion, Amdro, Ascend, Award, Distance, Extinguish, Extinguish Plus and others, may be applied to areas adjacent to the planting sites.
- **Abamectin** (Clinch) is registered for use in bearing citrus groves but not labeled in blueberry production areas. .
- **Fenoxycarb** (Logic) and pyriproxyfen (Distance) are registered for use in young, nonbearing fruit and nut tree orchards.
- **Pyriproxyfen** (Distance) are registered for use in young, nonbearing fruit and nut tree orchards.

Cultural Control Practices:

- Cultivation between rows often disturbs mounds in these locations

Biological Controls:

- A species of parasitic "phorid" flies in the family Phoridae, have been released and established in parts of most southeastern states, including *Pseudacteon tricuspis*, *P. curvatus*, and most recently, *P. litoralis*.
- A disease of fire ants, *Thelohania solenopsae*, is also wide spread in some states.

Post Harvest Control Practices:

- None

Other issues:

- None

Scale (various species)

Terrapin scale (*Mesolecanium nigrofasciatum*)

Chemical Controls:

- **Horticultural Oil** (Superior Oil) has Caution listed as the signal word. Applied pre-bloom use only. Applied at the rate of 2 gallons per 100 gallons of water per acre.

Alternatives:

- **Malathion** (Malathion 57EC, 2.67E):

Cultural Control Practices:

- **Scouting** aids in determining areas of infestation.
- **Pruning** and **removing infested canes**.

Biological Controls:

- Three species of endemic Hymenoptera have been reported as parasites of terrapin scale in the southeast. All three of these species as well as several predators (lacewings and lady beetles) represent potential biological control agents for local infestations of terrapin scale.

Post Harvest Control Practices:

- Pruning

Other issues:

- None

Other arthropod pests occasionally observed at post harvest include; blueberry bud mites, blueberry stem borer, fall webworm, stink bugs, sharpnosed leafhopper, imported fire ants, blueberry bud mite, flea and leaf beetles, yellow necked caterpillars, leaf tiers, grubs, caneberry fruitworm, cherry fruitworm, plum curculio, blueberry stem borer and spanworms.

Insecticides

Organophosphate insecticides

- **Diazinon** (Diazinon AG 500) has Caution listed as the signal word and is a Restricted Use Pesticide. It has a 5-day REI and a 7-day PHI. Applied at the rate of one pint per acre per application with no more than two applications per year. Labeled to control cranberry fruitworm, cherry fruitworm, blueberry maggot, aphids, two-spotted spidermite, gall midge and fire ants. Application cost of \$8.90 per acre per application.
- **Azinphos-methyl** (Guthion 50SWP) has Danger listed as the signal word, has a 7-day REI, and a 30-day PHI for U-Pick operations and a 7-day PHI for

conventional operations. Applied at the formulation rate range of 1 to 1.5 lbs per acre. No more than two applications per season. Labeled to control blueberry maggot, fruitworms, lecanium scale, and plum curculio. **NOTE: Not labeled in Tennessee.** Application cost would range from \$11.75 to \$17.63 per acre.

- **Malathion** (Malathion 57EC) has Caution listed as the signal word, has a 12-hr REI and 1-day PHI. The 57%C formulation is applied at the rate of 1.5 pints to 3.2 pints per acre. Product may be used to control imported fire ants, Japanese beetle, sharp-nosed leaf hopper, gall midge, and fruit worms. Application cost would range from \$5.16 to \$11.00 per acre per application depending on rate selected.
- **Phosmet** (Imidan 70W) has Warning listed as the signal word, has a 24-hr REI and a 3-day PHI. Applied at the rate of 1.33lbs formulation or 0.93 lbs ai per acre per application. Labeled to control blueberry maggot, cherry fruitworm, grasshopper, Japanese beetle and leaf rollers. **NOTE: Labeled in the Northeast US only, which does not include Tennessee.** Cost per application would be approximately \$11.24 per acre.

Carbamate insecticides

- **Carbaryl** (Sevin 80WSP) has Warning listed as the signal word, has a 12-hr REI and a 7-day PHI. Applied at the formulation rate of 1.25 to 2.5 lbs or 0.5 to 0.67 lbs ai per acre per application. Not to exceed 12.5 lbs formulation per season. Labeled to control blueberry maggot, fruitworms, Japanese beetles, leafhoppers, grubs and weevils. Cost would range from \$8.75 to \$17.50 per acre depending on rate used.

Cyclodiene Organochlorines insecticides

- **Endosulfan** (Thionex 3EC) has Danger listed as the signal word, has a 48-hr REI and a 0-day PHI. Applied at the formulation rate of 2 qts. or 1.5 lbs ai per acre and not to exceed 2 applications per season. Labeled for control of the blueberry bud mite. Applied immediately after harvest and again 6 to 8 weeks later. Application cost would be approximately \$13.75 per acre.

Pyrethroid insecticides

- **Esfenvalerate** (Adjourn, Asana 0.66) has Warning listed as the signal word, has a 12-hr REI and a 0-day PHI. Is a Restricted Use Pesticide due to toxicity to fish. Applied at the rate of 4.8 to 9.6 fl.oz . or 0.025 to 0.05 lbs ai per acre. Should only be applied as a pre-bloom or post-bloom spray. Will cause death to honey bees, if sprayed during bloom and will result in low fruit set. Labeled to control blueberry spanworm, cherry fruitworm, cranberry fruitworm, cranberry weevil, grasshoppers, Japanese beetle, leafhoppers, red striped firworms, blueberry maggot, black vine weevil (adult) and strawberry root weevil (adult). May cause skin or eye irritation to some users. Cost would range from \$3.90 to \$7.80 per acre depending on rate used.

Other insecticides

- **Horticultural Oil** (Golden Pest Spray) has Caution listed as the signal word and has a 4-hr REI and a 12-hr PHI. Should not be applied within 2 weeks of a sulfur spray or 7 days of an application of Captan or CaptEvate. Used to aid in the control of scale and mites. Cost ranges from \$10 to \$15 per acre depending on rate used.
- **Azadirachtin** (Aza-Direct 0.0987, Neemix 0.34) the Aza-Direct has Caution listed as the signal word and Neemix has Warning. Aza-direct has a 4-hr REI and the Neemix has a 12-hr REI. Each have a 0-day PHI. Applied at the formulation rate range of 1 – 2 pints per acre. Labeled to control aphids, Japanese beetles, leafrollers, leafhoppers, mites, mealy bugs and true bugs. NOTE: Fruit finish problems may occur with pre-harvest or harvest application of EC formulations.
- **Pyriproxyfen** (Esteem Ant Bait) has Caution listed as the signal word, has a 12-hr REI and a 24 hr PHI. Applied at the rate of 1.5 to 2 lbs formulation per acre or 2-4 tablespoons per mound. Used to control imported fire ants. Cost for an acre to be broadcast treated would range from \$10.58 to \$14.10 per acre.
- **Methoprene** (Extinguish Professional Fire Ant Bait 0.5%) has Caution listed as the signal word, has a 4-hr REI and a 0-day PHI. It is applied at the rate of 1.15 lbs formulation per acre or 3 to 5 tablespoons per mound. Used to control imported fire ants. **NOTE: not labeled for use on crop land, would be used in areas surrounding crop areas.**
- **Spinosad** (SpinTor 2SC, Entrust 80%) has Caution listed as the signal word, has a 4-hr REI and a 3-day PHI.. Applied at the rate of 4 to 6 fl.oz. formulation per acre. No more than 6 applications per year or 29 fl.oz. per year. Labeled to control the gall midge, leafrollers and cherry fruitworm.
- **Tebufenozide** (Confirm 2F) has Caution listed as the signal word, has a 4-hr REI and a 14-day PHI. Applied at the rate of 16 fl.oz or 0.25 lbs ai per acre. No more than 64 fl.oz per acre per season. Labeled to control cranberry fruitworm, cherry fruitworm, obliquebanded leafroller, redbanded leafroller, variegated leafroller, gypsy moth, and spanworm. Does not control the plum curculio. Product must be ingested by pest to be effective, therefore, timing is critical.
- ***Bacillus thuringiensis* subsp. *kurstaki*** (Dipel DF) has Caution listed as the signal word, has a 4-hr REI and a 0-day PHI. Applied at the rate of 0.5 to 1 lb formulation per acre. Labeled for control of various lepidopterous pests. Is an effective microbial insecticide, however should be applied to small, early stage caterpillars for best results. Cost would range from \$5.58 to \$11.15 per acre per application depending on rate selected.

Disease Control

As a rule, blueberry plants require the least amount of fungicides of all fruit crops. Treatments can usually be made on an as-needed basis. If diseases have been a problem in the planting in past years, captan is often used at 7- to 10-day intervals from bud break to harvest. The most commonly observed diseases include; phomopsis cane and twig blight and mummy berry. However, other diseases may be observed on an occasional

basis. Table 2, lists the estimated fungicide use for 2007 and Table 4, lists several fungicides and their current evaluated efficacies.

Anthracnose (*Colletotrichum gloeosporioides*)

Anthracnose also called "ripe rot." quickly infects berries and once infected, the berries remain symptomless until maturity. Soon after infection the affected area becomes slightly sunken. Masses of salmon-colored spores are exuded to the surface; therefore, ruining the ripened fruit, making them unmarketable.

Chemical Controls:

- **Azoxystrobin** (Abound 2.08):
- **Pyraclostrobin** (Cabrio 20 EG):
- **Fludioxonil** and **Cyprodinil** (Switch 62.5WG):
- **Fenhexamid** and **captan** (CaptEvate 68 WDG):
- **Fenbuconazole** (Indar 75WSP):
- **Chlorothalonil** (Bravo Weather Stik):
- **Ziram** (Ziram 76DF):
- **Potassium phosphate** (Prophyt):

Alternatives:

- None

Cultural Control Practices:

- Prune out and destroy blighted twigs, on which the fungus overwinters.

Biological Controls:

- None

Post Harvest Control Practices:

- None

Other issues:

- The QoI-fungicides (Azoxystrobin, pyraclostrobin) have had some resistance issues with other fungi.

Mummy Berry (*Monilinia vaccinii-corymbosil*)

As berries approach maturity, they become light pinkish to cream colored and drop to the ground as mummified fruit. Blighting of leaves, shoots, and flowers can occur. The fungus overwinters on the ground in mummified berries

Chemical Controls:

- **Pyraclostrobin** and **Boscalid** (Pristine WG) has a 24-hr REI and a 0-day PHI. Applied at the rate of 18.5 to 23 oz. No more than two sequential applications should be made before alternating with another mode of action. No more than four applications per acre per crop year.
- **Fenbuconazole** (Indar 75WSP) has a 12-hr REI and a 30-day PHI. Applied at the rate of 2 oz. per acre.
- **Propiconazole** (Orbit 3.6E) provides excellent control. No more than 30fl.oz. per acre per season should be applied.

- **Captan** (Captan) Make up to four applications, beginning at green tip and repeat at 7- to 10-day intervals through petal fall. May not be applied by aerial application.

Alternatives:

- **Cypridiniol / fludioxonil** (Switch):
- **Fenhexamid / captan** (CaptEvate 68WDG):

Cultural Control Practices:

- Where mummy berry is a problem, early spring cultivation will aid in control by covering the overwintered berries.
- Raking mummified berries to the row middles, followed by deep burial of mummies to a depth of at least one inch, will help to reduce the primary mummy berry inoculum source. This activity needs to be conducted prior to mid-January in the most southern blueberry regions.

Biological Controls:

- None

Post Harvest Control Practices:

- Same as listed in cultural control practices.

Other issues:

- Use caution; excessive amounts of dirt mounded on top of blueberry roots and stems can result in injury or plant death.

Stem Blight (*Botryosphaeria dothidea*)

One or more branches exhibit yellowed or reddened leaves, followed by death of the branch. Stems show brown discoloration of woody tissue, often only on one side of the stem. Penetration into the plant is primarily through wounds

Chemical Controls:

- None

Alternatives:

- None

Cultural Control Practices:

- Pruning during coldest and driest winter months may reduce infections, since inoculum is at lowest levels during the winter.
- Some cultivars are more resistant than others.

Biological Controls:

- None

Post Harvest Control Practices:

- None

Other issues:

- None

Alternaria fruit rot (*Alternaria tenuissima*)

Alternaria rot is primarily a postharvest disease of blueberry, although rots do occur in the field when fruit remains on the bush beyond normal ripening. This disease is the most damaging and most commonly occurring postharvest rot of blueberry.

The disease overwinters in old, dried-up berries and in dead fruit-bearing peduncles on bearing twigs from the previous season's crop. The pathogen causes sunken lesions on berries when infection occurs prior to harvest. The surface of the infected area is often covered with a greenish-black spore mass, making it easy to differentiate from the orange spore mass on a ripe rot-infected berry. *Alternaria* spores can be splashed or carried by wind-blown rain to other berries. Postharvest infections produce fuzzy mycelial growth on the surface of the berries.

Chemical Controls:

- **Azoxystrobin** (Abound):
- **Cyprodinil and Fludioxonil** (Switch):
- **Pyraclostrobin** (Cabrio EG):
- **Pyraclostrobin and Boscalid** (Pristine WG):

Alternatives:

- None

Cultural Control Practices:

- None

Biological Controls:

- None

Post Harvest Control Practices:

- Washing harvested fruit with a sodium hypochlorite solution may reduce decomposition of shelved fruit.

Other issues:

- Resistance issues have been reported with azoxystrobin and pyraclostrobin in other fungi.

Phytophthora Root Rot (*Phytophthora* spp.)

Various root rots of blueberry can be particularly problematic immediately following transplanting and until plants are well established. Even in well-drained soils, root rots have been observed in bark-amended beds, and root rots are particularly damaging in high-density bark beds, even when using new bark. Though cost is an issue, replanting into old bark (high-density plantings) is not a good practice; disease-causing organisms build up in the bark, and they can make reestablishment very difficult.

Root rot is generally a problem of low, poorly drained sites. Provisions for adequate drainage must be made prior to planting! Site selection and/or proper bedding operations are essential cultural practices for control of this disease. It also is very problematic in pine bark beds for southern highbush varieties. Treatment with fungicides is not effective for reversing root rot damage on plants with severe symptoms. Preventative treatments in pine bark beds may be warranted, since the beds are often saturated with water through either irrigation or rainfall.

Chemical Controls:

- **Mefenoxam** (Ridomil Gold 4EC) has a 48-hr REI and a 0-day PHI. Applied at the formulation rate of 3.6 pints per acre broadcast basis. Expensive.
NOTE: In high-density bark beds, use of mefenoxam will also provide good control of *Pythium* and *Phytophthora* root rots; use in field plantings is very

expensive and difficult, since the product has to be taken up by the roots for activity.

- **Potassium Phosphonate** (Prophyt): there is currently limited information as to the success of this product in southern blueberry production.

Alternatives:

- **Fosetyl-AI** (Aliette WDG): No more than 4 applications per year. Applied to the foliage and may not provide adequate control of previously infected plants, however may aid in reducing the spread. Best utilized after harvest, since it is not as efficacious against the fruit rots, and it serves as a resistance management tool for Septoria leaf spot.

Cultural Control Practices:

- Plant in areas with past history of being disease free of Phytophthora.
- Use water from sources other than pond, lake, stream or creek.

Biological Controls:

- None

Post Harvest Control Practices:

- None

Other issues:

- It is recommended that phosphite-containing materials (Aliette, ProPhyt, AgriFos, etc.) be utilized in non-bearing plants after establishment (for bedded and high-density bark plantings). Fully-expanded leaf tissue is required for plant uptake of these materials, as they are foliar-applied. In the initial year or planting, a minimum of four applications (spaced approximately one month apart) would be advisable. In general, phosphite materials are acidic, and they should not be applied with acidifiers or acidic water (pH < 6). Excessive application or application intervals which are less than those dictated by label will result in plant injury. These phosphite materials also suppress Septoria leaf spot and anthracnose, major foliar diseases of young plants.

Phomopsis cane and twig blight (*Phomopsis vaccinii*)

This disease causes dieback of fruit bearing twigs and may progress to the berries. The fungus overwinters in dead twigs infected during the previous year. Beginning in February, spores (conidia) are released from the old infections and dispersed by wind and rain. The largest numbers of conidia are released from budbreak in February through bloom in April; conidia become trapped in opening buds, germinate, and infect the vascular system. After the twig is killed, fruiting bodies called pycnidia are produced just under the surface of the bark. these fruiting bodies exude conidia which can cause additional infections, with conidial production continuing into August.

Chemicals

- **Azoxystrobin** (Quadris 2.08):
- **Pyraclostrobin** and **boscalid** (Pristine):
- **Fluidioxonil** and **cyprodinil** (Switch):
- **Ziram** (Ziram):

Alternatives:

- **Benomyl** (Benlate 50WP) **no longer labeled**, cancelled in 2003.

- **Copper Hydroxide** (Kocide 2000): currently not listed on the regional recommendations. May only provide fair control.

Cultural Control Practices:

- Pruning aids in removal of infected twigs reducing inoculum.
- Cultivar selection, some varieties are more susceptible.

Biological Controls:

- none

Post Harvest Control Practices:

- Removal of heavily infested canes

Other issues:

- None

Botrytis flower blight (*Botrytis cinerea*)

Botrytis blossom blight is an important disease of blueberries as well as several other flowering plants. The fungus most commonly infects and blights wounded or senescent plant tissues. As a blueberry bush blooms, corollas (the fused petal of the flowers) senesce and become quite susceptible to infection. Ideally the corolla should drop from the flower after pollination but before senescence occurs. Frost damage on tender new growth may wound the plant, delay petal drop, and facilitate infection by the fungus. The pathogen survives well as a saprophyte on dead host and non-crop plant material. Spores of the pathogen are abundant during blueberry bloom most years.

Chemical Controls:

- **Fenhexamid** (Elevate) provides excellent control. No more than 6 lbs formulation per year. No more two sequential applications before using another fungicide with a different mode of action.
- **Cyprodinil / fludioxonil** (Switch) provides excellent control. No more two sequential applications before using another fungicide with a different mode of action.
- **Boscalid / Pyraclostrobin** (Pristine) provides excellent control. No more two sequential applications before using another fungicide with a different mode of action. Has a 0-day PHI
- **Captan** (Captan) provides fair control
- **Captan** and **fenhexamid** (CaptEvate): has a 0-day PHI. Provides good control.
- **Pyraclostrobin** (Cabrio) provides good control.
- **Ziram** (Ziram 76DF) provides fair control.

Alternatives:

- None

Cultural Control Practices:

- Sanitation efforts to remove diseased and infested plant materials are good horticultural practices but would not significantly limit development of this disease.
- Blueberry cultivars differ in susceptibility to Botrytis blossom blight, but no one cultivar is completely resistant.
- Limit overhead irrigations during bloom development.

Biological Controls:

- *Paenibacillus polymyxa* (Isolate 18191) has shown promise in strawberry production and strain S33 of *Rhodosporidium diobovatum* has shown promise in tomato production, however no data is available in Tennessee production systems.

Post Harvest Control Practices:

- None

Other issues:

- Resistance issues have been reported for Qol-fungicides or strobilurin fungicides for other fungi.

Septoria leaf spot (*Septoria albopunctata*)

Septoria Leaf Spot is prevalent on most of the cultivated highbush and rabbiteye blueberry cultivars. Damage is also serious in rooting beds, causing severe defoliation and poor growth. The fungus overwinters in infected leaves on the ground and in stem lesions. Spores are produced in abundance on new lesions throughout the season with heaviest infection occurring between June and September. Spots on leaves are usually small (1/8 to 1/2 inches across) with a white to tan center and a purple border. Stem lesions are flat or slightly sunken with a tan to gray center and a reddish brown margin. Stem lesions and leaf spots are most severe on small plants or on the lower parts of large plants. May cause premature defoliation, resulting in poor bud development and subsequent yield loss.

Chemical Controls:

- **Azoxystrobin** (Abound 2.08):
- **Fenbuconazole** (Indar 75 WSP):
- **Propiconazole** (Orbit 3.6E):
- **Chlorthalonil** (Bravo Weather Stik):
- **Potassium phosphate** (Prophyt):

Alternatives:

- Copper hydroxide (Kocide 101):
- **Fosetyl-Al** (Aliette WDG): No more than 4 applications per year. Applied to the foliage and may not provide adequate control of previously infected plants, however may aid in reducing the spread. Best utilized after harvest, since it is not as efficacious against the fruit rots, and it serves as a resistance management tool.

Cultural Control Practices:

- Pruning

Biological Controls:

- None

Post Harvest Control Practices:

- Pruning

Other issues:

- None

Powdery Mildew (*Microsphaera alni*)

Powdery mildew usually does not develop on blueberry leaves until late summer after the crop is harvested. The disease may appear as a white fungus growth on the upper leaf surface of some cultivars, or it may be indistinct and confined to the lower leaf surface. Chlorotic spots with reddish borders are common on the leaf surface and may be mistaken for symptoms caused by the red ringspot virus.

Chemical Controls:

- **Azoxystrobin** (Abound 2.08):
- **Fenbuconazole** (Indar 75 WSP):
- **Propiconazole** (Orbit 3.6E):

Alternatives:

- **Sulfur** (Thiolux): provides fair control

Cultural Control Practices:

- Use of resistant cultivars

Biological Controls:

- None

Post Harvest Control Practices:

- None

Other issues

- Possible resistance issues when using QoI-fungicides (azoxystrobin).

There are several other diseases which are occasionally observed in blueberry production which include; double Spot (*Dothichiza caroliniana*), Gloeocercospora Leaf Spot (*Gloeocercospora inconspicua*), and Alternaria Leaf Spot (*Alternaria tenuissima*). Products commonly used for other foliar diseases also provide control of these pests.

Fungicides

Strobilurin Fungicides:

- **Azoxystrobin** (Abound 2.08) has Caution listed as the signal word, has a 4-hr REI and a 0-day PHI. Applied at the formulation rate range of 6.0 to 15.5 fl.oz. or 0.10 to 0.25 lbs ai per acre. No more than two sequential applications before switching to a fungicide with another mode of action. No more than 1.44 quarts or 0.75 lbs ia per acre per season. Used to control anthracnose fruit rot, Alternaria ripe rots, Botryospheria canker, powdery mildew, Septoria blight, mummy berry, and phomopsis stem canker. Applications are made from blue to after harvest depending on environmental conditions. Application cost ranges from \$13.13 to \$33.90 per acre depending on rate selected. **NOTE:** resistance to QoI-fungicides has been reported in some isolates of downy and powdery mildews.
- **Pyraclostrobin** (Cabrio 20EG) has Caution listed as the signal word, has a 24-hr REI and a 0-day PHI. Is applied at the rate of 14 oz per acre with no more than two sequential treatments and no more than 4 applications per season. Used to control anthracnose and Alternaria fruit rots. Applied from bloom until after

harvest depending on environmental conditions. Application cost is approximately \$22.93 per acre. **NOTE:** resistance to Qol-fungicides has been reported in some isolates of downy and powdery mildews.

- **Pyraclostrobin** and Boscalid (Pristine WG) has Caution listed as the signal word, has a 24-hr REI and a 0-day PHI. Applied at the formulation rate of 18.5 to 23 oz. Formulation contains 0.008 lbs of **pyraclostrobin** and 0.0158 lbs ai of boscalid in 1 oz. of Pristine. No more than 92 oz per acre per season. No more than two sequential applications should be made before alternating with another mode of action. No more than four applications per acre per crop year. Used to control mummy berry, phomopsis cane and twig blight and botrytis flower blight. May be applied when tips are greening until after harvest. Application cost ranges from \$41.81 to 51.98 per acre depending on rate selected. **NOTE:** resistance to Qol-fungicides has been reported in some isolates of downy and powdery mildews.

Phenylpyrrole fungicides:

- **Fludioxonil** and Cyprodinil (Switch 62.5WG) has Caution listed as the signal word and has a 72-hr REI and a 0-day PHI. Is applied at the formulation rate of 11-14 oz. Formulation contains 37.5% cyprodinil and 25% **fludioxonil**. No more than 56 oz. formulation per acre per year. Used for control of botrytis flower blight, phomopsis, Alternaria fruit rot, anthracnose, and mummy berry. Applied from bloom until after harvest. Application cost ranges from \$51.70 to 65.80 per acre depending on rate used.

Phenylamide fungicides:

- **Mefenoxam** (Ridomil Gold) has Caution listed as the signal word, has a 48-hr REI and a 0-day PHI. Applied at the formulation rate of 3.6 pints or 1.8 lbs ai per acre. Normally applied just prior to planting and when conditions are favorable for good root development. Labeled to control Phytophthora root rot. Application cost is approximately \$388.08 per acre.

Hydroxylamide fungicides:

- **Fenhexamid** (Elevate 50WDG) has Caution listed as the signal word and has a 12-hr REI and a 0-day PHI. Applied at the formulation rate of 1.5 lbs or 0.75 lbs ai per acre. No more than two consecutive applications should be made without switching to a fungicide with another mode of action. No more than 6 lbs formulation per acre per year. Used for control of botrytis flower blight. May be applied from bloom through harvest. Application cost is approximately \$53.25 per acre.
- **Fenhexamid** and captan (CaptElate 68WDG) has Danger listed as the signal word, has a 72-hr REI and a 0-day PHI. Formulation contains 14.3% **fenhexamid** and 53.6% captan per pound of formulation. Applied at the formulation rate ranging from 3.5 to 4.7 lbs per acre. Labeled for control of botrytis, anthracnose, and mummy berry. May be applied from bloom through harvest. Application cost ranges from \$47.25 to \$63.45 per acre depending on rate used.

Demethylation Inhibitor or Sterol Inhibitor fungicides:

- **Fenbuconazole** (Indar 75WSP) has Caution listed as the signal word, has a 12-hr REI and a 30-day PHI. Applied at the rate of 2 oz. or 0.094 lb ai per acre. No more than 4 applications per year. Labeled to control mummy berry, Alternaria,

anthracnose, Septoria leaf spot, phomopsis twig blight and fruit rot, powdery mildew, and rusts. Product has a supplemental label. Livestock should not be allowed to graze treated fields or offered treated material as a feed item.

Application cost is approximately \$16.54 per acre.

- **Propiconazole** (Orbit 3.6E) has Warning listed as the signal word and a 24-hr REI and a 30-day PHI. Applied at the rate of 6 fl.oz. per acre. No more than 30 fl.oz or 0.84 lbs ai per acre per season. Labeled to control mummy berry, Septoria leaf spot, rust, leaf and cane spot, and powdery mildew. Application cost is approximately \$17.78 per acre.

Carboximide fungicides:

- **Boscalid** and Pyraclostrobin (Pristine WG) has Caution listed as the signal word, has a 24-hr REI and a 0-day PHI. Applied at the rate of 18.5 to 23 oz. Formulation contains 0.008 lbs of pyrclostrobin and 0.0158 lbs ai of **boscalid** in 1 oz. of Pristine. No more than 92 oz per acre per season. No more than two sequential applications should be made before alternating with another mode of action. No more than four applications per acre per crop year. Used to control mummy berry, phomopsis cane and twig blight and botrytis flower blight. Cost previously provided.

Anilopyrimidine fungicides:

- **Cyprodinil** and fludioxonil (Switch 62.5WG) has Caution listed as the signal word and has a 72-hr REI and a 0-day PHI. Is applied at the formulation rate of 11-14 oz. Formulation contains 37.5% **cyprodinil** and 25% fludioxonil. No more than 56 oz. formulation per acre per year. Used for control of botrytis flower blight, phomopsis, Alternaria fruit rot, anthracnose, and mummy berry. Cost listed in above section.

Phthalimide fungicides:

- **Captan** (Captan 50WP, Captan 4L) both formulations have Danger listed as the signal word, the 4L formulation has a 72-hr REI and the 50WP has a 48-hr REI and both have a 0-day PHI. The 4L formulation is applied at the rate of 24 to 32 fl.oz per acre. No more than 70lbs 50WP or 35 quarts of 4L formulation per acre per crop year should be applied. Labeled to control Botrytis, berry rot and mummy berry. May not be applied by aerial application. Cost ranges from \$5.43 to \$7.25 per acre for the 4L formulation
- **Captan** and fenhexamid (CaptEvate 68WDG) has Danger listed as the signal word, has a 72-hr REI and a 0-day PHI. Formulation contains 14.3% fenhexamid and 53.6% **captan** per pound of formulation. Applied at the formulation rate ranging from 3.5 to 4.7 lbs per acre. Labeled for control of botrytis, anthracnose, and mummy berry. Pricing listed in previous section.

Phthalonitrile fungicides:

- **Chlorthalonil** (Bravo Weather Stik 6) has Caution listed as the signal word, has a 12-hr REI and 42-day PHI. Applied at the formulation rate range of 3 to 4 pints or 2.25 to 3.0 lbs ai per acre. Product should not be applied after full bloom. No more than 12 pints formulations should be applied. Product is used to suppress anthracnose ripe rot, control of mummy berry, Septoria leaf spot and rust. May not be applied by aerial application. Cost ranges from \$18 to \$24 per acre depending on rate selected.

Dithiocarbamate fungicides:

- **Ziram** (Ziram 76DF) has Danger listed as the signal word, has a 48-hr REI and a 30 day PHI. Applied at the formulation rate of 3 lbs or 2.28 lbs ai per acre. Should not be applied later than three weeks after full bloom. Labeled for control of mummy berry, phomopsis twig blight, anthracnose fruit rot, and aids in control of Botrytis. Cost is approximately \$8.73 per acre.

Phosphonate fungicides:

- **Fosetyl-AI** (Aliette 80WDG) has Caution listed as the signal word, has a 12-hr REI and a 12-hour PHI. Applied at the rate of 5lbs formulation or 4 lbs ai per acre. No more than 4 applications per year or 20 lbs formulation per year. Used to control Phytophthora root rot, anthracnose, Alternaria fruit rot and aids in suppression of phomopsis canker. Applied at the pink bud stage of growth. Should not be mixed with copper or foliar fertilizers, due to possible phytotoxicity. Cost is approximately \$130.86 per acre.
- **Mono and di-potassium salts of phosphorus acid** (AgriFos, K-phite) have Caution listed as the signal word. No pricing was available.
- **Potassium phosphate** (Prophyt) has Caution listed as the signal word and a 4-hr REI. Is formulated at 4.2 lbs ai per gallon. Applied at the rate of 4 pints per acre. Labeled to aid in control of Phytophthora root rot, Septoria leaf spot, Alternaria fruit rot and anthracnose. No pricing was available for this product.

Copper fungicides

- **Copper Hydroxide** (Kocide 101, 2000) has Warning or Danger arelisted as the signal word and 24-hr REI depending on formulation. Applied at the (77% formulation) rate of 3 to 5 lbs per acre. May cause phytotoxicity if spray solution has a pH less than 6.5. Product should not be mixed with Aliette. Used for control of fruit rot and phomopsis twig blight. For the 2000 (53.8%) formulation cost would range from \$9.00 to \$18.00 per acre depending on rate used.

Sulfur fungicides

- **Sulfur** (Thiolux Jet) Applied at the formulation rate of 5 to 10 lbs or 4 to 8lbs ai per acre and applied when new shoots are at least 6 inches in length prior to bloom at the first sign of disease. Labeled for control of powdery mildew.

Weed Control

Major weeds include the sedges such as yellow nutgrass or nutsedge, johnsongrass, pepper weed, crabgrass, various morningglories, and pigweeds. Products commonly used prior to planting to control weeds include items containing glyphosate or paraquat. Other herbicides are used on an as needed basis. Often, mulches aid in the control of various weeds. Commonly, row middles are mowed to remove weeds. In general, weeds compete for water and nutrients as well as provide habitats for insect and disease pests. Weeds may reduce yields a great as 75%, however, by using mulch, mowing row middles and herbicide use when needed will reduce the possibility of loss greatly. Table 3, lists the estimated herbicide usage during 2007.

Herbicides

Glycine herbicide

- **Glyphosate** (various) has caution listed as the signal word and has a 4-hr REI. It is used as a preplant or site preparation material and as a directed postemergence material. Applied 30 days prior to planting. Depending on formulation and rate use cost would range from \$20 to \$27 per acre. **NOTE:** this is a non-selective systemic herbicide. Some weeds have become resistant to glyphosate products.

Bipyridylum herbicide

- **Paraquat** (Gramoxone Inteon 2SL, Firestorm 3SL) both formulations have Danger listed as the signal word, they have a 24-hr REI and each are Restricted Use Pesticides. The 2SL formulation is applied at the rate of 2 -4 pints per acre. No more than 5 applications per year. These are applied before the new canes or shoots and as a coarse spray to avoid crop injury. Used as a burndown prior to planting to control various grasses and broadleaf weeds. Cost would range from \$8.05 to \$16.10 per acre depending on rate used. **NOTE:** this is a non-selective herbicide, if applied after establishment, applied when plants are dormant with low pressure sprayers.

Benzothiadiazinone herbicide

- **Bentazon** (Basagran 4L) has Caution listed as the signal word and a 48-hr REI. Applied at the formulation rate range of 1 to 2 pints or 0.5 to 1 lbs ai per acre. Used to control sedges and various other broadleaf weeds. Cost would range from \$11.88 to \$23.75 per acre depending on rate used. **NOTE: not labeled** for use in blueberry production, however may have a SLN in other states. If used, would be applied prior to planting and/or up to one year prior to harvest.

Triazolinone herbicide

- **Carfentrazone-ethyl** (Aim 2EC) has Caution listed as the signal word and a 12-hr REI. Applied at the formulation rate of 1 fl.oz. (0.016 lbs ai) during pre-plant to 2 fl.oz (0.031 lbs ai) in-season as a row middle application. No more than 6.1 fl.oz. (0.096 lbs ai) per acre per crop season. Used to control various broadleaf weeds. Application cost would range from \$6.56 to \$13.12 per acre depending on rate used.

Cyclohexanedione herbicides

- **Clethodim** (Select 2EC, Arrow 2EC, Select Max) has Caution listed as the signal word and has a 24-hr REI. The 2 E formulations are applied at the rate range of 6 to 8 fl.oz. or 0.09 to 0.125 lbs ai per acre. The 0.97 lb per gallon formulation is applied at the rate of 9 to 16 fl oz per acre. Applicators should not exceed 0.5 lbs ai per acre per season. Used to control various grasses. Labeled for used during non-bearing seasons only. Cost would range from \$6.06 to \$8.09 per acre depending on rate selected.
- **Sethoxydim** (Poast 1.5EC) has Warning listed as the signal word, has a 12-hr REI and a 30-day PHI. Applied at the formulation rate of 2.5pints or 0.47 ai per acre with a maximum per season application of 5 pints formulation or 0.94 lbs ai per acre per season. Application cost would be approximately \$23.81 per acre.

Aryloxyphenoxy-propionate herbicide

- **Fluazifop** (Fusilade DX 2EC) has Caution listed as the signal word and a 12-hr REI. Applied at the formulation rate range of 6 to 24 fl.oz. or 0.094 to 0.375 lbs ai per acre. Labeled for use during non-bearing season. May be phytotoxic to some varieties. Cost would range from \$7.17 to \$28.69 depending on rate used.

Preemergence products

Acetamide herbicide

- **Napropamide** (Devrinol 50DF) has Caution listed as the signal word and a 12-hr REI. Applied at the formulation rate of 8 lbs or 4 lbs ai per acre per season. May be applied to newly planted crops or established. Used to control various grasses and broadleaf weeds. Application cost would be approximately \$67.20 per acre.

Dinitroaniline herbicide

- **Oryzalin** (Surflan 4AS or FarmSaver) has Caution listed as the signal word and a 24-hr REI. Applied at the formulation rate range of 2 to 6 quarts or 2 to 6 lbs ai per acre per season and not to exceed 12 quarts per acre per year. Used to control many annual grasses and certain broadleaf weeds. Application cost would range from \$37 to \$111 depending on rate selected.
- **Benefin** (Balan) and **Oryzalin** (Surflan) XL 2G Applied at the rate of 150lbs formulation per acre after the soil has settled after transplanting. May not be applied the year of harvest. No pricing was available for this product, however the cost of the benefin portion would be approximately \$72.34 per acre.

Pyridazinone herbicide

- **Norflurazon** (Solicam 80DF) has Caution listed as the signal word, has a 12-hr REI and a 60-day PHI. Applied at the formulation rate of 2.5 to 5.0 lbs or lbs ai per acre per season. May be applied 6 months after planting. Cost would range from \$59.55 to \$119.10 per acre depending on formulation used.

Benzamide and Dinitroaniline herbicides

- **Isoxaben** and **Trifluralin** (Snapshot 2.5G) has Caution listed as the signal word and a 12-hr REI. It is formulated with 2% trifluralin and 0.5% isoxaben. Applied at the formulation rate of 150 lbs per acre. Applications should not exceed 600 lbs formulation per acre per year. May only be used in non-bearing years. Cost would be approximately \$298.50 per acre per treatment.
- **Isoxaben** (Gallery 75DF) has Caution listed as the signal word and a 12-hr REI. Applied at the formulation rate range of 0.66 to 1.33 lbs or 0.5 to 1 lb ai per acre. For use during non-bearing seasons. Application costs range from \$72.67 to \$144.97 per acre depending on rate selected.

Nitrile herbicide

- **Dichlobenil** (Casoron 4G) has Caution listed as the signal word and a 12-hr REI. Has a waiting period of 4-weeks after planting. Applied at the rate of 100 to 150 lbs formulation per acre. Product may be worked into the first few inches of soil and watered in for weed control. Cost would be approximately \$223.00 to \$334.50 per acre depending on rate used.

Triazinone herbicide

- **Hexazinone** (Velpar 2SL, 80WDG) has Danger listed as the signal word, has a 24-hr REI and a 90-day PHI for high bush and 450 day PHI for low bush

varieties. May be applied at the formulation rate of 1.3 to 3.6 lbs or 1.04 to 2.88 lbs ai per acre. Producers should not exceed 2.4 lbs formulation or 1.92 lbs ai per acre per season. Applied in the spring, prior to leaf emergence and directed towards the soil and weed areas. Should not be applied to foliage of blueberries. Labeled for control of certain herbaceous and woody weeds in established high bush and low bush blueberry fields. Cost would range from \$37.68 to \$135.56 depending on rate selected.

Benzamide herbicide

- **Pronamide** (Kerb 50WP) has Caution listed as the signal word and is a Restricted Use Pesticide. It has a 24-hr REI and 0-day PHI. Applied in the fall and winter at the formulation rates of 2 to 4 lbs. Should not be applied to newly planted canes until roots become established. Used to control various grasses and broadleaf weeds. Application cost ranges from \$86 to \$172 per acre, depending on rate selected.

Urea herbicide

- **Diuron** (Karmex 80DF) has Caution listed as the signal word and a 12-hr REI. May only be applied to fields which have been established for one year. Should not be applied to plants which have exposed roots. Applied at the formulation rate of 1.5 to 2 lbs or 1.2 to 1.6 lbs ai per acre in the spring prior to weed seed germination. Application cost ranges from \$5.57 to \$7.42 per acre, depending on rate selected.

Triazine herbicide

- **Simazine** (Princep 4L, 90) has Caution listed as the signal word and a 12-hr REI. Applied at the formulation rate of 2 – 4 quarts or 2 to 4 lbs ai per acre in the spring. May be applied as a split application in the spring at 2 qts followed by a second application in the fall at 2 qts. If plants are less than 6 months of age a half rate is suggested. Product should not be applied when fruit is present. Application cost would be approximately \$8 per acre per 2 qt formulation rate.

Uracil herbicide

- **Terbacil** (Sinbar 80WP) has Caution listed as the signal word and a 12-hr REI. Applied at the formulation rate range of 2 to 3 lbs or 1.6 to 2.4 lbs ai per acre. May be used in planting established for one year, and should not be used in highly eroded areas. Product should **not** be used in sandy loamy soils with less than 3% organic matter. Application cost would be \$77 to \$116 per acre depending on rate selected.

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Noncitrus Fruits and Nuts 2007 Preliminary Summary, January 2008, Fr Nt 1-3 (08).

Table 1. Estimated Percent Acreage Treated With an Insecticide For 2007 Blueberry Production

Active ingredient	Tradename	Typical Avg. annual usage	Estimated % acreage treated for 2007
Diazinon	AG500	0%	0%
Malathion	57EC	8%	1%
Carbaryl	Sevin 80WSP	35%	10%
Endosulfan	Thionex 3EC	3%	1%
Esfenvalerate	Asana 0.66	1%	1%
Horticultural oil	Golden Pest Spray	1%	0%
Azadirachtin	Aza-Direct	0%	0%
Spinosad	SpinTor	0%	0%
Tebufenozide	Confirm 2F	0%	0%
Bacillus	Dipel DF	0%	0%

Estimates provided by David Lockwood and Frank Hale

Table 2. Estimated Fungicide Use in 2007 Blueberry Production

Active ingredient	Trade name	Estimated % acreage treated in 2007*
Azoxystrobin	Abound 2.08	10%
Pyraclostrobin	Cabrio 20EG	10%
Fludioxonil / cyprodinil	Switch 62.5 WG	0
Mefenoxam	Ridomil Gold	0
Fenhexamid	Elevate 50WDG	0
Fenhexamid / captan	CaptEvate	trace
Fenbuconazole	Indar 75WSP	0
Propiconazole	Orbit 3.6E	0
Boscalid / Pyraclostrobin	Pristine WG	0
Captan	Captan 50WP	10%
Chlorothalonil	Bravo Weather stik	0
Ziram	Ziram 76DF	0
Fosetyl-AL	Alliette 80WDG	0
Mono and dipotassium salt-	AgriFos	0
Potassium phosphate	Prophyt	0
Copper hydroxide	Kocide 101	0
Sulfur	various	0

*Estimated percent acreage treated provided by Steve Bost,

Table 3. Estimated Herbicide Use in 2007 Blueberry Production

Active ingredient	Tradename	Estimated % treated acreage for 2007
Glyphosate	Various	25%
Paraquat	Gramoxone Inteon 2SL	15%
Carfentrazone-ethyl	Aim 2EC	0%
Clethodim	Select 2EC	0%
Sethoxydim	Poast 1.5EC	1%
Fluazifop	Fusilade 2EC	1%
Napropamide	Devrinol 50DF	
Oryzalin	Surflan 4AS	30%
Benefin / Oryzalin		0%
Norflurazon	Solicam 80DF	0%
Isoxaben / Trifluralin	Snapshot 2.5G	0%
Dichlobenil	Casoron 4G	0%
Hexazinone	Velpar 2SL	0%
Pronamide	Kerb 50WP	0%
Diuron	Karmex 80DF	0%
Simazine	Princep 4L	40%
Terbacil	Sinbar 80WP	0%

Estimates provided by Dr. David Lockwood, University of Tennessee, Extension Service.

Table 4. Efficacy of Selected Fungicides Against Blueberry Diseases

Fungicide	Phytophthora root rot	M U M M Y Berry	B O T R Y T I S	A L T E R N A R I A rot	P H O M O P S I S	R I P E R O T	S E P T O R I A	A N T H R A C N O S E leaf spot	R U S T
Azoxystrobin (Abound)	NA ^a	++	NA	+++++	++	+++++	++++	++++	???
Captan (Captan, Captec)	NA	+	++	++	++	+++	++	+++	NA
Chlorthalonil (Bravo)	NA	NA	NA	NA	NA	NA	++++	???	+++
Cyprodinil & Fludioxonil (Switch)	NA	++	+++++	+++++	+++	+++++	+++	++++	???
Fenbuconazole (Indar)	NA	+++++	NA	NA	NA	NA	++++	NA	+++
Fenhexamid (Elevate)	NA	++	+++++	NA	NA	NA	NA	NA	NA
Fenhexamid & Captan (CaptEvate)	NA	++	++	+++++	++	++	+++	++	???
NAFosetyl-Al (Aliette WDG)	+++	NA	NA	NA	+	+	++++	++++	NA
Mefenoxam (Ridomil Gold)	++++	NA	NA	NA	NA	NA	NA	NA	NA
Propiconazole (Orbit)	NA	+++++	NA	NA	NA	NA	++++	NA	+++
Pyraclostrobin (Cabrio)	NA	NA	NA	++++	+++	++++	++++	+++++	+++++
Mono and di-potassium (K-phite)	+++	NA	NA	NA	NA	NA	++++	++++	NA
Potassium phosphate (ProPhyt)	+++	NA	NA	NA	NA	NA	++++	++++	NA
Pyraclostrobin & Boscalid (Pristine)	NA	++++	+++++	+++++	+++	+++++	+++++	+++++	+++++
Ziram (Ziram)	NA	+	++	+	+++	+++	???	++	???

NA = no significant activity, ??? = unknown activity, + = very limited activity, ++ = limited activity, +++ = moderate activity, ++++ = good activity, +++++ = excellent activity.