

# Crop Profile for Ginseng in Virginia

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## General Production Information<sup>1, 2</sup>

- Between July 2004 and June 2005, 3,613 lbs. of ginseng worth approximately \$903,300 were harvested, inspected, and certified in Virginia.
- Ginseng is grown in and exported from at least 37 counties in Virginia.
- There were approximately 300 growers and 45 certified buyers regulated by the Virginia Department of Agriculture and Consumer Services (VDACS) in 2003.

## CROP DESCRIPTION AND REGULATIONS<sup>3, 4, 5, 6, 16</sup>

Ginseng (*Panax quinquefolius*) is a perennial, root-producing, medicinal herb native to the Appalachian Mountains that run from Maine to Georgia. It also grows naturally in rich soil in heavily shaded deciduous forests as far west as Minnesota and Louisiana. Ginseng plants have compound leaves that grow in a single whorl, greenish white flowers, and red drupes. Wild ginseng is known colloquially as “sang” to the Appalachian people who have been harvesting and exporting it since the 1700s for its world-renowned healing properties. In the United States, ginseng is believed to relieve stress and lethargy, while stimulating mental acuity. In Asia, ginseng is used to treat impotence, nervousness, nausea, and vomiting.

Ginseng is sold in three forms: dried roots, green roots (not dried), or stratified seed (held in moist soil to be sold to growers). Ginseng is potentially a very lucrative crop because wild or woods-grown populations thrive with little or no effort, and the roots are in high demand in Asia. However, yields of noncultivated ginseng, and there is more risk involved. In contrast, intensively cultivated ginseng plants produce more roots, but this production method requires a lot of work. Furthermore, cultivated plants are vulnerable to intense disease pressure.

Each year about 4 million pounds of dried roots worth over \$25 million are harvested in North America for shipment to the Far East. Approximately 90% of the wild ginseng harvested in the United States goes to Hong Kong, where it sells for as much as \$1,000 per ounce (an extreme price) after processing. The age and appearance of the roots are what set the market value. Asian buyers desire old roots that are gnarled, forked, moderate in size, stubby but tapered, off-white, and firm with closely formed rings. Wild ginseng is now rare in many areas due to poaching, deer feeding, and destruction of its shady, wooded habitat. However, it is still abundant in some isolated regions, including parts of Southwest Virginia.

In 1973, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) was implemented. This authority requires permits to export American ginseng. VDACS is responsible for regulating ginseng harvests and sales in Virginia. Anyone can buy ginseng for personal use, but a dealer's license from VDACS is required to resell the herb. In the past few years, typical annual yields were approximately 4,000 lbs. of roots worth about \$1.2 million. The U.S. Fish and Wildlife Service passed a law in August 2005 mandating that wild American ginseng roots must be at least ten years old to be exported from Virginia and 18 other mid-Atlantic and North Central states. However, this rule was overturned; the minimum root age is currently five years. The age of a ginseng plant is most reliably determined by counting the number of stalk scars, although some opt to count the number of leaves, or "prongs." In order to legally harvest ginseng, the roots must have at least four bud-scale scars and three prongs. However, people are permitted to grow and sell ginseng at any stage if they can prove they cultivated it themselves using purchased seed or transplants.

## Cultural Practices<sup>3, 7, 8, 9, 10, 16</sup>

Based on the cultural practices used, there are four types of ginseng: *wild* roots, which are most valuable and require no gardening because they are taken from their native habitat; *virtually wild* or *wild-simulated* roots, which are worth nearly as much as wild roots and need very little cultivation; *cultivated woods-grown* roots, which require intensive cultivation in a natural setting but are worth far less than wild roots; and *field-cultivated* roots, which are least valuable and are grown using intensive cultural practices under artificial shade.

**Wild Ginseng Harvest and Conservation:** Wild ginseng is grown with no human intervention and is the most profitable (\$400 to \$600 per dried pound) because of its gnarled appearance, which is similar to oriental ginseng (*Panax ginseng*). Because of wild ginseng's high market value, the risk of theft is high. Ginseng roots can grow in the wild for 20 to 30 years, and consumers believe that wild roots grown slowly over time are more potent. Wild ginseng is dark tan, forked, small, lightweight, and has a long neck. Wild roots take seven to eight years to mature, which is twice that of cultivated roots. The collection season runs from August 15 to December 31 in Virginia. It is illegal to possess uncertified ginseng (unregulated by VDACS) from land other than one's own from April 1 to August 14. The punishment for harvesting ginseng from another person's land or public property is a fine and/or prison time. Ginseng MAY NOT be collected on state and federal lands without written permission. A permit is also needed to harvest this herb from National Forest lands. A landowner-seller declaration form must be filed if the roots are dug from one's own land and sold before ginseng season or September 1.

Ginseng roots should be harvested only from plants with at least three prongs and many red berries. The mature seeds should be planted in the soil where the ginseng was harvested in order to replenish the natural population. Ginseng seeds typically take two years to germinate in the wild. Four- to five-year-old plants begin to produce flowers in late spring and set seed in late summer. The protocol for harvesting wild ginseng is to dig up a clump of soil 1 ft. in diameter around the plant and shake off the loose dirt without breaking off the fine roots. Whole roots are more profitable. The berries are squeezed to expose the seeds and are planted at least 12 inches apart and 1/2 inch deep in loose soil. Leaf litter can be used to cover the soil. The harvested roots may be left to wilt for a few days. Alternatively, the remaining soil is washed off immediately, and the roots are allowed to air dry.

**Virtually Wild/Wild-Simulated Ginseng:** Wild-simulated ginseng is grown with minimal cultivation under natural tree cover. It results in valuable roots very similar in appearance to wild ginseng. It is a good alternative crop for those with shady, wooded land. However, this crop is vulnerable to theft, rodents, market price drops, plant diseases, and crop failures. Cultural practices may include raking leaves, scratching the soil surface to plant seeds, spreading gypsum, and covering seeds. Roots are typically grown organically without pesticides. The only required tools are a rake and a garden hoe. No tillage is involved because it lowers the root value. Unfortunately, the site must be left fallow for several years following the ginseng harvest.

In the past, ginseng was thought to grow best in mountainous regions, but interest in this herb is moving to the Piedmont region. The best sites are north- or east-facing slopes with at least 70% to 75% shade provided by deep-rooted hardwoods such as yellow poplar, walnut, basswood, and oak. Ginseng thrives in loose, rocky soil, like that found in limestone or sandstone areas. Ginseng will sometimes grow on southwest-facing slopes in sandy or clay soil under mixed softwoods and hardwoods, but these sites are not ideal. Heavy clay soil and swampy areas should always be avoided. Winter weather must be cold enough to stratify the seeds, or they may not germinate properly. Summer temperatures should be moderate. Certain companion plants indicate that a site is hospitable to ginseng production (e.g., black cohosh, blue cohosh, goldenseal, bloodroot, Solomon's seal, jewelweed, galax, trillium, hepatica, wild ginger, ferns, spleenwort, jack-in-the-pulpit, and mayapple). However, ferns release defensive chemicals into the soil, so ginseng should not be grown near these plants. If the soil on the planting site is acidic, dolomite can be added to increase plant vigor and deepen the color. The only other cultivation methods necessary are removing weeds and plants that appear diseased.

Red berries are collected from ginseng plants in August or September. The seeds are separated from the fruit and planted in the fall in flats. Purchased seed typically costs \$60 to \$80 per pound (1 lb. = 6,500 seeds), and 10 lbs. of stratified seed will cover 1/2 acre. The total start-up fee is approximately \$3,800 per 1/2 acre. If purchased seeds are used to establish a ginseng garden, they should be soaked in a 10% bleach solution for two minutes and rinsed off to prevent fungal diseases. Seeds should be ordered early (July or August) from one of the approximately 20 commercial suppliers for delivery in October. Avoid purchasing suspiciously cheap seed, as it may not be of the highest quality. Bad seeds can be separated from good seeds by pouring them into a bucket of water; viable seeds will sink to the bottom. Seeds should be stored in the refrigerator and misted once a week until planting or else they will dry out and die.

Seedlings should be planted deep enough to accommodate the taproot comfortably and cover the terminal bud with 1 inch of soil. Add light mulch to the leaf litter. Upon emergence in the spring, the trilobed seedlings are ready to be transplanted to deep pots in groups of three. The seedlings are planted in the ground the following autumn in full shade under hardwoods in well-drained but moist soil.

Ginseng plants usually produce three leaflets in the first year, five in the second year, and two to four prongs with three to five leaflets over the next several years. Flowers develop during the two-pronged stage (four to five years old). They can be removed annually to hasten root development, but this also changes the root's appearance. This is more common in cultivated gardens. Flowers that are left alone will produce annual seed crops, and the seeds and seedlings can be harvested and sold to other growers. Wild-simulated ginseng plants grow for nine to ten years before they reach a desirable root size. In general, it takes about three hours to dig up 3 lbs. of roots ( $\approx$  400 plants), which shrink to 1 lb. when dried. Roots are exhumed in autumn using a digging tool such as a mattock. The roots should be removed intact, if possible, using extra care to keep the neck attached. Roots should be gently rinsed, but not scrubbed clean, because dirty root rings may actually increase the value. In a dry climate, clean roots can be dried on screens in a well-ventilated area in the shade and turned often for a period of a few days up to three weeks. If the humidity is high, drying can be hastened by blowing warm air over the screens. Temperatures should not exceed 100°F. This can be done in a small room or in a specially built herb dryer. Roots should not be dried in a kitchen oven. Care must be taken to dry the roots slowly and thoroughly. Dried roots are stored in a dry, well-ventilated, pest-proof place until they are sold. Wild-simulated ginseng roots have the greatest market value between November and April.

**Cultivated Woods-Grown Ginseng:** Like wild-simulated ginseng, cultivated woods-grown ginseng is planted in a natural forest setting. This operation is often on a larger scale, and the cultivation methods are more intense in order to maximize yield. Roots may be grown

organically, but often pesticides and fertilizers are used. However, far fewer chemicals are used with this method than in field-cultivated ginseng. Woods-grown ginseng roots are worth more (\$30 to \$100 per pound) than field grown but not nearly as much as wild-simulated or wild roots. To prepare the site, first remove understory plants, including trees, but leave enough vegetation to yield at least 70% shade. Since the primary goal is to reap the most roots in the shortest amount of time, plants are grown close together and fertilizers are applied. One key difference between wild-simulated ginseng and cultivated woods-grown is that the soil is tilled 6 to 8 inches deep in the latter case. Seeds or seedlings are planted approximately 6 inches apart in 4- to 6-ft.-wide beds that are sloped and raised 6 to 8 inches to allow water to drain away. Rows are 6 to 12 inches apart and 1/2 inch deep.

Soil samples should be monitored annually so the pH, calcium, and phosphorus levels can be adjusted as necessary. Ginseng flourishes in slightly acidic soil (pH 5 to 6) that is rich in calcium, phosphorus, and organic matter. If these nutrients are lacking, gypsum (calcium sulfate) should be applied rather than lime (calcium carbonate) every two or three years so that calcium is added but the pH remains low. It is believed that acidic soil may help prevent diseases, although more research is necessary to state this conclusively. Gypsum can be applied at a rate of up to 5 lbs. per 100 sq. ft. to reach calcium levels of 4,000 lbs. per acre. Calcium absorption is facilitated in soils with available phosphorus. If the soil is deficient, phosphorus should be applied to bring levels up to 95 lbs. per acre. Fertilizers may also be applied to the soil surface. An organic or balanced fertilizer is applied as well as gypsum if the soil is too acidic. Bone meal and blood meal are organic fertilizers that also serve to repel deer and rabbits. In the fall, the seedbeds are covered with 1 to 2 inches of leaf or straw mulch. Plant beds should be weeded regularly, flowers can be removed, and pesticides may be applied as necessary.

Fungicides used for control of alternaria stem and leaf blight may be applied weekly when weather is humid or precipitation is heavy. Diseased plants should be destroyed or removed. When necessary, insecticides can be applied to control ginseng pests (e.g., Lygus bugs, white flies, aphids, and leaf beetles). Pesticide use should be minimized in the year before the harvest to avoid chemical residues. Moles, mice, turkeys, deer, and slugs can be controlled by cultural methods, traps, or poison baits. Rodents can be excluded by building a metal perimeter around the ginseng plot that extends 1 foot below ground and 2 feet aboveground. Roots are harvested by hand or using a modified potato digger. They are dried in the same way as other ginseng cultivation methods. After harvest, the land may not be able to support another ginseng garden. Although good sites can be planted up to three times in a row, this is not recommended.

**Field-Cultivated Ginseng:** In the United States, field-cultivated ginseng is grown in raised beds under artificial shade on large farms in Wisconsin, Michigan, and the West Coast. Roots can be harvested in as little as three to four years. However, cultivation still requires a great deal of time, money, and equipment with a modest payoff. It costs \$30,000 per acre to run an operation and takes four years for gross profits to reach \$100,000. Cultivated roots resemble cream-colored carrots and are worth a maximum of \$15 to \$30 per pound. Although risks and inputs are high, high yields can make this method profitable if the market is strong. Unlike those from the wild, field-cultivated roots are smooth, fat, and heavy, with few growth rings and a short neck. It is almost impossible to grow organically in this kind of system. Chemicals are applied frequently to control diseases and pests caused by close, unnatural growing conditions.

## Worker Activities

Virginia ginseng growers do not often use pesticides since the herb is mostly grown in the forest and is worth more when it is grown organically. Furthermore, few pesticides are specifically labeled for use on ginseng in Virginia. However, field-cultivated ginseng grown in other states is often bombarded with fungicides in the final year because diseases are so prevalent. Seeds are often treated preventively with fungicides before planting. Pesticide exposure can be limited by wearing coveralls, long-sleeved shirts, chemical-resistant gloves, protective footwear, and goggles.

## SPECIAL USE LABELS

Section 18 Emergency Use Exemption and Special Local Need 24 (c) labels are used to supplement the chemical tools available to producers for pest control. Once the problem or gap in pest control has been identified, specialists submit the proper documentation for the Emergency Use/Special Local Need label. Special Local Need (SLN) labels in Virginia are granted by VDACS and are usually only valid for limited time intervals. However, a fee must be paid annually by the registrant to keep the product registered for use in Virginia. Section 18 Emergency Use labels are evaluated and granted by the Environmental Protection Agency (EPA) and can be renewed annually. Thus far, Extension specialists have been successful in obtaining these labels for other crops. Ginseng had no existing Section 18 or Section 24C labels at the time of this writing.

## Invertebrates<sup>11, 12, 17, 18</sup>

### INSECTS

#### Aphids, Aphididae spp.

Aphids suck plant juices from ginseng berries and leaves, which causes the foliage to become twisted. These pests tend to be more problematic later in the season, especially if the ginseng plot is located near alfalfa fields. Aphids can also transmit viruses.

**MONITORING:** Monitor weekly for small insects (1/16 inch long) on the underside of leaves and stems. Aphids have cornicles on the ends of their abdomens that resemble tailpipes.

**CHEMICAL CONTROL:** See the Chemical Invertebrate Pest Control section.

**BIOLOGICAL CONTROL:** Natural predators may help keep aphids under control.

**CULTURAL CONTROL:** Avoid planting ginseng near alfalfa fields.

#### Cutworms, Noctuidae spp.

#### Variegated Cutworms, *Peridroma saucia*

Cutworms are one of the top invertebrate pests of ginseng gardens particularly in first-year seedling beds. These nocturnal moth larvae feed on tops and girdle stems of one- to two-year-old plants. Most of the damage will appear on the perimeter of the ginseng bed. Cutworm feeding causes plants to wilt, fall over, and separate from the root.

**MONITORING:** Cutworms can be identified by their habit of curling into a C-shape when disturbed.

**CHEMICAL CONTROL:** See the Chemical Invertebrate Pest Control section.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** Plant ginseng in uninfested, thoroughly tilled beds (except for wild or wild-simulated ginseng). Remove weeds because cutworms tend to feed on them.

### **Four-Lined Plant Bugs, *Poecilocapsus lineatus***

Four-lined plant bugs attack the leaves of ginseng plants, particularly seedlings, resulting in dark-colored spots that turn tan and papery. This damage causes the plants to starve since the tan spots are no longer capable of photosynthesis. These bugs are 1/4 inch long with four black stripes on their greenish yellow backs. Nymphs are red to yellow and emerge in late May after overwintering as eggs. Four-lined plant bug adults are most active in late June and July.

**MONITORING:** Signs of feeding activity include small yellow spots on the upper leaf surface. These pests tend to drop off or run around the leaf when disturbed.

**CHEMICAL CONTROL:** Horticultural oils are used in addition to chemicals. See the Chemical Invertebrate Pest Control section.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** Eliminate potential overwintering sites (e.g., dead ginseng plant material and weeds).

### **Leafhoppers, Cicadellidae spp.**

Leafhoppers are small (1/8 inch long), green, wedge-shaped insects that feed on plant juices causing leaves to curl and turn yellow.

**MONITORING:** No specific monitoring protocol is recommended.

**CHEMICAL CONTROL:** See the Chemical Invertebrate Pest Control section.

**BIOLOGICAL CONTROL:** Natural predators of leafhoppers include lacewings, damsel bugs, lady bugs, minute pirate bugs, and spiders.

**CULTURAL CONTROL:** Destroy infested leaves.

### **Leaf Rollers, *Archips purpurana***

Leaf rollers are the larvae of small moths that lay their eggs on ginseng. These pests feed on ginseng during the day and use the chewed, wilted leaves to build nighttime refuges.

**MONITORING:** No specific monitoring protocol is recommended, but look for rolled leaves.

**CHEMICAL CONTROL:** See the Chemical Invertebrate Pest Control section.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** Remove infested leaves and destroy the larvae.

### **Lygus Bugs, *Lygus lineolaris***

Lygus bugs are flat, oval-shaped insects with white, yellow, and black splotches. They are 1/4 inch long and tend to fly or move away when disturbed. These pests often seek winter refuge in nearby weeds.

**MONITORING:** No specific monitoring protocol is recommended.

**CHEMICAL CONTROL:** See the Chemical Invertebrate Pest Control section.

**BIOLOGICAL CONTROL:** Lygus bugs have several natural predators, including big-eyed bugs, damsel bugs, and some beetles.

**CULTURAL CONTROL:** Control weeds around the ginseng patch during the growing season and fall.

**Spittle Bugs**, Cercopidae spp.

Spittle bugs are tan or reddish brown in color and 1/4 to 1/2 inch long. They destroy ginseng flower heads and damage the seeds.

**MONITORING:** No specific monitoring protocol is recommended, but look for foamy masses that are indicative of this pest.

**CHEMICAL CONTROL:** See the Chemical Invertebrate Pest Control section.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** Maintain vigorous ginseng plants and remove infested plant parts.

**Thrips**, Thysanoptera spp.

Thrips are minute, spindle-shaped pests that feed on ginseng leaves, damage flower heads, and may provide an entry point for botrytis fungi.

**MONITORING:** No specific monitoring protocol is recommended, although yellow sticky cards are used to monitor thrips populations in other crops.

**CHEMICAL CONTROL:** See the Chemical Invertebrate Pest Control section.

**BIOLOGICAL CONTROL:** Natural predators may help control thrips.

**CULTURAL CONTROL:** Maintain vigorous ginseng plants, avoid overfertilizing, and control weeds.

**Treehoppers**, Membracidae spp.

Treehoppers resemble leafhoppers. They attack ginseng seedlings, causing them to collapse.

**MONITORING:** No specific monitoring protocol is recommended.

**CHEMICAL CONTROL:** See the Chemical Invertebrate Pest Control section.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** No specific controls are recommended.

**White Grubs**, Scarabidae spp.

White grubs are pale-colored root feeders with a long life cycle. These beetle larvae hollow out roots as they feed.

**MONITORING:** No specific monitoring protocol is recommended.

**CHEMICAL CONTROL:** See the Chemical Invertebrate Pest Control section.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** Let garden lie fallow for one year, and keep weeds under control during this time.

**Wireworms**, Elateridae spp.

Wireworms feed on roots and seeds or seedlings of various plants, especially those of cereal crops. These beetle larvae are yellowish brown with hard, shiny exoskeletons.

**MONITORING:** Use corn or oats as bait to detect wireworms.

**CHEMICAL CONTROL:** See the Chemical Invertebrate Pest Control section.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** Plant cover crops and choose sites that have not had cereal crops planted recently. Leave land fallow for one to two years. Keep weeds under control during fallow period.

**OTHER ARTHROPOD PESTS**

**Millipedes**, Diplopoda spp.

Millipedes are black or brown wormlike arthropods with two sets of legs per segment. They feed on detritus and decaying plant tissue. Although harmless to ginseng, their presence may signal root rot.

**MONITORING:** No specific monitoring protocol is recommended.

**CHEMICAL CONTROL:** No chemical controls are necessary.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** Maintain vigorous ginseng plants.

**MOLLUSK PESTS**

**Slugs**, Gastropoda spp.

Slugs are one of the primary invertebrate pests of ginseng. They leave feeding holes and mucous trails on foliage. Slugs are active at night and on cloudy days during cool, damp weather, particularly in spring. They spend the day resting in tall grass, under leaf litter, or in the soil. Slugs overwinter as eggs and hatch in early spring. These mollusks have both male and female organs and can lay as many as 150 eggs.

**MONITORING:** Beer or grapefruit rinds can be used as bait to scout for slugs.

**CHEMICAL CONTROL:** See the Chemical Invertebrate Pest Control section.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** Apply sawdust mulch, ash, lime, or diatomaceous earth around the perimeter of the garden after each rainfall. Do not plant ginseng in extremely damp areas. Keep weeds under control, especially around the perimeter, because slugs use them for refuge. Avoid use of straw mulch.

### CHEMICAL INVERTEBRATE PEST CONTROL

*The following control recommendations were taken from the Kelly Registration Systems Pesticide Database for Virginia.  
<http://www.kellysolutions.com/va/>*

**PHI** = Pre-Harvest Interval, **REI** = Re-Entry Interval

- **azadirachtin** (*Aza-Direct* 1.2EC) – Limonoid Insect Growth Regulator. PHI = 0 days. For control of pests such as aphids, beetles, borers, true bugs, caterpillars, flies, leafhoppers, leafminers, whiteflies, mealy bugs, midges, mites, psyllids, weevils, scales, and thrips, make two to three applications of 1 – 2 pints/A at 7- to 10-day intervals. REI = 4 hours.
- **carbaryl** – Carbamate. Not registered for use on ginseng in VA, but an IR-4 Food Use request has been submitted by NC, KY, and WI.
- **cyfluthrin** (*Baythroid 2* 25EC) – Pyrethroid. PHI = 0 days. For control of leafhoppers, cutworms, and flea beetles, apply 1.6 – 2.8 fl. oz. (0.025 – 0.044 lb. a.i.)/A. Reapply up to four times at 7-day intervals, if necessary. Do not apply more than 14 fl. oz. (0.220 lb. a.i.)/A/season. REI = 12 hrs. **RESTRICTED-USE PESTICIDE.**
- **deltamethrin** (*Battalion* 0.2EC) – Pyrethroid. PHI = 3 days. For control of cabbage loopers, cutworms, and pea aphids, apply 7.7 – 17.9 fl. oz. (0.012 – 0.028 lb. a.i.)/A. For suppression and/or control of armyworms, Colorado potato beetle, European corn borer, flea beetles, green peach aphids, leafhoppers, Lygus bugs, and tarnished plant bugs, apply 11.5 – 17.9 fl. oz. (0.018 – 0.028 lb. a.i.)/A. Reapply at 3-day intervals. Do not apply more than 89.6 fl. oz. (0.14 lb. a.i.)/A/season. REI = 12 hrs. **RESTRICTED-USE PESTICIDE.**
- **diazinon** (*Diazinon AG600* 56EC) – Organophosphate. PHI = 30 days. For control of aphids, flea beetles, jumping plant lice, Lygus bugs, and leafhoppers, apply 9.5 – 12.75 fl. oz. product/A when pests first appear. DO NOT apply during flowering of three- to four-year-old plants. REI = 3 days. **RESTRICTED-USE PESTICIDE.**
- **imidacloprid** (*Impulse* 1.6F) – Neonicotinoid. PHI = 7 days. For control of aphids, flea beetles, leafhoppers, and whiteflies on ginseng, apply 3.5 fl. oz./A at 5-day intervals. Do not apply more than 10.5 fl. oz. (0.13 lb. a.i.)/A/crop season.
- **metaldehyde** (*Trails End LG* 3.5P) – Molluscicide. For the control of slugs and snails, apply to the soil up to 40 lbs. (1.4 lbs. a.i.)/A, but no more than 129 lbs. (4.5 lb. a.i.)/A/season. REI = 12 hours.
- **methoxyfenozide** (*Intrepid* 22.6F) – Diacylhydrazine. PHI = 14 days. For control of armyworms, cabbageworms, cutworms, loopers, saltmarsh caterpillars, and webworms on ginseng, apply 6 – 16 fl. oz. (0.09 – 0.25 lb. a.i.)/A when eggs hatch or feeding damage appears. Reapply at 14-day intervals. Do not apply more than 64 fl. oz. (1 lb. a.i.)/A/season. REI = 4 hrs.
- **pyrethrin** (*Bug Buster-O* 1.4EC) – Pyrethrin. For the control of aphids, beetles, caterpillars, flies, leafhoppers, thrips, true bugs, leafrollers, stink bugs, and whiteflies, apply 2.5 tbsp./gal. water when pests appear.
- **spinosad** (*Spintor 2SC* 22.8EC) – Spinosyn. PHI = 3 days. For control of armyworms, dipteran leafminers, European corn borer, flea beetles, loopers, and thrips, apply 3 – 6 fl. oz. product (0.05 – 0.10 lb. a.i.)/A. Reapply at 5-day intervals, if necessary. Do not apply more than 21 fl. oz. (0.33 lb. a.i.)/A/crop or make more than four applications per year. REI = 4 hrs.

Deer, *Odocoileus virginianus*

Rodents, Rodentia spp.

Deer feed on ginseng foliage, which diminishes plant reproductive potential. With repeated feeding, plants can die. Research has shown that for a wild ginseng population to survive over the next century, it must have at least 800 plants. However, the average population size is just under 100 plants. Deer are taking a serious toll on wild populations; if left unchecked, they will likely drive ginseng to extinction. Rodents can also be highly destructive pests of ginseng roots. They typically gain access to ginseng gardens via mole burrows.

**MONITORING:** Deer can be identified by their habit of consuming foliage but leaving roots behind.

**CHEMICAL CONTROL:** No commercial controls are recommended.

**BIOLOGICAL CONTROL:** Wolves are natural predators of deer. Cats may help control rodent populations.

**CULTURAL CONTROL:** Use fencing, balloons, and noisemakers. Hunt female deer to prevent them from reproducing. Use traps, barriers, and baits to control rodents.

## Diseases<sup>11, 12, 14, 15, 16</sup>

In general, diseases can be prevented by planting on well-drained sites with good airflow and leaving enough room between ginseng plants. Disease-free stock should be used, and seedlings must be handled very carefully. If possible, several small ginseng gardens should be planted rather than one large patch to avoid catastrophic losses if diseases appear. The soil nutrient levels and pH should be maintained at appropriate levels. When diseases are identified in ginseng gardens, infected plants should be removed and destroyed to avoid the spread of harmful fungi. However, with some diseases plants can simply be unearthed, soaked in fungicides, and planted away from the main site. Seeds should be treated before planting because they will likely be contaminated with diseases caused by *Alternaria*, *Rhizoctonia*, *Fusarium*, and *Phytophthora* spp.

### BACTERIAL DISEASES

Bacterial Leaf Blight, *Pseudomonas*, *Erwinia*, and *Xanthomonas* spp.

Bacterial leaf blights are more prevalent after warm, rainy weather when leaves are turgid. Bacteria are spread by splashed water, rain, or air. This disease is usually more serious on raised beds that lack mulch. The main symptoms are light brown irregular rotting spots that appear water-soaked around the edges. These lesions can merge and may cause leaf drop. Also, the top growth of the plant is sometimes destroyed.

**MONITORING:** No specific monitoring protocol is recommended.

**CHEMICAL CONTROL:** See the Chemical Disease Pest Control section.

**BIOLOGICAL CONTROL:** See the Chemical Disease Pest Control section for more information on *Bacillus subtilis* (Serenade).

**CULTURAL CONTROL:** Mulch plants sufficiently to prevent water from splashing onto plants.

## FUNGAL DISEASES

### **Alternaria Leaf and Stem Blight**, *Alternaria panax*

Alternaria leaf and stem blight, or ginseng blight, is the most common fungal disease of ginseng. Cultivated ginseng is extremely vulnerable to this infection. Shoots, leaves, and stems of plants of any age may be affected. The primary symptoms of alternaria blight are yellowish green, halolike lesions with dark brown margins and light brown centers. Holes develop in the leaves once the plant tissue within the lesions dies. Infected stems may collapse, and the roots can turn dark brown, become flattened, and die. White mycelium may appear in severe infections. Plants can die within three to four weeks if no treatment is initiated. Some ginseng plants may lose all their leaves, which results in diminished root yield. Alternaria blight renders young plants more susceptible to winter kill. This disease is more likely to occur when there is high humidity and frequent precipitation. The most vulnerable plants are those that are unhealthy or senescing. Fungal spores overwinter in plant debris. Alternaria blight spreads via infected clothing and equipment, or when contaminated soil is splashed onto the plants.

**MONITORING:** No specific monitoring protocol is recommended.

**CHEMICAL CONTROL:** See the Chemical Disease Pest Control section for more information. Chemicals should be applied preventively each week when weather conditions are conducive to disease development. Disease resistance to iprodione has been documented.

**BIOLOGICAL CONTROL:** See the Chemical Disease Pest Control section for more information on *Bacillus subtilis* (Serenade).

**CULTURAL CONTROL:** Plant gardens in such a way as to increase air movement and reduce humidity, rotate crops, and make sure plants are healthy. Reduce garden size, or leave gaps in the shade (~1 ft. wide, every 100 ft.) to increase airflow. Remove plant debris regularly. Dig trenches to drain standing water away from the garden.

### **Botrytis Blight**, *Botrytis cinerea*

Botrytis blight, or gray mold, is a fuzzy fungus common on cut flowers, greenhouse plants, and dead plant waste in ginseng patches. Botrytis blight is more likely to develop during cool, cloudy, humid weather with frequent precipitation. Leaves, flowers, and fruits become infected and discolored, which results in reduced seed yield and defoliation. Left untreated, the entire ginseng garden may be lost. This fungus is most severe in plants older than two years, but it can cause widespread damage to seedlings as well. Symptoms include tan, water-soaked lesions shaped like a bull's eye that first appear at the leaf tips and move backward along the midrib. Botrytis can spread from leaf to leaf in crowded gardens or via spores released when disturbed by the wind or humans.

**MONITORING:** Monitor for the symptoms described above, and apply chemicals as soon as possible.

**CHEMICAL CONTROL:** Spray preventive fungicides when environmental conditions are conducive to disease development or apply chemicals as soon as botrytis appears. See the Chemical Disease Pest Control section for more information.

**BIOLOGICAL CONTROL:** See the Chemical Disease Pest Control section for more information on *Bacillus subtilis* (Serenade).

**CULTURAL CONTROL:** Rotate crops, and increase airflow by limiting ginseng plant density. Minimize humidity by using methods recommended for alternaria blight. Avoid overfertilizing with nitrogen.

### **Damping-off Root Rot**, *Fusarium* spp., *Pythium* spp., *Rhizoctonia solani*

Damping-off root rot is caused by several different species of soil-borne fungi. Collectively, these fungi cause preemergence damping-off and

postemergence seedling root rot, primarily in one- to two-year-old plants. With postemergence damping-off, seedlings will wilt at the stem, become constricted, and collapse. *Rhizoctonia solani* causes damping-off, crown rot, bud rot, and seed rot. Winterkill is a quite common effect once the crown becomes infected. *Fusarium* and *Pythium* species exist as spores on decaying ginseng debris. Fungi may also spread via straw mulch or from infected soil. *Fusarium* root rot affects the stem, crown, roots, and foliage. The initial symptoms are wilted leaves, followed by vascular discoloration. *Fusarium* species also cause damping-off in emerging seedlings.

**MONITORING:** Monitor for the symptoms described above.

**CHEMICAL CONTROL:** See the Chemical Disease Pest Control section.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** Rotate crops and plant ginseng on well-drained sites. Remove decaying plant debris regularly. Do not overmulch. Avoid overfertilization, particularly with nitrogen. Leave enough space between ginseng plants. Plant smaller gardens or leave enough space between plants to allow airflow.

#### **Disappearing Root Rot, *Cylindrocarpon destructans***

Disappearing root rot is a serious disease that occurs in ginseng plants of any age. It is most common in softwood soil but may also occur in other types of earth. It infects all underground plant parts, beginning with the root tip and moving up into the entire root. Crown rot, stem rot, and root "stubbing" may also result. The initial disease symptoms are small gold-brown spots on the root surface that grow quickly but later turn reddish brown and spongy. The entire root eventually disintegrates. Aboveground, seedlings may fail to emerge, or older plants may wilt on one side, turn reddish brown, and die. Infections move through a ginseng patch in an expanding circle. Disappearing root rot is spread via root-to-root contact by conidia that grow on the root surface, or by infected clothing, equipment, and soil. Fungal spores overwinter in soil and on plant debris.

**MONITORING:** Monitor for the symptoms described above.

**CHEMICAL CONTROL:** None registered for use on ginseng in Virginia.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** Rotate crops and remove dead plant residue regularly. Avoid sites previously planted with ginseng. Minimize disease transmission to healthy gardens from infected gardens by using clean equipment and wearing clean shoes.

#### **Phytophthora Foliar Blight and Root Rot, *Phytophthora cactorum***

Phytophthora foliar blight is caused by a soil- and seed-borne oomycete fungus that infects hundreds of different plant species. It typically occurs during wet weather on sites with poor drainage. Infected ginseng, especially one- to two-year old plants, will exhibit preemergence damping-off and postemergence seedling root rot. An entire crop can be wiped out within weeks if this disease is left untreated. Symptoms include bronzed, wilted leaves and spongy roots with light brown, water-soaked blotches. *Phytophthora cactorum* fungi overwinter as mycelia in the roots or soil. These fungi produce many reproductive spores, which are resistant to both environmental stress and certain chemicals. Consequently, blight infections can spread very rapidly.

**MONITORING:** Monitor for the symptoms described above.

**CHEMICAL CONTROL:** See the Chemical Disease Pest Control section.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** Plant clean, healthy seed on sites with good drainage and airflow. Rotate crops and avoid sites planted with ginseng in the recent past. Use clean cultivation equipment. Do not overmulch, but make sure enough mulch is applied to avoid splashing spores in soil onto plants. Avoid overfertilization, particularly with nitrogen. Leave enough space between ginseng plants to allow airflow, and plant smaller gardens.

**Powdery Mildew**, *Erysiphe* spp.

Powdery mildew infections cause dusty white conidia to form on the upper leaf surface during the summer when weather is overcast and damp. Ginseng tissues at first turn reddish purple, but they later become yellow and drop. As a result, seed yield is reduced along with fresh root weight. Winter hardiness is also diminished. Powdery mildew infections persist on decaying plant debris.

**MONITORING:** Monitor for the symptoms described above.

**CHEMICAL CONTROL:** See the Chemical Disease Pest Control section.

**BIOLOGICAL CONTROL:** See the Chemical Disease Pest Control section for more information on *Bacillus subtilis* (Serenade).

**CULTURAL CONTROL:** None recommended.

**Sclerotinia White Rot**, *Sclerotinia sclerotiorum*

Sclerotinia white rot infects the stem, foliage, and roots of many plant species. It causes leaves to become discolored, wilted, and desiccated while ginseng roots become soft and watery. This fungus produces black sclerotia that remain viable in the soil and on plant refuse for more than five years. Cool, wet weather encourages the development of white rot. Sclerotinia spreads between plant parts by way of mycelium and spores that are released into the wind. Spores become infective after two to three days of moist conditions. Disease development is accelerated at higher temperatures (20°C to 25°C).

**MONITORING:** Monitor for the symptoms described above.

**CHEMICAL CONTROL:** No fungicides registered for use on ginseng in Virginia.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** None recommended.

**Septonema Disease**, *Septonema* spp.

Septonema disease infects ginseng buds, seeds, and seedlings. As a result, roots darken and turn brown.

**MONITORING:** Monitor for the symptoms described above.

**CHEMICAL CONTROL:** No fungicides registered for use on ginseng in Virginia.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** None recommended.

### **Stromatinia Black Rot, *Stromatinia panacis***

Stromatinia black rot affects ginseng roots and prevents plants from emerging. It is obvious which parts of the root are infected and which are healthy. Diseased roots develop black, bumpy surfaces with pale, spongy insides. They also exhibit reddish brown to black concave lesions. When cut in half vertically, black vascular strands may appear in the root from the core to the surface. Black rot is most likely to occur during cool, humid weather in spring and fall. Stored roots appear mummified and corky.

**MONITORING:** Monitor for the symptoms described above.

**CHEMICAL CONTROL:** No fungicides registered for use on ginseng in Virginia.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** None recommended.

### **Verticillium Wilt, *Verticillium dahliae***

Verticillium wilt is a periodic disease of solanaceous crops and older ginseng plants. This soilborne fungus results in wilted foliage and dead plants. Diseased roots are firm but yellowish. Verticillium wilt is more common when plants are dormant and/or temperatures are below 20°F. Fungi enter leaf scars or the roots and disrupt water flow through the plant by growing in the xylem. Verticillium microsclerotia overwinter in soil or plant debris and are spread via infected soil, equipment, and irrigation water.

**MONITORING:** Monitor for the symptoms described above.

**CHEMICAL CONTROL:** No fungicides registered for use on ginseng in Virginia.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng in Virginia.

**CULTURAL CONTROL:** None recommended.

## **Nematodes**

### **Root-Knot Nematodes, *Meloidogyne hapla***

Roots infested with root-knot nematodes are short and deformed with hairy, branched secondary roots. In heavy infestations, plants may be stunted or killed. Overall, the foliage will appear healthy, but affected leaves may be lighter, stunted, or reddish. Older leaves turn yellow, brittle, and eventually fall off. Taproot development is delayed, and nodules appear on lateral roots shortly after planting. Nematodes penetrate the roots and feed on the swellings that develop. Egg masses hatch two weeks after being laid on the knot surfaces.

**MONITORING:** Monitor for the symptoms described above.

**CHEMICAL CONTROL:** No fungicides registered for use in Virginia.

**BIOLOGICAL CONTROL:** None registered for use in Virginia. However, *Myrothecium verrucaria* (DiTera WDG) is labeled for use in

California.

**CULTURAL CONTROL:** Rotate crops and use trap crops (e.g., oil seed radish). Avoid sites that were or are infested with nematodes. Use clean equipment.

### CHEMICAL DISEASE PEST CONTROL

The following control recommendations were taken from the Kelly Registration Systems Pesticide Database for Virginia.

<http://www.kellysolutions.com/va/>

**PHI** = Pre-Harvest Interval, **REI** = Re-Entry Interval

- **azoxystrobin** (*Quadris F*) – Methoxyacrylate. PHI = 0 days. For control of alternaria leaf spot and powdery mildew, apply at a rate of 6.2 – 15.4 fl. oz. (0.10 – 0.25 lb. a.i.)/A. Reapply at 7- to 14-day intervals (5- to 7-day intervals for mildew). For control of rhizoctonia and pythium rots, apply not more than 3.75 qts. (2 lbs. a.i.)/A/season. REI = 4 hrs.
- **bacillus subtilis** (*Serenade ASO 1.34EC*) – Bacterial biofungicide. PHI = 0 days. For control of black root and crown rot (*Alternaria* spp.), bacterial leaf blight (*Xanthomonas campestris*), downy mildew (*Peronospora* spp.), powdery mildew (*Erysiphe* spp.), white mold (*Sclerotinia sclerotinium*), gray mold (*Botrytis* spp.), early blight (*A. solani*), and late blight (*Phytophthora infestans*), apply 2 – 6 qts./A at 5- to 7-day intervals (early and late blight) or 7- to 10-day intervals (others). REI = 4 hrs.
- **boscalid** (*Endura*) – Not labeled for use on ginseng in VA, but an IR-4 Food Use request from MI is under evaluation.
- **captan** (*Captan 80WDG*) – Carboximide. Not labeled for use on ginseng in VA, but an IR-4 Food Use request has been submitted by WI, NC, and SC.
- **chlorothalonil** (*Bravo Weatherstik*) – Nitrile. Not labeled for use on ginseng in VA, but it has a Section 18 label in MI and WI. NC, KY, SC, and TN have requested an IR-4 Food Use evaluation, which is complete with ongoing trials.
- **copper hydroxide** (*Champ Formula 2F*) – Inorganic. For control of alternaria leaf and stem blight, apply 1-3/4 pints product/A tank mixed with iprodione 50WP in 100 gal. water/A. Begin applications when plants emerge in spring, and reapply at 7-day intervals until fall dormancy. REI = 24 hrs.
- **dimethomorph** (*Acrobat*) – Cinnamic acid. Not registered for use in VA, but an IR-4 Food Use petition for control of *Phytophthora cactorum* submitted by OR and MI is under review.
- **fenhexamid** (*Elevate 50WDG*) – Hydroxyanilide. PHI = 1 year. For control of botrytis (nonfood use), apply at a rate of 1.5 lbs. (0.75 lb. a.i.)/A at 7- to 14-day intervals. Do not apply more than 6 lbs. (3 lbs. a.i.)/A/season. REI = 12 hrs.
- **fluazinam** (*Omega 500*) – Pyradinamine. Not labeled for use on ginseng in VA, but an IR-4 Food Use request for control of rhizoctonia and stromatinia rots submitted by MI and WI is complete.
- **fludioxonil** (*Maxim 4FS*) – Phenylpyrrole. For seed treatment control of damping-off (pythium), seed decay, seed-borne disease/fungi, seedling blight/rot, and soilborne fungi, apply 0.08 – 0.16 fl. oz. of product/100 lbs. seeds. REI = 12 hrs.
- **flutolanil** (*Moncut*) – Benzamide. Not registered for use in VA, but an IR-4 Food Use project is complete with ongoing trials. Found to be effective against sclerotium in MI/WI trials.
- **fosetyl-AI** (*Aliette 80WDG*) – Organophosphate. PHI = 31 days. For suppression of alternaria leaf blight (*A. panax*) and control of phytophthora foliar and root rot (*P. cactorum*) in ginseng, apply at a rate of 5 lbs. product/100 gal. water when conditions are conducive to disease development. Reapply at 7-day intervals, if necessary. Do not exceed nine applications per season. May become phytotoxic when mixed with or applied after copper compounds. REI = 12 hrs.
- **harpin protein** (*Messenger 3WDG*) – Biofungicide. For seed treatment control of disease-causing organisms on all seeds or tubers, apply 1/4 tsp. of product per pound of seed.
- **iodomethane** – Developmental compound, not yet registered to replace methyl bromide for control of *P. cactorum* and *Cylindrocarpon* spp.

- **iprodione** (*Iprodione 4L AG 41.6EC*) – Dicarboximide. PHI = 36 days. For alternaria blight, apply 1.0 – 2.0 pints product/A. Do not make more than five applications or use more than 10 pints/season. REI = 24 hrs.
- **mancozeb** (*Dithane 4SC Rainshield 37F*) – Carbamate. Not labeled for use on ginseng, but used under a Section 18 label in MI and WI. An IR-4 Food Use request has been submitted by VA and NC.
- **mefenoxam/metalaxyl** (*Axle 2E 24.3EC*) – Acylalanine. Labeled in WA for control of phytophthora root rot. Apply to soil surface as a drench at a rate of 1.5 pts./A in 100 – 400 gal. water in spring before plant emergence. REI = 48 hrs.
- **Myrothecium verrucaria** (*DiTera ES 27.5EC*) – Biofungicide. Not labeled for control of nematodes in VA, but used in CA (13 – 100 lbs./A/application) and WI (25 – 100 lbs./A/application).
- **potassium salts of phosphorous acid** (*Agri-Fos Systemic Fungicide 45.8*) – For control of phytophthora root rot and foliar diseases (*P. cactorum*), apply at a rate of 4.5 tsp. product /gal. water. Administer at 7-day intervals, but do not make more than eight applications.
- **polyoxin D zinc salt** (*Endorse 2.5WP*) – Streptomycin. Not labeled for use on ginseng in VA, but an IR-4 Food Use request is on hold while the manufacturer evaluates a food use label.
- **thiophanate methyl** (*Topsin M*) – Carbamate. An IR-4 Food Use EPA petition has been submitted.
- **zoxamide** (*Gavel 75DF*) – Amide. Not labeled for use in VA, but used to control phytophthora under a Section 18 label in MI/WI.

## Weeds

*The following control recommendations were taken from the Kelly Registration Systems Pesticide Database for Virginia.  
<http://www.kellysolutions.com/va/>*

**PHI** = Pre-Harvest Interval, **REI** = Re-Entry Interval

Common weeds in ginseng patches include various grasses, yellow nutsedge, dandelion, creeping jennie, lambsquarters, broadleaf weeds, sedges, pigweed, poison ivy, and thistles.

**MONITORING:** No specific monitoring protocol is recommended.

**CHEMICAL CONTROL:** No chemicals are registered for use on bearing ginseng in Virginia.

- **clethodim** (*Intensity 26.4EC*) – Oxime. PHI = 30 days. For postemergent control of grasses, apply 6 – 8 fl. oz. of product at 14-day intervals. REI = 24 hours.
- **DCPA** (*Dacthal 75W*) – Phthalate. Not labeled for use in VA, but used in WI for preemergent weed control in ginseng. An IR-4 Food Use request to establish tolerances has been filed by WI and NC.
- **diquat dibromide** (*Reglone Dessicant 37.3SC*) – Bipyridylum. PHI = 1 year. For postemergent control of weeds and grasses in nonbearing ginseng, apply 1.5 – 2.0 pints/A. REI = 24 hrs.
- **fluazifop-P-butyl** (*Fusilade DX 24.5EC*) – Phenoxy. PHI = 1 year. For control of annual and perennial grasses in nonbearing ginseng, apply 16 – 24 oz. (0.25 – 0.375 lb. a.i.)/A with 1% crop oil concentrate. Do not apply more than 72 fl. oz./A/season. REI = 12 hrs.
- **glyphosate** (*Roundup Original Max 48.7*) – Phosphoric acid. PHI = 1 year. For control of grasses and broadleaf weeds in nonbearing ginseng, apply not more than 5.3 quarts/A/year. REI = 4 hrs.
- **napropamide** (*Devrinol*) – Propionamide. Not registered for use on ginseng in VA, but an IR-4 Food Use request submitted by WI, NC, and TN is under evaluation.

- **phenmedipham** (*Phen-Des 8+8 Herbicide*) – Carbamate. Not registered for use on ginseng in VA, but an IR-4 Food Use request submitted by MI is under evaluation.
- **sethoxydim** (Poast) – Oxime. Not registered for use on ginseng in VA, but an IR-4 Food Use petition has been submitted by KY, WI, and TN.

**BIOLOGICAL CONTROL:** None recommended for use on ginseng weeds in Virginia.

**CULTURAL CONTROL:** Use an adequate amount of weed-free mulch, and remove weeds by hand.

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## On-Line Resources

Virginia Agricultural Statistics Service  
<http://www.nass.usda.gov/va>

Virginia Tech Pesticide Programs  
<http://www.vtpp.ext.vt.edu>

Virginia 2006 Pest Management Guides  
<http://www.ext.vt.edu/pubs/pmg/>

Appalachian Ginseng Foundation  
<http://www.a-spi.org/AGF/index.htm>

Fish and Wildlife Service Ginseng Finding  
<http://www.fws.gov/international/pdf/2006ginsengfinding.pdf>

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