

Ginseng

A Production Guide for North Carolina



**North Carolina Cooperative Extension Service
North Carolina State University**

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Ginseng:

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American ginseng (*Panax quinquefolium* L.) is a shade-requiring, herbaceous plant native to the hardwood forests of eastern North America. Its fleshy root and short underground stem are perennial. The leaves and stems die at the end of the growing season and regrow each spring.

Ginseng is best adapted to cool, temperate climates. Its range in North Carolina is generally limited to the mountain and foothill counties of the western part of the state. Rarely have native stands been reported east of a line connecting Gaston and Stokes counties.

Ginseng is valued by people in many nations who believe it has health-promoting properties. An Asian species, *Panax ginseng* C. A. Meyer, has been an important component of Chinese folk medicine for over 4,000 years. Early colonists found the North American Indian using American ginseng in much the same way as the Chinese were using the Asian species. The root of American ginseng has been collected for export to the Orient since early in the 18th century.

Description and Stages of Growth

Ginseng emerges in late April in much of its range, or about the time dogwood trees bloom. A first-year ginseng seedling has three small, simple leaflets joined at the top of a 2- to 4-inch erect stalk. A small, generally carrot-shaped root with a bud at its upper end is formed during the seedling year. The foliage dies in the fall, but the root and bud lie

dormant through the winter. A new top grows from the bud the following year.

With age the plant increases in size and complexity. Second-year plants generally have two compound leaves terminating a 4- to 7-inch erect stalk. The compound leaves normally consist of five ovate leaflets; the three middle leaflets are much larger than the basal ones. In subsequent years, the plant may have three, four, or rarely five prongs of compound leaves and may reach a height of 12 to 24 inches. After the seedling year, roots may become irregularly branched and may develop rings. Rings are especially noticeable on wild ginseng. A mature plant is illustrated in Figure 1 above.

Flowering occurs in late spring during the third and later years of development. An erect stalk, arising from the juncture of the

leaf prongs, terminates in a cluster of small, greenish white flowers. Green fruit, or berries, nearly the size of dogwood berries, develop from pollinated flowers. These ripen to a bright red in late summer, and each usually contains two flattened, hard-coated seeds (Figure 2). In the wild, ripe berries fall to the ground, where the seeds are covered by leaves. The seeds must be stratified (exposed to low temperatures) and do not germinate for 18 to 20 months.

Leaves turn bright yellow with the approach of fall, and the top of the plant dies back to the neck of the underground stem, or *rhizome*. Ginseng growth is very slow in the wild. It may take several years for a plant to develop to the two- or three-prong stage. Counting the stalk scars left on the neck is the most reliable way of determining a plant's age.

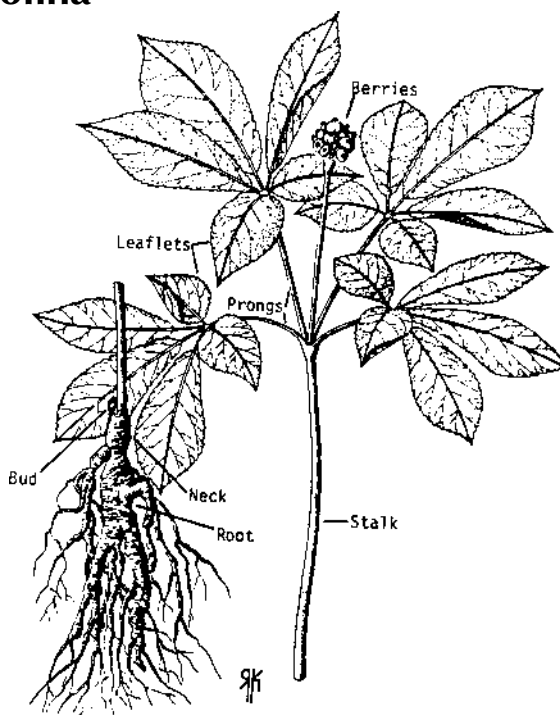


Figure 1.
Parts of a mature ginseng plant.

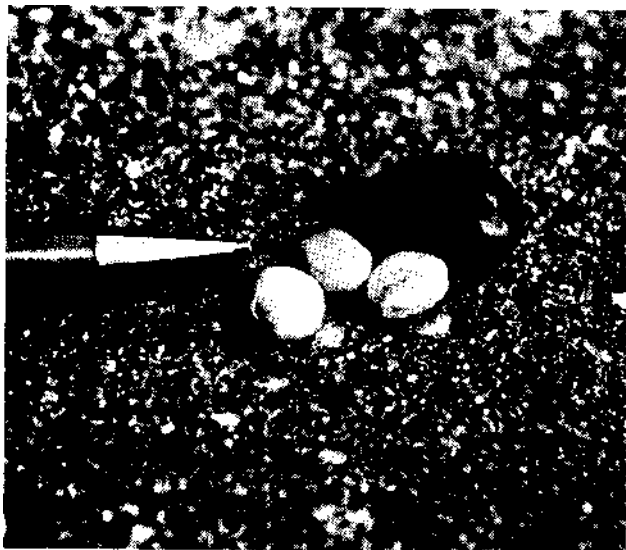


Figure 2.
Mature ginseng fruit and freshly extracted seed.

Site Selection

The most favorable temperature and soil moisture conditions for ginseng production are generally associated with north- or east-facing slopes. Southern and western exposures are usually too warm and dry for good growth. At higher elevations and in cooler climates, however, exposure is of less importance. A sloped site is desirable because good surface drainage is important. Wet conditions usually result in rotting of the ginseng roots.

Ginseng tolerates a wide variety of soil types, although heavy clay or light sandy soils should be avoided. Ideal soils are loams with high organic matter content. In wooded areas, the presence of herbaceous weeds or wildflowers, such as trilliums, bloodroot, and mayapple or wild ginseng, is a valuable indicator that soil moisture is adequate and that conditions are suitable for ginseng. A forest floor devoid of such growth is unlikely to be a good site.

Soil samples should be collected from prospective sites and analyzed for nutritional status, pH, and nematodes. Native western North Carolina soils often

General Culture

To grow ginseng successfully it is necessary to provide growing conditions that closely resemble those where wild ginseng grows well. Critical needs include sufficient shade (75 percent or more), moist but well-drained soil, moderate summer climate, and a winter season cold enough to satisfy seed and root chilling requirements. Protection from pests and reduction of competition from other plants are also important.

The type and intensity of culture must be selected. Intensity can range from low-density, low-input random plantings in relatively undisturbed soil in natural wooded sites to high-density, high-input plantings on raised, mulched beds in artificially shaded gardens with fertilization and pest control programs. The cost of preparing the site, the labor to care for the planting, and the yield of seeds and roots generally increase with the intensity of culture.



Figure 3.
Intensive culture of ginseng under natural shade.
Note the planted beds, the desirable shade pattern, and the absence of weeds, brush, and unnecessary trees.

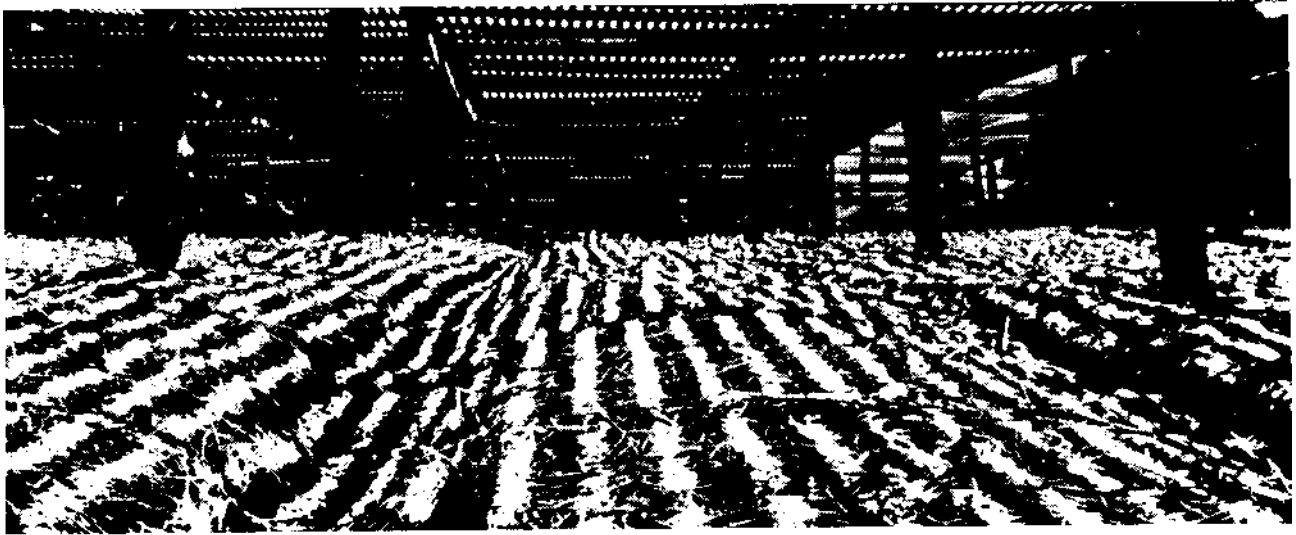


Figure 4.

Intensive culture of ginseng under wood lath shade. Note the overhead lath panels, the support posts located in the center of the raised beds, and the pattern of shade on the beds.

are more acid and lower in phosphate than is required for rapid ginseng growth. Root-knot nematodes cause galls on roots and slow plant growth.

Shade Requirements

Ginseng cannot tolerate long, daily exposure to full sunlight. It grows best where 75 to 85 percent of the sky is obscured. Excessive light causes bronzing of the leaves and early death of the tops. Shade may be provided by planting in an established wooded site or by erecting artificial shade over an open planting site.

Natural Shade. Deeply rooted deciduous trees such as walnut, oak, poplar, and basswood are best for shading ginseng. Solid stands of coniferous or other shallow-rooted trees should be avoided because they offer serious competition for soil moisture and nutrients. Stand establishment in such areas is difficult and growth is very slow. Undergrowth, weeds, and trees that are not needed for the required shade compete with ginseng and interfere with air circulation and management practices. Eliminate some or all weeds and undergrowth before planting (Figure 3).

Artificial Shade. Ginseng can be shaded with wooden lath or polypropylene shade cloth supported over the growing area (Figure 4). For convenience, moveable panels of lath can be constructed and supported by joists on posts. Shade cloth, with metal eyelets positioned at close intervals around the margins, can be attached to heavy wires or small cables across the tops of support posts. The cloth must be stretched tightly over well-anchored and securely braced posts to ensure a stable structure. Place posts in the center of beds where they will not interfere with cultural operations. (Beds usually are 6 feet wide, center to center.)

Artificial shade materials should be at least 8 feet above the ground, and at least 2 sides of the structure should be open. Clearance less than 8 feet makes cultural operations difficult and uncomfortable. Enclosed sides and low clearance also prevent good air circulation, which is important in minimizing the buildup of heat and humidity. The overhead shade should extend beyond the planted areas by several feet, especially on the south and west sides, so that the margins of the planting will not receive excessive light.

The site should be plowed and tilled several times during the summer and early fall before planting, especially for sites that have been in sod. Tillage encourages decomposition of plant residue and reduces populations of soil-borne insect pests and weeds. Incorporating green manure crops into the soil is also beneficial. Incorporate any needed lime and phosphate fertilizers at this time.

Shade support posts should be set 1 to 2 feet deep on an exact grid pattern that will accommodate the shading material. A 12-by-12-foot spacing is normal for wood lath panel shading, whereas a 24-by-24-foot spacing is often used for cable-supported polypropylene shade cloth. The posts around the edge of polypropylene-shaded gardens should be 12 feet apart and securely anchored with "dead men."

Site Preparation

The planting site should be completely ready and the required mulch should be on hand before planting time. Preparation requirements depend on the intensity of culture and the method of shading.

Wooded sites should be selected and prepared while trees are in full leaf. Undesirable tree species and trees not needed for shade can be easily identified and marked at this time. Remove marked trees and all undergrowth by the spring before the fall or spring seeding. Follow a program for destroying weeds and preventing regrowth of woody plants throughout the summer.

For low-intensity, low-input woodland culture, rake the natural surface mulch aside for seeding and then redistribute it over the seeded area. Seed may be planted 1 inch deep in a prepared seedbed or simply raked or lightly tilled into the soil surface before it is covered with mulch. To facilitate management, plant the seed in defined beds 4 to 6 feet wide separated by walkways 2 to 3 feet wide.

For high-intensity, high-input woodland culture or for production under artificial shade, clear the area of any objects that will interfere with tillage of the soil and bed formation, such as stumps, roots, or rocks. To assure thorough incorporation into the soil, apply any preplant lime or phosphate fertilizer materials before tilling. After the soil has been tilled to good seedbed condition, form raised beds 6 to 9 inches high and 4 to 5 feet across the top with 2-foot-wide walkways between them.

To promote good drainage and efficient removal of surface water, beds should be oriented up and down the slope with their surfaces arched 2 to 3 inches higher in the middle than at the edges (Figure 5). A diversion ditch across the uphill side of the planting may be needed to control surface runoff and reduce erosion.

Seeding

Ginseng is most commonly propagated by seed. The seeds, which must always be kept moist, require special handling to

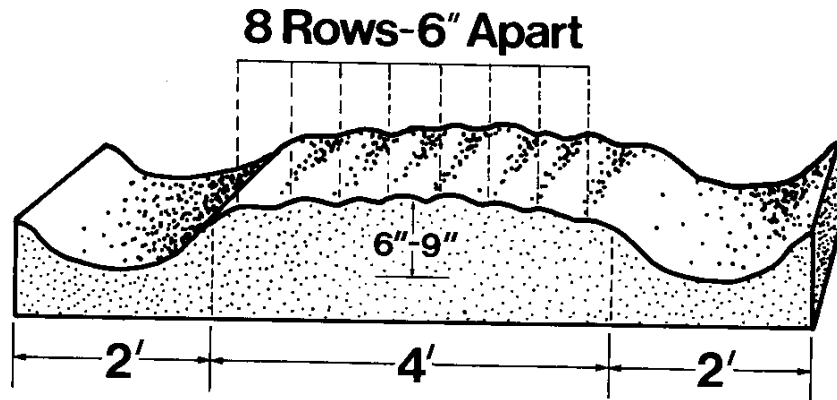


Figure 5.
Dimensions of raised beds for ginseng.

germinate. They must be subjected to a long period of storage in a moist medium with alternating periods of warm and cold temperatures. This process is known as *stratification*. Consequently, ginseng seed normally does not germinate until the second spring after the harvesting of the berries in fall. If the fall after the berries are harvested is long and warm, some seeds will germinate the first spring after harvest.

In the spring, when stratification is complete, seed germination will proceed and usually cannot be delayed appreciably, even if the seeds are refrigerated. Germinating seeds are perishable and will be wasted if not planted at that time.

Time of Seeding. Ginseng seeds may be planted any time after the berries ripen but before the seeds germinate. Nonstratified (green) seeds may be planted in the soil immediately after the berries have been harvested. Over the next year and a half, they will be stratified naturally and emerge at the proper time. Loss to rodents and insects, however, may be quite high. For perpetuation of wild ginseng, it is appropriate to plant the ripe berries, or just the seeds, when the roots are harvested. Plant stands will be greater, however, if fresh seeds are stored and stratified in a secure container and planted in a protected site a year later.

Commercial seed suppliers stratify seed for a year and then market it in the fall as stratified seed. Fall-planted, stratified seed usually emerges in the following spring between April and June.

Stratified seed can be safely planted from late summer until the soil freezes in the fall. Since time of germination cannot be controlled effectively, it is often unsafe to delay planting of stratified seed until the second spring because weather or soil conditions may prevent seeding before germination begins. Spring seeding must be completed by the middle of April, or before dogwoods bloom.

Whether the seed is green or stratified, it should be carefully inspected when obtained. If the seeds are soft, moldy, or discolored, return them to the supplier for replacement.

Seeding Depth. Seeds must be in contact with a damp medium both during storage and after seeding. They must be covered at planting with enough soil, mulch, or both to keep them from drying out. Plant the seeds ½ to 1 inch deep and cover the bed with 1 or 2 inches of mulch. For high-intensity culture, broadcasting seeds on the soil surface and raking or lightly tilling them into the seedbed is not recommended because the seeds will be planted at varying depths, usually resulting in variable stands. For more

even plant stands, it is desirable to seed into a well-prepared seedbed using a hand-operated garden seeder with adjustable seeding depth and rate.

Seeding Rate. The rate of growth of ginseng roots is affected by plant population; closely spaced plants grow more slowly. Closer spacing also reduces individual root size but increases the yield in weight per unit area of bed.

For intensive culture, plant in rows 6 inches apart oriented with the long dimension of the bed; each bed (4 feet across the top) should contain eight rows. Seeding 1 inch apart in the row will result in 24 seeds per square foot, or approximately 800,000 seeds (100 pounds) per acre of bed space. Common seeding rates for intensive culture vary from 25 to over 100 pounds per acre. For low-intensity, natural woodland culture, space seeds 6 to 12 inches apart.

Temporary Seed Storage. Seeds removed from storage for shipment or for seeding must not be allowed to dry out and should be kept cool. In the fall, they may be stored temporarily in a plastic bucket in a cool basement. Place a damp cloth on top of the seeds and cover the bucket with a lid. Every day or two, gently stir the seeds well or pour them back and forth into a second container to aerate them. Rewet the cloth and replace the cover. If planting cannot be completed before the soil freezes, return the seeds to a stratification unit. (See Seed Production, Harvesting, and Handling.)

As spring approaches, the seeds may begin to germinate in the stratification unit as early as March, or about the time maple trees bloom. Handling the seeds after the seed root (radicle) begins to grow may result in some damage. If spring planting must be delayed, germination of stratified seeds may be slowed

slightly by placing them in a refrigerator, but the gain in time is likely to be a few days at most. In addition, germination of stratified seeds may be delayed for an extra year after the seeds are held temporarily in a refrigerator. This phenomenon, known as double dormancy, is not understood.

Transplanting Roots

Ginseng can be transplanted readily, and small roots can be used as planting stock for establishing a garden. Transplanting ensures a more uniform stand than seeding and reduces the time from planting to harvest of seeds and marketable roots. The price of roots, however, is considerably greater than that of seeds; one-year-old roots may cost 12 to 16 times as much as the same number of seeds. Transplanting is also considerably more time consuming than seeding.

Roots must be planted by hand, but the preparations for planting and the cultural needs of transplants are the same as for a seeded crop. Roots may be 3 or 4 inches in length; therefore, it is important that the soil be loose to a depth of at least 4 to 5 inches to facilitate transplanting.

The closest practical spacing for roots, depending on their age and size, is 3 or 4 inches apart in 6-inch rows. It is convenient to prepare a board with in-row spacing marks along one edge and lay it across the bed as a guide when planting. After one row has been planted, the board can be moved 6 inches (or other desired row spacing) to guide the planting of the next row.

Carefully dig roots for transplanting during the dormant period, preferably in the fall after the tops die. Plant the roots as soon as possible after digging or receiving them. Spring planting is possible if done very early. The development of a new top begins very early in the spring, often before the last frosts of the season,

and the risk of damage from digging and planting increases as the spring advances.

If roots cannot be planted immediately, they may be held for a day or two in plastic bags in the refrigerator. Open the bags daily to aerate the roots; check for mold and add a few drops of water if the roots start to feel dry. For longer temporary storage, cover the roots with 4 to 6 inches of soil or place them between layers of nonmilled sphagnum moss in a container. The storage medium should be damp but not wet and the container should not be airtight. The roots should be stored at outdoor soil temperatures or in a cool basement.

If dug roots cannot be planted in the fall, they should be stored over the winter at outdoor soil temperatures, preferably in loose, well-drained soil. Roots can also be overwintered in damp sphagnum moss in a refrigerator. Store them for 3 months or more below 45°F to satisfy the chilling requirements for breaking bud dormancy. When the chilling requirement has been satisfied, top growth will commence when spring arrives, even if the roots are still in a refrigerator. Therefore, plant them as soon as the soil can be worked in the spring.

Mulching

The ginseng seedbed should be covered with 1 or 2 inches of organic mulch immediately after seeding. Mulch prevents packing of the soil, conserves moisture, moderates soil temperatures, and helps control weeds.

Acceptable mulching materials include weathered hardwood bark or sawdust, leaves from deciduous trees, and small grain straw. Use mulch material that is free of weed seeds. Straw should be free of any viable grain seeds, which could cause a serious weed problem. Oat straw is desirable for fall mulching because young oat

plants are killed by freezing weather. Solarization of the straw through clear plastic mulch will also kill many weeds.

Maintain a good mulch throughout the crop cycle. Mulch should be added, if needed, in the fall after the tops have died. The walkways should be kept free of mulch and other obstacles so surface water will drain freely from the garden.

Shade Management

In areas where snow or ice are likely to accumulate, precautions need to be taken to prevent damage to artificial shade materials. Polypropylene shade cloth, especially, can be weighed down by snow or ice or damaged by high winds. In the fall, release the cloth along one side and at both ends of each panel. Gather the panel and tie it securely with rope to the cable along the fourth edge. When snow is no longer a threat, reattach the cloth.

Properly constructed and supported wood lath panels will support moderate snow loads. If appreciable snow or ice accumulations are likely, remove the panels and stack them until spring.

Fertilization

Ginseng tolerates a wide range of soil pH and fertility levels. Most native soils where ginseng grows in North Carolina are very acid (with a pH from 4.0 to 5.0) and contain little available phosphorus. Research shows that in North Carolina the pH required for optimum root growth is about 5.5 and that raising the soil phosphorus to a moderately high level increases root growth. Use soil analysis results to make lime and phosphorus adjustments before planting. Recommendations for native woody ornamentals in North Carolina are appropriate for ginseng. Relatively little is known about other nutrient requirements. More vigorous top growth has



Figure 6.
Symptoms of ginseng blight on leaves.

been observed after nitrogen has been added, but root response has not been clear-cut. It is suggested that 20 to 30 pounds of nitrogen per acre ($2/3$ pound of nitrogen per 1,000 square feet) be applied before emergence each year.

Irrigation

Good soil moisture is needed for best growth of ginseng roots, but wet soil is undesirable and will often result in root rot.

Inadequate soil moisture slows growth and may be one of the causes of a longer production cycle in woodland-grown ginseng. Feeder roots of trees and other weedy plants often permeate the soil and compete successfully for moisture and nutrients. Supplemental irrigation is helpful under such conditions. The bed mulch, the shaded environment, and the absence of other competing plants in artificially shaded gardens help conserve soil moisture. Except in unusual situations, supplemental irrigation should not be needed with artificial shade.

Pest Management

Pests that are of greatest concern to ginseng growers include weeds, insects, diseases, and rodents. Theft of cultivated ginseng is also a serious concern.

At present there are few pesticides labeled for use on ginseng; consult the current *North Carolina Agricultural Chemicals Manual* for current registrations. There are, however, certain cultural precautions that aid in reducing pests.

Weeds. Weeds compete with ginseng for moisture and nutrients, and they may harbor insects and diseases. Make a special effort to control or eliminate weeds during site preparation because at present herbicides cannot be used, and cultivation is not practical after the crop has been planted. Weedy growth should be destroyed periodically during the summer before seeding. Weeds that are not suppressed by the mulch should be pulled by hand.

Insects. Only minor insect damage has been noted on

ginseng. Grubs and wireworms occasionally have caused damage, especially in sites prepared from sod areas. Appropriate measures taken during site preparation will help control these pests. Slugs may hide in the mulch and damage stems, leaves, and berries of the ginseng plants. Check the *North Carolina Agricultural Chemicals Manual* for chemicals that are currently registered for insect and slug control. Aphids and leafhoppers have been observed on a few occasions but do not appear to be cause for serious concern.

Diseases. Ginseng diseases have been more widely associated with cultivated plantings than with wild ginseng and more with high-intensity plantings than low-intensity plantings. This difference may be due partly to the greater attention given to cultivated plots than to native stands, making it more likely that disease problems will be noticed. Cultivation frequently involves changing the growing conditions that favor the occurrence and severity of disease. These include:

- greater plant densities, which promote the rapid spread of certain diseases;
- higher temperatures and humidity that are associated with the kind, height, and expanse of the shading material and the site and exposure chosen;
- generally poorer soil drainage—tree roots take up large quantities of water, thus effectively draining the soil;
- overfertilizing and overliming—certain root rots are associated with high pH.

At least a dozen pathogenic diseases of ginseng have been identified, but only a few have been observed in North Carolina. *Alternaria* blight (*Alternaria panax* Whetzel) is the most serious and widespread fungus disease. The most obvious symptoms are leaf spots and leaf blighting (Figure 6), but the stalks and roots can also be

infected. The disease is often first noticed as small water-soaked spots on the leaflets. These enlarge to ½ inch or more in diameter and may join together. The spots gradually dry out and leave a tan, papery center and a darker border. The surrounding leaf tissue turns yellow, and the leaflets and leaves wilt and die. Under epidemic conditions, the entire plant top may die before berries are formed.

Initial infection in the spring is most likely to be on the stalks. The disease develops from spores that remain on debris of diseased plants from the previous year. The dark lesions may enlarge and girdle the stem; they are the most likely source of foliar infection. The roots of most plants infected with *Alternaria* survive and produce a top the following spring but are undoubtedly smaller than uninfected plants.

Damping-off is a seedling disease caused by one or a combination of fungal organisms (*Rhizoctonia*, *Fusarium*, and *Pythium* species). These fungi cause seed decay or attack the stalk at the soil surface, causing decay and collapse of the stem. Damping-off is enhanced by excessive moisture at the soil surface or in the mulch.

Other diseases identified on ginseng in North Carolina include botrytis blight (caused by *Botrytis cinerea*); root galls caused by the root-knot nematode; mildew; *Phytophthora*, the most common cause of root rot; and papery leaf spot, which is associated with insufficient soil moisture.

Cultural practices that aid in disease control include:

- Selecting a site with good soil drainage or improving the drainage of the site chosen. Root rots and damping-off usually occur in wet, poorly drained soils.
- Selecting a site with (or arranging for) good air circulation. Foliar diseases are favored by stagnant, humid

air. Remove dense undergrowth and weeds around beds.

- Avoiding sites with root-knot nematodes or sites where ginseng has been grown previously unless the soil can be treated to destroy disease-causing organisms.
- Using disease-free seeds or plants and handling planting stock with care to prevent injury.
- Avoiding crowding; very dense plantings are conducive to the spread of diseases. Particularly in natural, woodland plantings, give each plant enough space for good air movement and little contact with other plants.
- Removing and destroying diseased plant parts as soon as they are observed.
- Planting several small areas to ginseng instead of one large area. This separation may prevent a loss of the entire crop to disease.
- Providing good fertility and soil pH. Avoid excessive nitrogen. Plants stressed by too much or too little nitrogen are more prone to some diseases.

Rodents. Rodents are blamed for destruction of large proportions of some ginseng plantings, especially those located in or adjacent to wooded sites where rodents are normally found. Some growers attempt to control rodents by trapping, baiting, constructing barriers around the planting, and maintaining large families of cats at the site. Rodents are thought to use mole runs to get to ginseng roots. Trapping or otherwise eliminating moles should reduce ready access to the ginseng roots.

Seed Production, Harvesting, and Handling

The native North Carolina strain of ginseng generally emerges in May and flowers in July. Berries ripen in September. Northern

strains planted in North Carolina are two to four weeks earlier in these developmental stages.

With vigorous growth, by the third year, seed production may be appreciable under artificial shade. Yields of 150 to 200 pounds per acre are possible; a yield of 500 pounds is possible by the fourth year. Since ginseng is propagated by seed, the seeds are a valuable part of the crop. If the seeds will not be harvested, it is beneficial to remove the flower buds as early as possible. Development of flowers, fruits, and seeds require energy that otherwise could be used in root growth.

Pollination. Honeybees, bumblebees, and sweat bees have been observed visiting and collecting pollen from ginseng flowers. Such activity undoubtedly affects pollination. Flowers deprived of insect visits, however, also set a full complement of fruit. It appears that plant vibration caused by wind may be fully effective in pollinating ginseng, but bee activity at flowering should not be discouraged.

Harvesting and Extraction of Seed. Ginseng berries are ready to harvest when they turn red. Berries around the outside of the cluster ripen first. Individual berries can be picked as they ripen; however, it is more efficient to delay harvest until all the berries of a cluster are ripe and can be removed at one time.

Although not a requirement, it is desirable to extract the seeds from the berry pulp before placing them in a stratification unit. When working with a large quantity of berries, fermentation is a simple, effective extraction process. Place the berries in a bucket or tub three or more times larger than the volume of seeds. Mash the berries to rupture the skins. Cover and place the container in a shaded area or shed and leave it for five days or more, stirring daily, until the pulp has fermented and disintegrated. Spray water from a pressure hose into the container to separate the remaining pulp from the seeds. Fill the container with water, let the

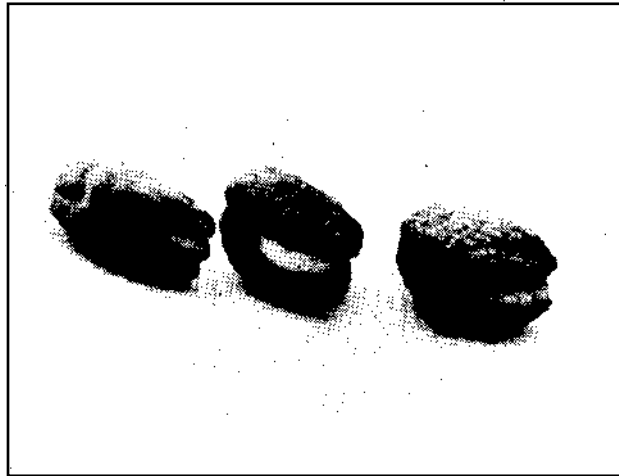


Figure 7.
Ginseng seeds after a year of stratification. Note the opening of the seedcoats.

seeds settle for 30 seconds, and gently pour off the liquid and suspended pulp. Repeat this process several times until only clean seeds remain in the container. Discard any seeds that float. Strain the seeds and spread them on a clean cloth or screen to allow their surfaces to dry for a few hours in a shaded, ventilated area. Do not allow the seeds to dry out; dry them only long enough to remove surface water and prevent them from sticking together. The seeds are now ready to be placed in storage for stratification.

Stratification. As explained earlier, freshly extracted (green) ginseng seeds must undergo stratification before planting.

Stratification can be accomplished most easily by placing the seeds in a screened container to protect them from rodents and storing the container in shaded, well-drained soil.

For small quantities of seeds, form a pouch of aluminum screen wire large enough to contain the seeds and twice their volume of clean, moist sand. Fill the pouch with alternating layers of sand and seeds, and fasten the edges of the pouch to prevent rodent damage. Bury the pouch securely under 4 or 5 inches of loose soil in a shaded or north-facing area and cover the soil with several inches of mulch. Mark the spot well.

For large quantities of seeds,

construct a wooden box 8 to 12 inches deep with a screen bottom and removable screen lid. Fill the container with a mixture of seeds and clean, damp sand (that will pass through 1/8-inch mesh screen), using at least twice as much sand as seeds. Bury the box in an area as described above so the top of the box is only 1 to 2 inches below the soil surface. Cover the box with soil and mulch, and mark the location well.

Early the next spring, open the container and check the seeds for decay, removing any that are soft. Some seeds, particularly those that were harvested first, may germinate the first spring after they are harvested. Remove these seeds and plant them immediately. Stir the remaining seeds carefully to aerate them, make certain the sand is still moist, and rebury the container. If soil conditions are extremely wet or dry, check the stratification unit periodically. Many seeds will enlarge and begin to open after a year in storage (Figure 7). This is a good indication that the seeds are viable. In the fall, plant the seeds according to the procedure recommended for stratified seed.

Root Harvesting, Handling, and Drying

Harvesting of ginseng roots, whether collected from the wild or

from cultivated gardens, should be delayed until after the berries ripen. Harvesting earlier will sacrifice not only the seed crop but also root weight.

With good growth, roots may be harvested by the fourth year in artificially shaded gardens. Harvesting may need to be delayed until the eighth year or later in naturally shaded plantings. Yields of up to 3,000 pounds per acre (air-dried weight) may be expected from successful, well-managed, artificially shaded crops. Naturally shaded plantings of comparable cultural intensity are not likely to yield more than two-thirds as much.

Harvesting. Before harvest, remove the tops of the plants and the mulch from the beds. In artificially shaded plantings, remove the shade structure. Removing the shade and mulch aids in drying the soil and makes digging easier.

Exercise care in digging to minimize root injury. Spades or forks can be used for most plantings. Mechanical diggers, similar to potato harvesters, are used by large-scale growers. Digging is easiest when the ginseng is grown in raised beds. Gather roots promptly into baskets or boxes. Carefully wash all soil from the roots with clean running water and take care not to damage or destroy feeder roots or the neck of the root. Do not scrub or skin the roots, and do not attempt to remove natural soil stains in the skin of the roots.

Drying. Roots must be air dried for storage and marketing. Drying can best be accomplished by exposing the roots to warm, dry, moving air.

Spread the roots evenly in a single layer on a screen-bottom tray to allow maximum ventilation. A fan and small heater can be used to circulate and warm the air in the drying room. The temperature should not exceed 95°F. If the roots dry too quickly, the exterior will darken, reducing their value.

Use a dehumidifier or ventilation fan to remove moisture from the drying room. Roots are sufficiently dry when they break with a snap. Drying should be complete in three or four weeks under good conditions.

Packing and Storing Roots. Carefully place dried roots in clean cardboard barrels or boxes. Do not place them in plastic or other airtight containers because mold and mildew may develop on the roots. Store the roots in a cool, dry atmosphere until marketed. Be sure to keep rodents and insects out of the storage area.

Production Economics

Despite the long history of collection, production, marketing, and use of ginseng, there is little reliable information on the economics of ginseng culture. The great range in cultural intensity implies a similar range in costs and labor input. The productivity and returns are therefore also likely to vary widely.

Lowest costs and returns can be expected when ginseng is planted in undisturbed soil under natural shade. In this case, the essential inputs include the cost of seeds and the labor for clearing the site, maintaining it, planting the seeds or roots, and harvesting the crop. Greatest inputs are required for high-density plantings on formed beds under artificial shade. In addition to the considerable cost of seeds, mulch, shade, and the labor required to establish and maintain the planting and harvest the crop, considerable use must be made of equipment in preparing the land and beds and in harvesting.

It is not possible to present one general budget for ginseng production because of the many variables involved, including level of cultivation intensity, root and seed prices, paid labor versus unpaid family labor, and loss due to disease and theft. Two estimates, however, are provided here based on a compilation of

information from a number of sources. Please keep in mind that these are very rough estimates for scenarios where everything goes right—a rare phenomenon in any agricultural venture.

For one acre of ginseng grown in the woods and harvested after 6 years of growth, estimated production costs are \$3,900 for seeds (60 pounds at \$65), \$26,600 for labor (3,800 hours at \$7), \$5,000 for equipment and supplies, and \$1,500 for drying and packaging, for a total of \$37,000. A total estimated income is \$73,000 from 200 pounds of seed (\$65 per pound) and 1,000 pounds of roots (\$60 per pound). This would provide a net income of \$36,000 per acre.

In contrast, a 4-year budget for 1 acre of intensively cultivated ginseng under polypropylene shade may include production costs of \$6,500 for seeds (100 pounds at \$65), \$14,000 for shade structure, \$4,500 for equipment rental and supplies, \$13,500 for labor, and \$14,500 to custom harvest, dry, and package, for a total cost of \$53,000. A total estimated income is \$129,000 from 600 pounds of seed (\$65 per pound) and 3,000 pounds of roots (\$30 per pound). This would provide a net income of \$76,000 per acre.

Note that there are large differences in capital investment and risk involved with both systems. Also note that diseases, weeds, rodents, poaching, and a volatile market for seeds and roots can seriously impact the costs and returns for ginseng. Sound advice for beginning ginseng growers is to start small and not to invest more than you can afford to lose.

Ginseng production is not a quick or easy way to get rich. By its very nature, growing ginseng requires great patience. There are also hazards to its culture. But ginseng is an unusual and mysterious plant, and its successful culture can return a very high value to land and management resources.



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Cooperative Extension Service**
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COLLEGE OF AGRICULTURE & LIFE SCIENCES

Cover photos showing ginseng berries and roots were supplied by T.R. Konsler.

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3,000 copies of this public document were printed at a cost of \$xx, or \$xx per copy.

Published by
North Carolina Cooperative Extension Service

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