

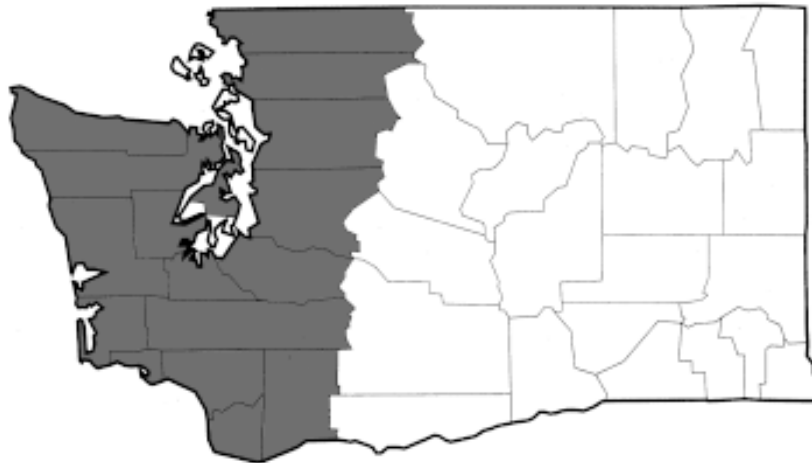
Crop Profile for **Ginseng** in Washington

Production Facts^(1,8)

- ❖ Washington State is relatively new in ginseng production; modern cultivated plantings started in 1990
- ❖ Roughly 200 acres are planted to ginseng, over approx. 130 growers
- ❖ The majority of ginseng plantings are small, often only 1/4 acre
- ❖ Washington production is approximately one half of one percent of total U.S. production
- ❖ 1998 production is estimated at 12,000 pounds, valued at \$240,000
- ❖ Yields range from 2,000 to 4,400 lbs. of dried root per acre. Growers strive for an average yield of 3,000 lbs. per acre
- ❖ Production costs per acre over the 4-year growing cycle total approximately \$26,000

Production Regions

The major producing region is west of the Cascade Mountains with a few isolated growing areas near Wenatchee and Ellensburg.



Cultural Practices

American ginseng (*Panax quinquefolis*) is a fleshy rooted perennial herb, started from seed. As this is an open pollinated crop there are no individual cultivars (3). Growers often use seed from their own crop to further expand their acreage. If growers only put in a 1/4-acre garden to begin with, they may find they will have enough seed production to plant another 2 acres in the future. While the top growth of the plant dies down over the winter months the underground root continues to enlarge each year. In September of the fourth year the roots are dug and prepared for either drying or fresh sales.

Dried root from North America is sent intact to China where it is sliced, packaged, and sold in state-owned drugstores (2). Packaged ginseng roots are sold as health food and are available in state-owned hospitals. Northwest growers have found that there is a good demand for fresh root in Korean grocery stores in southern California.

Growers select sites possessing well-drained sandy loam soil. Some growers have installed agricultural drain tile in their fields where winter flooding has been observed. Poorly drained ground has been found to be the leading cause of root rot in established gardens. In the Northwest, ginseng plantings are predominately established on pasture ground. All existing vegetation is cleared using



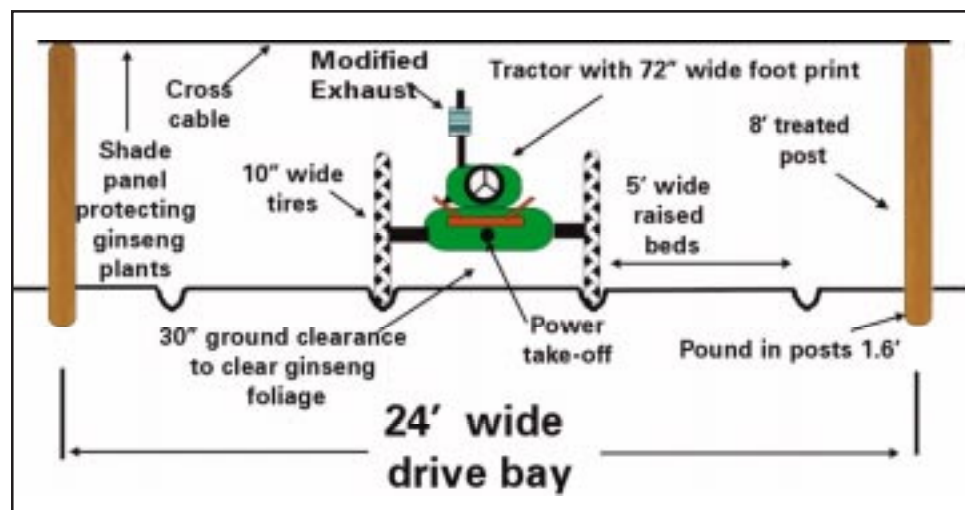
Freshly dug root waiting to be washed

non-selective herbicides such as Roundup. If the pasture has had a serious problem with perennial weeds, cover crops are grown for a year prior to planting. Failure to control all existing vegetation prior to planting has proven to be the principle management problem facing new growers.

Ginseng will grow under a wide range of soil pHs but does best on slightly acidic (pH of between 5.6 to 5.8) soils (4). Raised planting beds are formed using a bed shaper mounted behind a tractor that has a wide enough wheel base (72 in.) to straddle the rows. Resulting beds will be from 9-12 in. tall. Besides the wide wheel base, machines come with narrow tires (only 9.5 in. wide), high ground clearance (29 in.), and modified exhaust systems so that the tractor can drive under the shade panels. Growers using narrow wheel base

tractors have seen their yields reduced as there is less bed acreage planted in relation to total land area.

Unlike other regions where growers use mechanical seeders to sow their seed, Northwest growers simply scatter seed by hand after having mixed it 50/50 with sand. The optimum seeding rate is



Ginseng bed architecture and tractor design

somewhere between 80 and 100 lbs./acre. On good sites the 80 lb./ac rate has resulted in larger root sizes at harvest. After seeding, growers apply 1-2 in. of sawdust mulch. Douglas-fir sawdust is used to help prevent weed seed germination, and to help reduce soil moisture evaporation during the summer (fields west of the Cascades are not irrigated). Northwest growers differ from other growing regions in that they don't use straw for mulching. Straw mulch would exacerbate problems with slug depredation. It also leads to more problems with Botrytis leaf blight (see *Disease* section). Beds should be orientated in a north-south direction. If this is not possible the next best orientation is to layout the rows parallel to the prevailing wind currents to help speed air movements over the plants which helps reduce disease pressure.

In order to shield the ginseng plants from the harmful rays of the sun, growers use 80% woven shade panels, suspended by 8-10 ft. posts and 1/8 in. wire rope over their garden throughout the growing season. During the winter the wire rings used to secure the panels to the wire rope are cut, thus allowing the panels to be furled (gathered together) over the winter.



Posts, wire, and 80% shade panels used to shield plants from the sun's rays.

on a human hand). In year two a stalk emerges which supports two leaves, each with five leaflets. In years three and four, the emerging stalk gives rise to three and four leaves, respectively, once



Modern plastic-weave shade structure

again with five leaflets. Under optimum conditions mature plants can grow to a height of 30 in. In late April the shade panels need to be pulled tight across the support structure and hooked in place. During the first two summers of growth hand weeding is the primary task. Weeds have to be pulled by hand when they are still very small, otherwise pulling them when they are larger could result in pulling up the ginseng plants as well. Slugs must be controlled especially on younger plants. Shade panel tension must be checked during the summer to ensure that it stays tight. A fungicide spray program and foliar fertilizer program must be started in the spring and continued through the end of June.

During years two, three and four ginseng plants begin to flower and set seeds. Beginning in year three growers will have their crews pick the red berries for stratification. The berries are picked from the fields and placed into burlap bags. The bags are wet down and laid onto a concrete slab. Through natural fermentation the pulp of the berries is separated from the seeds contained within. These seeds are then placed into shallow sand boxes (12 in. deep), which have been set into the ground. Ginseng seeds stay in these boxes for 12 months to break the internal seed dormancy. During the first winter they receive a cold period (38-42 °F). During the subsequent summer they receive a warm period (50-55 °F). One year later they are dug out of the sand and are ready for fall

bed sowing, and thus receive a second cold period (38-42 °F). Without the cool/warm/cool regime ginseng seed will simply not germinate. When the sand boxes are first dug up the seeds will have swollen and begun to open (4).

In September and October new fields are prepared for planting. If they have been planted into summer cover crops the fields are plowed, disked and beds shaped for September seeding. In gardens ready for digging (year four) all posts, wire, and shade cloth must be removed. For any garden over an acre in size a potato harvester pulled behind a tractor is used to lift the roots to the soil surface where they can be picked up by hand. After freshly harvested roots wilt for 3-4 days (to help improve their color), they are washed carefully with clean water. If roots are destined for the fresh trade they are placed into cold storage



Ginseng drying shed, showing shallow trays and fan to distribute warm air.

(32 °F with high humidity). For the dried market the roots are placed onto shallow trays and dried at 100 -105 °F. It generally takes 10-12 days to dry all the roots.

Insect pests

Cultivated ginseng has relatively few insect pests. None of the pests described below contribute any significant damage to Northwest ginseng gardens.

SLUGS

Cultivated ginseng is highly susceptible to slug damage in the spring, as the weather stays cool and damp. Ragged holes in the leaves (see photo) and mucus trails are the characteristic signs of slug feeding. However, slug damage does not appear on the roots below the soil surface. A moderate amount of slug feeding on developing leaves probably has very little effect on eventual root yield. Most slug feeding occurs at night.

Chemical Control

PRODUCT: Deadline Bullets (4% metaldehyde)

APPLICATION: Broadcast 20 to 40 pounds over



Slug damage on ginseng plant leaves.

the top of the beds. Do not contaminate the ginseng roots. For best results apply in the evening. Especially beneficial if applied following a rain shower. Baiting has been found to be considerably more effective in the fall to kill mature slugs and prevent them from laying eggs. Young slugs are harder to kill in the spring.

Cultural Control

By using sawdust to mulch their ginseng beds Northwest growers have greatly reduced slug

populations. The drying action of the sawdust repels the slugs from entering the garden. Where straw is used on ginseng, slug damage can become overwhelming. Growers should delay pulling shade panels over the beds in April to give the garden

time to dry out and keep the area surrounding the garden tilled or covered with sawdust to discourage slugs from crawling into the garden. Surrounding ginseng gardens with dense vegetation is discouraged as this will inhibit air circulation.

Diseases

During the course of development of the cultivated ginseng industry in the Pacific Northwest both foliar and root pathogens have been encountered. The Northwest's mild spring weather, with frequent showers and cool temperatures during early stages of ginseng growth, greatly contributes to disease buildup.

BOTRYTIS BLIGHT

Botrytis cinerea

Of the foliar disorders affecting ginseng in areas west of the Cascades, Botrytis leaf blight is the most common. The cool, cloudy weather, with abundant spring rainfall, sets the ideal conditions for pathogen spread. *Botrytis cinerea* overwinters in the debris and surrounding vegetation near the ginseng garden (5). In the spring the fungus begins to grow and release spores which can be carried by



***Botrytis cinerea* lesion on cultivated ginseng leaves.**

the wind and rain to infect developing leaves, and occasionally flowers.

The characteristic symptoms on leaves include water-soaked, concentric lesions, which start at the leaf tips and proceed back along the leaf midrib (see photo). Where plant growth is dense, the pathogen can easily spread from one plant to the next.

The fungicide Rovral is efficacious against Botrytis if applied early when the plants are first emerging. The Rovral label lists *Alternaria panax*, and not *Botrytis cinerea*. There is concern on the part of Northwest horticultural producers towards developing Botrytis resistant strains towards Rovral. This has been the case with Northwest berry crops, as well as with Wisconsin ginseng. In order to reduce the chance of developing resistance, growers are urged to tank-mix Rovral with Kocide (61.4% fixed copper hydroxide).

Chemical Control

PRODUCT: Rovral 4F (flowable iprodione)

APPLICATION: Apply as a foliar spray using 1.5 to 2.0 pints per acre. Make the first application when conditions become favorable for disease development. Use sufficient water (10 gallons at least) to attain thorough coverage. Do not apply more than 5 times per season. Do not apply within 36 days of harvest.

When used in an alternating program with copper hydroxide products (Kocide or Champion) apply 1.0 to 1.5 lbs./ac Rovral on a 14 day basis when used with copper hydroxide.

PRODUCT: Rovral 50 SP (soluble packets)

APPLICATION: Apply 2 packets per acre; follow

remaining directions as above. When alternated with copper hydroxide, use only one packet per spray.

Cultural Control

The best way to reduce Botrytis infections is to ensure that the garden receives sufficient air movement, to dry the foliage during the day. Growers are advised to clear enough of the vegetation surrounding the garden in order to reduce the build-up of still, humid air (4). Seeding rates should be reduced in new beds by 1/2 of the typical seeding rates to reduce plant density and thus speed plant drying. Gardens established by transplants have considerably less infection, as there is more air movement between the plants.

ALTERNARIA LEAF & STEM BLIGHT

Alternaria panax

Alternaria leaf and stem blight caused by *Alternaria panax*, is the most common disease of ginseng throughout the world (6). It has been isolated in ginseng growing in eastern Washington, but not in areas west of the Cascades.



Alternaria leaf blight lesions, circular and angular.

The fungus attacks all parts of the ginseng plant. Leaves will show circular light brown lesions surrounded by yellow halo (see photo). During humid or wet weather, the lesions will become darker, while in dry weather they become papery dry, and may fall out. The yellow halo helps distin-

guish this pathogen from either Botrytis or Phytophthora leaf blight. Under severe infection, lesions can circle the leaf stems causing the leaf stalks to collapse and foliage to die.

Chemical Control

PRODUCT: Kocide DF, 61.4% copper hydroxide

APPLICATION: Use as a tank mix with Rovral. Combine 2.6 pounds of Kocide or Champion with 2 lbs. of Rovral 5OW in 100 gallons of water. Apply in the spring at 7 day intervals until warm weather begins (generally first half of June). Apply at least 8 hours before an expected rain shower. Thorough coverage is very important.

Alternaria blight is worse in dense canopies of two, three, and four year old ginseng. Use of a spreader sticker is strongly advised to keep the copper on the plants.

PHYTOPHTHORA ROOT ROT

Phytophthora cactorum

The pathogen *Phytophthora cactorum* can lead to serious root rot on primarily three and four year old stands. This disease is common in poorly drained portions of the ginseng garden. The first sign of this disease is a cluster of wilting plants. When the roots are dug for examination, they will have a beige interior, and the root will feel rubbery. A field test to determine the presence of this disorder is to squeeze the suspect roots. Roots with a creamy consistency are clearly infected. There may be a pungent odor as well. While roots may appear normal at harvest, during the drying phase obvious gray black discoloration on the roots will be clearly evident.

Oospores of the fungus survive in the soil over winter (7). They germinate and form fungal mycelium. From this fungal mat, zoospores are formed and are carried by free water movement. Once infected the roots start a gradual rotting process. Warming soil temperatures and saturated soils due to excessive spring rain or poor soil drainage can exacerbate this disease.

While there are fungicides registered for the control of root rot, growers should not rely upon them without giving serious consideration to the proven cultural steps that can reduce root rot incidence.

Chemical Control

PRODUCT: Aliette WDG, (water dispersible granules), Aliette WSP (water soluble packets), Fosetyl-Al

APPLICATION: APPLY 5 lbs/100 gallons of water in the spring when conditions become favorable for disease development. Do not tank mix with copper compounds as leaf phytotoxicity can occur.

PRODUCT: Ridomil 50W, metalaxyl

APPLICATION: Apply either pre plant or post plant to help control damping off. Use 2-4 lbs./treated acre. Incorporate with irrigation (rainfall will substitute for irrigation).

PRODUCT: Ridomil Gold EC

APPLICATION: Apply 3/4 pint/acre in a drench with at least 100 gallons of water in the spring before the plants start growing.

Cultural Control

Cultural prevention of root rot begins during the preparation months leading up to planting. Raised beds and excellent tilth are the keystones of prevention. Cover crops planted prior to planting ginseng build up the soil organic matter levels. Sanitation in existing fields is important. Soil fumigation has not been found effective against *Phytophthora*. Diseased plants should be dug up and removed, as well as their neighbors within a one foot radius. Spray a 10% bleach/water solution onto boots, and shovels used to dig up the infected areas. Pressure wash the lugs of the tractor that traverses a rot infested area. Purchase seed from a grower that has had healthy ginseng plants.

Nematodes

ROOT-KNOT NEMATODE

Meloidogyne hapla

ROOT LESION NEMATODE

Pratylenchus penetrans

The root-knot nematode and the root lesion nematode have both been found in Northwest ginseng gardens.

The crop grown before ginseng plays a role in nematode population dynamics. Alfalfa can



Root-knot nematode damage.
Note swellings on root hairs.

serve as host for both root-knot, as well as root lesion nematodes. Grasses have been found to be a suitable host for root lesion nematodes. As ginseng stays in the ground for at least 4 years nematodes have a chance to increase their populations. The symptoms of root-knot nematode feeding on ginseng roots are the presence of enlarged, tumor-like swelling on the fine root hairs (see photo). Dr. Terry Vrain, nematologist (vrain@em.agr.ca), with Pacific Agri-Food in Summerland British Columbia reports that root lesion infestations can adversely affect cultivated ginseng.

Threshold levels for both species of nematodes have been set. If root lesion nematode populations exceed 100 per 100 cc of soil, when sampled in late summer, soil fumigation prior to planting is suggested. For root-knot nematodes, the population threshold is only 1 per 100 cc of soil.

The highest population of lesion nematodes will be found in fields that were once planted to perennial horticultural crop such as berries, orchard crops, or ornamentals. The best recommendation for horticultural crop producers is to collect soil samples in late summer for nematode testing. If the populations are high enough, soil fumigation is often recommended. The fumigant Telone II is the most commonly used product for areas west of the Cascades. In general September through early October is the best time to fumigate soils in the Pacific Northwest. It would be advisable to fumigate ginseng gardens at least year prior to seeding.

Chemical Control

FUMIGANT: Telone II (1,3-dichloropropene)

APPLICATION: Have Telone II custom applied pre-plant broadcast to weed, debris, and clod-free soil in early September by the use of injection equipment. Wait 2 weeks, before seeding or planting a crop. Once "clean," fumigated soil should not be re-contaminated with planting stock or soil from gardens known to have a history of nematodes.

Cultural Control

Potato growers have learned that if they grow a crop of either oats (cultivar "Saia") or cereal rye (cultivar "Wheeler") for 2 years prior to planting that they can nearly eliminate root-knot nematodes and reduce root lesion populations significantly. Ginseng growers could take this finding and apply it to their gardens as well.

Weeds

Pre-plant Weed Control

Pre-plant weed control is of the utmost importance. Perennial weedy plants such as Canada thistle, field bindweed, and quackgrass have to be completely eliminated prior to seeding the beds in the fall. One application of a translocated (glyphosate) herbicide may not be enough to completely kill all perennials. Ginseng growers should consider spraying a pasture in mid to late April, wait two weeks for the sod to die off, disc the field twice, and then wait to see if any of the perennials resume growth. The field should be carefully walked to look for any weed re-growth. After the weeds are under control, drill in a cereal cover crop to keep weed seeds from germinating during the summer.

Post-plant Weed Control

Once the beds have been seeded, cover them with a 2 in. thick layer of sawdust. During the first

year of growth growers often have to re-apply sawdust to areas where winter winds have blown some of the mulch away. Weed pressure will be the highest during year one. As the young ginseng plants are emerging so will weeds. It is important that the weeds are pulled when they are still very small. Otherwise, pulling them up often will pull up a small ginseng seedling. Afterwards be sure to smooth the sawdust back around the ginseng plants to exclude all light from reaching the soil surface.

Herbicide Use in Established Beds

Monsanto has a federal label for Roundup Ultra that can be used in ginseng. Northwest ginseng growers have found that one application to the beds in mid to late March, before the ginseng emerges, has been very effective in killing winter annuals, biennials, and any residual perennials that escaped the pre-plant weed control program.

(continued next page)

PRODUCT: Roundup Ultra (glyphosate)

APPLICATION: A non-selective, translocated herbicide with no apparent soil activity. Will travel to the root systems of perennial weeds, thus killing them. In non-bearing ginseng, apply Roundup with boom, shielded sprayer, hand-held, or wiper equipment. If used after the ginseng plants have emerged, avoid contact with any green foliage, stems, and exposed roots as severe injury to the ginseng can occur. Do not apply within one year of harvest.

Cultural Control

While the majority of the weed control effort will occur within the beds themselves, attention should be given to the area surrounding the garden. Many weed species produce seeds that can be carried by air currents. Surrounding pasture ground can be treated with broadleaf weed killers such as Crossbow (containing triclopyr and 2,4-D), or Weedmaster (containing dicamba and 2,4-D). When used during late April through mid June, these products will control the broadleaf weeds without harming the pasture grass.

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Additional Resources

Northwest Ginseng News is a bi-monthly newsletter, established in April 1992, that covers the entire spectrum of issues surrounding the production and marketing of cultivated ginseng in the Pacific Northwest. A complete set of back issues is available for purchase at \$100.00. Send orders to Pacific Rim Ginseng, 1504 NE 234th St., Ridgefield, WA 98642, or call 360/ 887-3128.

In the Pacific Northwest the 4-year-old Northwest Ginseng Growers Association (NWGA) has created a Commission House where dues-paying (\$125 yearly) members can display a sample of their product to prospective buyers. Using leased office space 15 minutes from the Portland International Airport, the board of directors of the NWGA hopes to attract the attention of both international visitors as well domestic buyers. Web: <http://www.nwginseng.org>.

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College of Agriculture and Home Economics

Use pesticides with care. Apply them only to plants, animals, or sites listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

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