

---

# WASHINGTON'S SMALL-SEEDED VEGETABLE SEED INDUSTRY

---



**Beet seed harvesting in Skagit County, Washington**  
**Photo by Marvin Jarmin**

Washington's agricultural industry may be better known for the apples, carrots, hops, or wines produced here; however, the small-seeded vegetable seed grown in this state is the foundation for a major share of vegetable production in the United States and worldwide. Washington is known to produce high-quality vegetable seed: an essential ingredient in any crop equation. Without quality seed, no matter how much time growers spend preparing the land and controlling pests, they cannot produce prime crops. Washington's vegetable seed also commands a large share of some seed markets. Seventy percent or more of all the nation's carrot, spinach, radish, and beet seed is produced here. These same crops account for approximately 50% of worldwide seed production.

Washington is a prime vegetable seed production area for many reasons. The soil and climate are conducive to producing high-quality vegetable seed. The dry summers in eastern Washington discourage the diseases that hamper seed production in many other growing regions in the United States. Additionally, eastern Washington's long growing season is an asset to many of the small-seeded vegetable seed crops. In western Washington, a cool marine climate is ideal for the production of cool season *Brassica* and other seed crops.

Equally important to state vegetable seed production are the human resources available in Washington. Seed companies are now working with third-generation growers, whose cumulative expertise is valued throughout the industry. Further, Washington State University Cooperative Extension offices and research centers have helped find timely solutions to seed production problems.

Washington's small-seeded vegetable seed production takes place on approximately

15,000 acres. Roughly 30 seed crops are produced in two primary seed growing regions. In western Washington, growers produce seed crops on 6,000 acres spread throughout the Skagit Valley and in Lewis, Island, Snohomish, and Whatcom counties. In eastern Washington, crops are grown in the greater Columbia Basin on approximately 9,000 acres (5-year average from 1985 to 1990).

## History

The United States vegetable seed industry began on the East Coast. Over time, however, the hot and humid climate proved less than ideal for many crops. In the late 1800s the vegetable seed industry began its westward migration, initially into California and Washington, while seed marketing operations remained on the East Coast. It was not until the 1940s that East Coast companies shifted some marketing operations west.

Washington's seed industry predates statehood. The oldest seed company is believed to be the Tillinghast Seed Company, founded in 1885 by Alvinza Gardner Tillinghast in Padilla, Washington. Tillinghast moved to the West from Pennsylvania and began his business initially by purchasing seed from eastern companies for packaging and sale. After the company moved to La Conner, Washington, Tillinghast began contracting with local farmers for cabbage seed production.

Although not the first company to operate in Washington, the Charles H. Lilly Company was the premier seed company operating in Washington from the late 1880s through the early 1900s. Other early Washington seed companies were Alf Christianson, Burpee, Ferry Morse, Northrup King (now Rogers Seed Company), and Associated Seed Growers (now Asgrow). The earliest small-seeded vegetable seed crops grown in Washington were turnip, mustard, collard, kale, cabbage, beet, spinach, and rutabaga. Seed production, initially limited to western Washington, did not extend into the eastern portion of the state until the 1950s, when the Columbia Basin Reclamation Project made irrigation water more widely available. Although the project began in the 1930s with the construction of Grand Coulee Dam, the first irrigation water was unavailable in the Columbia Basin until the earliest section of the irrigation distribution network, called Block 1, north of Pasco, was completed in 1948. The distribution system near Othello was built between the mid-1950s and 1960. The system supplying the Basin City area was under construction from the late 1950s to mid-1960s. Radish, produced in the Quincy area in about 1953, is thought to be the earliest vegetable seed crop grown in the Columbia Basin.

## The Business of Vegetable Seed Production

Approximately 25 seed companies contract Washington acreage in any one year for seed production. The group is relatively stable. Few companies have entered or withdrawn from Washington's market in the past 10 years. Currently, no open market (noncontracted) small-seeded vegetable seed production exists in Washington.

Commercial vegetable seed production within the state is conducted under bailment contracts, whereby a seed company (bailor) provides a grower with the seed necessary to produce a crop. The seed company retains ownership of the seed, the growing crop, and the resulting harvested seed. The growers (bailees) produce and harvest the crop and are paid the contract price for the resulting seed. Seed contracts typically specify quality criteria that a grower must meet to be paid for the crop. These conditions are germination percentage and purity. Most seed crops must meet an 85% germination rate and must be cleaned to 99% purity. While it is uncommon for a seed company to reject a crop, it does happen. Four possible scenarios are given below:

**Germination.** The most common reason for rejecting a seed crop is that the crop does not meet the contract-specified germination percentage. (This has been a particular problem with carrot seed grown in the greater Columbia Basin between 1990 and 1995.)

**Purity.** A seed company might declare a seed crop unmerchantable if it is contaminated with weed seeds that cannot be removed efficiently at a seed conditioning plant.

**Mixture.** Contractors might reject a crop while it is still in the field, if a physical mix of different varieties in the seed has been planted (e.g., the seed company inadvertently provides the grower a mixture of carrot cultivars and one variety can't be rogued. Roguing is the removal of plants not displaying true varietal characteristics). A crop also might be rejected if sufficient invasion of a cross-compatible weed pest occurs (e.g., wild radish in a radish seed field) that is too dense to rogue effectively.

**Market Demand.** A seed company might buy a crop from a grower prior to harvest, if the crop yield exceeds the seed company's needs. This has happened with carrot seed, where one year's crop was planted before the preceding year's crop had been harvested. If yield is particularly high, not all the new crop acreage may be required to meet the company's needs.

Crops not initially meeting the germination or purity criteria may be reprocessed at a conditioning facility to bring them into compliance with contract specifications. Each reprocessing, however, results in seed loss, effectively reducing the grower's yield and profit.

Other than normal direct contracting, seed companies will sometimes establish third-party contracts for vegetable seed production. This might be the case if a company is interested only in limited acreage or crops, or if a company does not routinely contract acreage in Washington. For example, a Dutch seed company might contract with other seed companies for carrot and cabbage seed, which it then exports to its headquarters in Holland.

Growers produce either open-pollinated or hybrid vegetable seed, each with different production considerations. Hybrid seed allows for the production of consumption crops displaying higher yields, better flavor, uniform maturation, or pest resistance. As hybrid seed has become more important in worldwide agriculture, the quantity grown in Washington has increased.

In open pollination seed production, the pollen that fertilizes the plant, via wind or insects, is generally from the same population of plants within the field. In hybrid

seed production, the source of the pollen is controlled in one of several ways. Growers may use plants with missing or nonfunctional reproductive parts, such as separate pistillate (female) plants and staminate (male) plants, for seed production. Self-sterile plants, where the pistil and stamens mature at different times, also are used.

Growers must control the location of seed crop fields to prevent cross pollination. Planting an open-pollinated crop next to a field of hybrid seed would defeat efforts to produce hybrid seed. Individual fields of cross-compatible crops (e.g., beet and Swiss chard) also must be isolated from each other. Isolation distances vary depending upon the crop. Growers typically separate insect-pollinated crops by at least 1/4 mile and sometimes by as much as 2 miles. For crops such as beet and spinach, which are wind-pollinated, growers separate cross-compatible varieties by 1/2 to 2 miles for market seed and by 2 miles or more for stock seed. Market seed is produced and used for vegetable production, while stock seed is grown specifically for use in planting seed crops. Seed companies work cooperatively under the direction of Washington State University Cooperative Extension agents in Ephrata and Mt. Vernon to maintain adequate isolation distances.

Seed crops are either grown directly from seeds (seed-to-seed production) or from roots or bulbs (root-to-seed production). With seed-to-seed production, the crops either may be seeded directly in the field (direct-seeded) or sown as seed in high-density seedbeds or greenhouses and transplanted as seedlings at the proper time. The main vegetable seed crops grown in Washington that are not direct-seeded are beets and cabbage. Onion and leek seed often are produced as root (bulb)-to-seed crops. Occasionally, stecklings (root-crop transplants grown from seeds in either a field seedbed or greenhouse) are used to augment carrot crops, when significant winterkill has occurred in a certain cultivar, or if sales indicate a need for additional production. When seed-to-seed production is to be used with biennials, growers must select the planting time so that the crop enters the dormant season when the root or bulb is only partly developed. If the crop has developed too far, plants are susceptible to decay or damage from freezing during the winter. If plants are underdeveloped, they are likely to be killed or heaved out of the ground and desiccated by freezing and thawing during the fall or spring.

## Seed Conditioning

Growers typically harvest vegetable seed crops by cutting or swathing the plants at maturity, drying the cut crop in the field, then threshing the crop with a combine. Threshing separates the seed from the rest of the vegetative matter and cannot be done efficiently if the crop is not dry.

The seed is next sent to a seed conditioning plant for further processing, to attain the industry's standard 99% purity. A majority of the state's vegetable seed is processed in local seed conditioning plants, which are owned and operated by the seed companies. Seed may be precleaned at harvest and then sent out of the state for further conditioning, when companies without local facilities have contracted the seed production.

Seed conditioning plant operations vary depending upon which type of seed is to be cleaned. Typically, the material from the combine first passes through a series of

screens to remove debris either smaller or larger than the seed. The seeds then pass into rotating drums dimpled with indents. Regularly shaped seeds fall into the indents and are flung into a separation trough.

Next, the seed is fed onto a tilted, vibrating gravity table. Vibration coupled with air blown up through the seeds separates the material by density. Rocks, soil particles and other heavy debris are separated at one location on the table. Seed itself is separated further into several cuts or densities. Typically, the heaviest cut of seed has the highest percentage of germination. If a seed crop does not demonstrate the required germination percentage, it may be reprocessed on the gravity table to remove more of the lighter seed. In this way, the germination rate of a crop may be raised to pass the contract specifications.

Very round, regularly shaped seeds (e.g., turnip seed) may be cleaned further in a piece of equipment called a spiral separator. The material feeds into the top of a tall spiral trough enclosed in a tube. The seeds roll quickly because of their round shape and are flung out of the inner trough and collected.

Some seeds require a final cleaning in an electronic separator, if the remaining impurities are of the same shape and density as the seed but of a different color. The material passes in front of an electronic eye. If the device detects a contrast between what is expected (desired seed) and what is actually seen, a blast of air blows the unwanted material out of the stream of seed (e.g., barnyardgrass seed is removed from onion seed by this type of separator).

## Washington's Small-Seeded Vegetable Seed Crops

Unless otherwise specified, all crop information is based on 1993 data and is from *Washington Minor Crops*. A. Schreiber and Ritchie, L. FEQL, WSU Tri-Cities, Richland, Washington. 1995. Where specified, the abbreviations O.P. and Hy following crop information denote values for open pollinated and hybrid seed crops, respectively.

### Onion Family

Leek and onion seed are produced either as seed-to-seed or bulb-to-seed crops. If direct-seeded, these crops are planted in July, overwintered, and harvested in August or September of the following year. If grown from bulbs, the crops are planted in March and harvested in August of the same year. In both crops, fields are mechanically cultivated and hand hoed throughout the growing season. Roguing is not economically feasible in seed-to-seed crops; however, it is done when the seed is grown from bulbs. The seed may be harvested either by hand or by machine. If mechanically cut, the crop is swathed onto paper and usually is tied down to protect it from wind. The crop then dries in the field for 2 to 4 weeks before it is threshed. When hand harvested, the crop is cut, placed in burlap and dried via forced air. The dried crop is then hand fed into a combine. The seed is sent to a conditioning plant for final cleaning.

Thrips and seedcorn maggot are the primary insect pests in leek and onion crops.

Weed pests include barnyardgrass, smartweed, wild buckwheat, and nightshade. While *Botrytis* is the most severe disease—because it moves between the food crop and the overwintering seed crop—*Fusarium* basal rot, purple blotch, and downy mildew also may be problematic.

### Onion Family (Amaryllidaceae)

Crop	Washington Acreage			Production %		Per-acre Value
	Total	Eastern	Western	U.S.	World	
Leek	8	8	—	—	—	\$2800-\$4000
Onion	749*	—	—	10-20	20	\$2800-\$4000 (O.P.) \$4000-\$6000 (Hy)

\*Both bulb and bunching (or green) onion seed are grown in Washington. In 1993, the onion acreage was divided as follows: 293 acres of open-pollinated bulb, 347 acres of hybridized bulb, and 109 acres of bunching onion seed.

### Beet Family

Beet and Swiss chard are biennial seed crops. Seed is sown initially in high-density seed beds. Most growers isolate beet root beds from production beds. Beet seed is sown in mid-June, followed by Swiss chard in August. In early October beets are topped, dug, placed in windrows, and covered with 1 foot of soil to protect them from freezing. In early April both beets and Swiss chard plants are moved to fields. In addition to the above process, approximately 100 acres of open-pollinated beet seed are direct-seeded each year and overwinter in the field. Both seed crops are ready to harvest in late fall. Roguing is done in the seedbeds to remove off-type plants. In the field, beets are mechanically cultivated and occasionally hand hoed as needed to control weeds. At harvest, the crop is cut, windrowed, and left to dry in the field for 10 to 14 days before being threshed. While the seed is in the field curing, the crop is turned to prevent molding. Hand turning prevents damage to the seed.

Cabbage aphid, green peach aphid, and a black aphid (possibly the black bean aphid) are the most critical insect pests; however, thrip and leafminer also may impact beet and Swiss chard seed crops. Weed pests include shepherdspurse, mustard, lambsquarters, pigweed, smartweed, henbit, groundsel, chickweed, wild turnip, quackgrass, wild oat, Canada thistle, bolt thistle, vetch, nightshade, bedstraw, and pineapple weed. Lambsquarters is especially difficult to control, because it is also a member of the beet family. Downy and powdery mildew are the two diseases that may affect these crops.

### Beet Family (Chenopodiaceae)

Crop	Washington Acreage			Production %		Per-acre Value
	Total	Eastern	Western	U.S.	World	
Beet, Table	700	—	700	80	50	\$1500-\$1800

Beet, Sugar*	—	—	—	—	—	—
Swiss chard	100	—	100	70	—	\$1000-\$1200

\*No acreage was contracted for sugar seed production in 1995; however, the crop has been produced in the state in previous years. No information on this crop is available. Produced in a manner similar to table beet and Swiss chard seed, it is also vulnerable to the same pests.

## Oriental Vegetables

The oriental vegetable seed crops are planted in March or April and are ready for harvest in August or September. The crops are hand hoed and are rogued to remove any plants not displaying true varietal characteristics. At harvest, the crop is cut, windrowed, and dried in the field for 10 to 14 days. After drying, the crop is threshed, and the seed is sent to a conditioning plant for final cleaning.

Pest problems in oriental vegetable seed crops are more extensive in western Washington than in eastern Washington.

Cabbage maggot is a severe insect pest in eastern Washington oriental vegetable seed crops. Other insect pests include sugarbeet leafhopper, cabbage and turnip aphid, looper, and cutworm. Cabbage and turnip aphid, seedpod weevil and cabbage maggot are severe insect pests in western Washington. Others include cabbage looper, springtail, webworm, diamondback moth, cutworm, symphylans, and wireworm.

Weed pests in eastern Washington include nightshade, pigweed, lambsquarters, wild buckwheat, volunteer crops, foxtail, and barnyardgrass. Western Washington weed pests include shepherdspurse, mustard, lambsquarters, pigweed, smartweed, henbit, groundsel, chickweed, wild turnip, quackgrass, wild oat, Canada thistle, bolt thistle, vetch, nightshade, and bedstraw. Shepherdspurse, groundsel, and henbit are the more problematic weeds.

*Sclerotinia* causes the only disease of oriental vegetable crops in eastern Washington. The most serious diseases in western Washington are powdery mildew, downy mildew, and those caused by *Alternaria* and *Sclerotinia*. Additional diseases are caused by *Cladosporium*, *Fusarium*, *Rhizoctonia*, *Stemphyllium*, *Pythium*, and *Phytophthora*.

### Oriental Vegetables (Cruciferae)

Crop	Washington Acreage			Production %		Per-acre Value
	Total	Eastern	Western	U.S.	World	
Chinese cabbage	<250*	<50	<200	90-100	—	\$1000-\$1200
Chinese kale	300	50	250	90-100	—	\$1000-\$1200
Chinese mustard	180*	100	80	90-100	—	\$1000-\$1200

\*Eighty percent of both the Chinese cabbage and Chinese mustard grown in Washington are hybrid seed crops.

## Radish Family

Both daikon and radish seed are annual crops planted in March and April and harvested in August. The crop is direct seeded but can be supplemented with root propagation if needed to replenish winter damaged crops. Mechanical cultivation, hand hoeing and hand roguing are used as needed during the growing season. At harvest, the crop is cut, windrowed, and left to dry for 10 to 14 days before being threshed. The seed then receives a final cleaning at a seed conditioning plant.

In eastern Washington, leafhoppers are the most severe insect pests, because of beet leafhopper transmitted virescence agent (BLTVA). In western Washington, where leafhoppers and the subsequent BLTVA are not a concern, the seedpod weevil is considered a severe insect pest of these crops. Cabbage maggot, cabbage and turnip aphid, cabbage looper, and cutworm are common to all radish seed crops. In addition, western Washington radish seed may be impacted by springtail, webworm, diamondback moth, symphylans, and wireworm.

Weed pests common to all crops include lambsquarters, pigweed, Canada thistle, and nightshade. Wild buckwheat, volunteer crops, foxtail, and barnyardgrass are problematic in eastern Washington, while shepherdspurse, mustard, smartweed, henbit, groundsel, chickweed, wild turnip, quackgrass, wild oat, bolt thistle, vetch, and bedstraw cause problems in western Washington.

In eastern Washington, radish family diseases include viruses, white rust, and occasionally those caused by *Sclerotinia*, *Pythium*, and *Phytophthora*. Diseases are a more severe problem in western Washington and include powdery mildew, downy mildew, and those caused by *Alternaria* and *Sclerotinia*. Additional diseases common in western Washington are caused by *Cladosporium*, *Fusarium*, *Rhizoctonia*, *Stemphyllium*, *Pythium* and *Phytophthora*.

Robins and starlings also are considered major pests.

### Radish Family (Cruciferae)

Crop	Washington AVERAGE			Production %		Per-acre Value
	Total	Eastern	Western	U.S.	World	
Daikon	227*	227	—	10	—	\$900-\$1000
Radish	1490	1370	120	70	40	\$900-\$1000

\*Daikon radish seed acreage in Washington has decreased recently due to disease pressure. In 1990, 3875 acres, representing 80% of U.S. production, were grown in Washington.

## Flavoring Umbelliferae

Coriander and dill are annual crops, direct-seeded in March or April and harvested in late August or early September. During the growing season, fields are hand hoed to control weeds and hand rogued to remove any plants not displaying true varietal characteristics. At harvest, the crop is cut and windrowed for 10 to 14 days before being threshed. After threshing, seed is transported to a conditioning plant for final cleaning.

Lygus bug is the most severe insect pest in central and eastern Washington. Other pests include looper, redbacked and variegated cutworm, and European and twospotted spider mite. In western Washington, aphids and thrips are a problem also. Weed pests common across the state are lambsquarters, pigweed, Canada thistle, and nightshade. Wild buckwheat, volunteer crops, foxtail, and barnyardgrass are problematic in eastern Washington, while shepherdspurse, mustard, smartweed, henbit, groundsel, chickweed, wild turnip, quackgrass, wild oat, bolt thistle, vetch, and bedstraw cause problems in western Washington. Shepherdspurse is the most difficult weed pest to control. Disease is rare in coriander and dill crops; however, outbreaks of bacterial blight, aster yellows, powdery mildew, and diseases caused by *Sclerotinia* and *Alternaria* may occur on occasion.

### Flavoring Umbelliferae (Umbelliferae)

Crop	Washington Acentage			Production %		Per-acre Value
	Total	Eastern	Western	U.S.	World	
Coriander	200	50	150	33	—	\$900-\$1000
Dill	130	125	5	—	—	\$800-\$1000

### Other Umbelliferae

Carrot, parsley and parsnip are grown generally as direct-seeded biennial crops, planted one summer and harvested the next. Carrots are generally direct-seeded; however, stecklings are used to supplement crops when significant winterkill occurs in a certain cultivar, or if sales indicate additional production is necessary. Stecklings are grown in either western Washington or California. Seed for stecklings grown in western Washington is sown in late June or early July in seedbeds. Stecklings are either dug in October and stored, or are left in the ground and dug when needed. Parsley and parsnip seed crops are planted somewhat earlier in June or July, depending upon location. In western Washington, parsley may either be direct-seeded in June or planted in a seedbed and later transplanted. In eastern Washington, parsley is direct-seeded in July. During the growing season, mechanical cultivation is used as needed along with hand hoeing and roguing to remove plants not displaying true varietal characteristics. All crops are harvested in August and September, at which time the crop is cut, windrowed, and left to dry for 10 to 14 days. The crop is then threshed, and the seed is transported to a conditioning plant for further processing.

Lygus bugs are the most severe insect pest. They feed on the developing seeds and reduce the germination percentage. Occasional insect pests include looper,

redbacked and variegated cutworm, and European and twospotted spider mite. In western Washington, cabbage and turnip aphids, as well as thrips, cause problems with parsley and parsnip seed crops.

Weed pests common across the state are lambsquarters, pigweed, Canada thistle, and nightshade. Wild buckwheat, volunteer crops, foxtail, and barnyardgrass are problematic in eastern Washington. Shepherdspurse, mustard, smartweed, henbit, groundsel, chickweed, wild turnip, quackgrass, wild oat, bolt thistle, vetch and bedstraw cause problems in western Washington. Shepherdspurse is the most difficult to control.

Diseases are rare; however, outbreaks of bacterial blight, aster yellows, powdery mildew, and diseases caused by *Sclerotinia* and *Alternaria* may occur on occasion.

### Other Umbelliferae (Umbelliferae)

Crop	Washington Acreage			Production %		Per-acre Value
	Total	Eastern	Western	U.S.	World	
Carrot	2448	1750 (O.P.) 743 (Hy)	—	75	50	\$900-\$1200 (O.P.) \$1800-\$2500 (Hy)
Parsley	60-70*	10 (O.P.)	50-60 (O.P.)	50	—	\$1500 (O.P.)
Parsnip	70-100	40-50	40-50	50	—	\$900-\$1200

\*Typically, between 100 and 150 acres of parsley seed are grown in Washington each year; however, only 60 to 70 acres were grown in 1993.

## Leafy Greens

The leafy green vegetable crops are direct-seeded annuals, typically planted at the beginning of April and harvested the first part of September. Endive and lettuce are harvested somewhat earlier in mid-August. Spinach, the most economically important seed crop grown in western Washington, is planted between late March and mid-May and harvested in July and August. During the growing season, fields are occasionally hand hoed to control weeds and hand rogued to remove plants not displaying true varietal characteristics. At harvest, the crop is cut, windrowed, and left to dry in the field for 10 to 14 days. During this period, spinach crops may require hand turning to facilitate drying. Next, the crop is threshed and transported to a seed conditioning plant for final processing.

Common pests affect arugula, broccoli raab, rapeseed, and spinach mustard. Cabbage and turnip aphids, as well as seed pod weevil and cabbage maggot, are severe insect pests of these crops. Other insect pests include the cabbage looper, springtail, webworm, diamondback moth, cutworm, and wireworm.

Weed pests include shepherdspurse, mustard, lambsquarters, pigweed, smartweed, henbit, groundsel, chickweed, wild turnip, quackgrass, wild oat, Canada thistle, bolt

thistle, vetch, nightshade, and bedstraw.

The most serious diseases are powdery mildew, downy mildew, and those caused by *Alternaria* and *Sclerotinia*. Additional diseases are caused by *Cladosporium*, *Fusarium*, *Rhizoctonia*, *Stemphyllium*, *Pythium* and *Phytophthora*.

Birds, particularly blackbirds and sparrows, also are major pests.

Aphids may be an occasional pest of endive and lettuce seed crops; however, they do not limit production. *Sclerotinia* causes the only disease of these two crops. There is currently no chemical used for disease control on endive. Weeds are the most severe pests of these crops; grasses and broadleaf weeds are equally problematic.

Spinach insect pests include aphid, cabbage looper, springtail, European crane fly, and cutworm. All weeds are a serious problem in spinach seed crops. Common weed pests include shepherdspurse, mustard, lambsquarters, pigweed, smartweed, henbit, groundsel, chickweed, wild turnip, quackgrass, wild oat, Canada thistle, bolt thistle, vetch, nightshade, and bedstraw. Diseases include downy mildew and those caused by *Sclerotinia*, *Fusarium*, and *Cladosporium*.

Birds, particularly blackbirds and sparrows, are also considered pests of spinach seed.

### Leafy Greens (Umbelliferae)

Crop	Washington Acentage			Production %		Per-acre Value
	Total	Eastern	Western	U.S.	World	
Arugula	5	—	5	—	—	\$1000-\$1200
Broccoli raab	<20	—	<20	—	—	\$1000-\$1200
Endive	<20	<20	—	—	—	—
Lettuce	10	10	—	—	—	—
Rapeseed	60-75	—	60-75	—	—	—
Spinach	3000-4000	—	300-400 (O.P.) 2700-3600 (Hy)	75	50	\$1000-\$1200
Spinach mustard	5	—	5	—	—	\$1000-\$1200

### Biennial Brassicas

Each of these brassica seed crops is a biennial, planted in the summer and harvested the following summer or fall. Brussels sprouts, cabbage, and cauliflower are grown from seedlings that are transplanted in the fall (mid-August to mid-September) and harvested the following summer. Harvest is in mid-June or early July for Brussels sprouts, from July through September for cabbage, and in August for cauliflower.

Seedlings are grown either in high-density seedbeds or in greenhouses. Although it is uncommon, cauliflower can be direct-seeded. When this is done, seed is sown in April. Kale, collard, kohlrabi, rutabaga, and turnip are all direct-seeded. Collard, kale, kohlrabi and western Washington turnip crops are all planted in August; harvest occurs the following July or August. Turnip grown in eastern Washington is planted somewhat later in September or October. Rutabaga is planted between mid-August and mid-September and is harvested from mid-June through early July. Fields are hand hoed to control weeds and hand rogued to remove plants not displaying true varietal characteristics. In addition, turnip crops are mechanically cultivated as needed during the growing season. Typically, these crops are cut, windrowed, and left to dry in the field for 10 to 14 days before they are threshed. In eastern Washington, however, the mature turnip seed crop is threshed as it is cut. Seed is transported to a seed conditioning plant for final processing.

The most severe insect pest of biennial brassicas grown in eastern Washington is the cabbage maggot. Other insect pests include cabbage and turnip aphid, looper, cutworm, and sugarbeet leafhopper, which can transmit BLTVA. The severe insect pests of these crops in western Washington are cabbage and turnip aphids, seedpod weevil, and cabbage maggot. Other insect pests include cabbage looper, springtail, webworm, diamondback moth, cutworm, symphylans, and wireworm.

Weed pests common across the state are lambsquarters, pigweed, Canada thistle, and nightshade. Wild buckwheat, volunteer crops, foxtail, and barnyardgrass are problematic in eastern Washington. Shepherdspurse, mustard, smartweed, henbit, groundsel, chickweed, wild turnip, quackgrass, wild oat, bolt thistle, vetch, and bedstraw cause problems with western Washington crops. Shepherdspurse is the most difficult weed pest to control.

In eastern Washington, *Sclerotinia* causes the most significant disease problem for these crops. More diseases occur in western Washington; the most serious of these are powdery mildew, downy mildew, and those caused by *Alternaria* and *Sclerotinia*. Additional diseases are caused by *Cladosporium*, *Fusarium*, *Rhizoctonia*, *Stemphyllium*, *Pythium*, and *Phytophthora*. Kale, kohlrabi, rutabaga and turnip seed also are subject to black rot. Although no specific information is available for cress, the authors assumed this crop is subject to pests similar to those discussed above.

### Biennial Brassicas (Cruciferae)

Crop	Washington Acreage			Production %		Per-acre Value
	Total	Eastern	Western	U.S.	World	
Brussels sprouts	40	—	40 (Hy)	100	50	\$4000 (Hy)
Cabbage	700	—	350 (O.P.) 350 (Hy)	—	—	\$1500-\$2000 (O.P.) \$4500-\$6000 (Hy)
Cauliflower	5*	—	5 (Hy)	75	50	\$4000 (Hy)
Collard	58	38	20	—	—	\$1500
Cress	10**	—	10	—	—	—
		108		100		\$1500-\$2000

Kale	228	(O.P.)	120 (Hy)	(Hy)	—	(O.P.) \$4000 (Hy)
Kohlrabi	46	31 (O.P.) 10 (Hy)	5 (Hy)	—	—	\$1500-\$2000 (O.P.) \$4000 (Hy)
Rutabaga	60	—	60 (O.P.)	—	—	\$1200-\$1500 (O.P.)
Turnip	629	329	300	—	—	\$1200

\*30 acres a year is a more typical annual average.

\*\*Cress seed is typically only grown every other year.

## Other Brassicas

Broccoli and mustard seed are both annual crops that are planted early in April and harvested the first part of September. During the growing season, fields are hand hoed for weed control and also hand rogued to remove plants that do not display true varietal characteristics. At harvest, the crop is cut, windrowed, and left to dry in the field for 10 to 14 days. After drying, the crop is threshed, and the seed is sent to a conditioning plant for cleaning. Mustard seed is grown as an open-pollinated crop.

Cabbage and turnip aphids, as well as seed pod weevil and cabbage maggot, are severe insect pests. Other insect pests include the cabbage looper, springtail, webworm, diamondback moth, cutworm, and wireworm.

Weed pests include shepherdspurse, mustard, lambsquarters, pigweed, smartweed, henbit, groundsel, chickweed, wild turnip, quackgrass, wild oat, Canada thistle, bolt thistle, vetch, nightshade, and bedstraw.

The most serious diseases are powdery mildew, downy mildew, *Alternaria*, and *Sclerotinia*. Additional diseases are caused by *Cladosporium*, *Fusarium*, *Rhizoctonia*, *Stemphyllium*, *Pythium*, and *Phytophthora*.

Birds such as blackbirds and sparrows also are major pests.

### Other Brassicas (Cruciferae)

Crop	Washington Acreage			Production %		Per-acre Value
	Total	Eastern	Western	U.S.	World	
Broccoli	—	—	—	—	—	—
Mustard	250	—	250	—	—	\$1000-\$1200 (O.P.)

\*Both bulb and bunching (or green) onion seed are grown in Washington. In 1993, the onion acreage was divided as follows: 293 acres of open-pollinated bulb, 347 acres of hybridized bulb, and 109 acres of bunching onion seed.

**Seed Companies Operating in Washington**

---

**Alf Christianson Seed Company** was founded by Alf Christianson in 1926. The company operated initially in western Washington; however, in 1972, it expanded into eastern Washington with carrot and radish seed crops. Alf Christianson operations include seed production in Oregon, as well as limited production in California. Its Washington seed crops include spinach, cabbage, beet, carrot, radish, mustard, turnip, rutabaga, Swiss chard, and several herbs (parsley, dill, basil, cress, and arugula). Alf Christianson operates three seed conditioning plants in Washington – one in Quincy and two in Mt. Vernon, where the company is headquartered.

**Asgrow Seed Co.**, originally Associated Growers, was founded in the early 1900s and started with the production of cabbage seed on the East Coast. Asgrow was purchased by E.L.M in 1995. Asgrow's Washington vegetable seed production began in the 1930s. The principal Washington vegetable seed crops for the company include onion, carrot, spinach, beet, and cabbage. Currently, Asgrow conducts seed production operations in approximately half of the 50 states, producing grain and soybean seed as well as most vegetable seed. In Washington, Asgrow operates seed conditioning plants in Warden, and a production plant in Mt. Vernon.

**B&M Seeds, Inc.** started as a seed cleaning business in 1976 in Salem, Oregon. The company began seed production operations in 1990. B&M produces a variety of vegetable seed as well as flower seed in operations spread throughout Washington, Oregon, and Idaho. While no seed crops were grown in Washington in 1995, B&M has in previous years contracted acreage for both carrot and onion seed. Seed crops grown in Washington by B&M are trucked to the company's Salem, Oregon, facility for cleaning.

**Bakker Brothers** of Idaho is a division of the Dutch company Bakker Brothers, which has been in business for approximately 65 years. Operations in Idaho began in 1975 with bean seed, which remains the major Idaho vegetable seed crop for the company. The company also operates in California, Oregon, and Washington. Bakker Brothers began contracting acreage for onion and carrot seed in Washington 12 or 13 years ago. Previously, Bakker Brothers trucked its Washington seed crops to Caldwell, Idaho, for processing; however, for the last few years, Kapa Seed Services in Quincy, Washington, has been conditioning these crops.

**Betaseed, Inc.** was founded more than 200 years ago. The company specializes in sugar beet seed and, although sales outlets are located in several states, seed production occurs primarily in Oregon. For the past 3 years, Betaseed has contracted for sugar beet seed production in Washington; however, because the crop was not particularly successful, no acreage was contracted in 1995. Previous Washington seed crops were rough cleaned under contract with local seed conditioners before shipping to Betaseed's conditioning plant in Tangent, Oregon, for final cleaning.

**Daehnfeldt, Inc.**, a subsidiary of the 150-year old Danish company L. Daehnfeldt A/S, was founded 10 years ago in Albany, Oregon. Daehnfeldt produces both flower and vegetable seed throughout the western hemisphere. The resulting vegetable seed is marketed by both Daehnfeldt, Inc. and its parent company. Daehnfeldt produces vegetable seed in Oregon, Idaho, California, Arizona, and Washington. The major vegetable seed crops produced by the company in Washington are beet, carrot, and the brassicas. Daehnfeldt has no seed conditioning plant in Washington. Precleaned seed is transported to Daehnfeldt's Oregon facility for final cleaning.

**Dorsing Seeds, Inc.** was originally the Bill Wahlert Seed Co., founded in 1969. Originally based in Oregon, the company moved to Idaho in 1975. The name changed in 1980, when the company was purchased by Doug Dorsing. Dorsing Seeds has been contracting acreage in Washington since 1982. Currently, Dorsing also contracts acreage in Idaho, California, Oregon, Nevada, and Arizona. Dorsing's Washington operations are limited to the Columbia Basin, where major crops are the brassicas, radish, carrot, endive, and some flower seed. Dorsing operates a seed conditioning plant in Othello, Washington.

**The Ferry Morse Seed Company** is the oldest seed company in the United States, founded in Detroit, Michigan, by DM Ferry in 1856. In 1929, the original company merged with the California-based company founded by CC Morse and AL Kellog in 1877. This merger created the Ferry Morse Seed Company. Initially, the company produced and marketed both vegetable and flower seed; now, however, flower seed is the business of Ferry Morse's sister company Advanced Seed. Ferry Morse contracts for vegetable seed production across the United States and in France, China, Thailand, Australia, India, South Africa, and Chile. The company has been operating in Washington for 40 years, producing beet, bean, spinach, Swiss chard, onion, and carrot seed. Ferry Morse has no seed conditioning plant in the state. Crops are either cleaned under contract with a local custom cleaner or are trucked to the Ferry Morse facility in Hansen, Idaho.

**The Harris Moran Seed Company** is the result of a merger some 15 years ago between the Harris Seed Company (founded in New York more than 100 years ago) and the Moran Seed Company (founded in California in the 1960s). The company now contracts for vegetable seed production worldwide. In the United States, seed crops are grown in Washington, Idaho, Oregon, California, and Arizona. Vegetable seed is also produced by Harris Moran in South America and in the Far East. The company first began seed production in Washington in 1986 and now contracts for bean and corn seed, as well as radish, onion, and carrot seed. All seed grown in Washington is transported either to Idaho or California for processing.

**Hulbert Farms**, headquartered at Mt. Vernon, produced its first seed crop in 1917. The company had been a seed production company with operations limited to contracting acreage in western Washington for flower and vegetable seed. In 1990, with the completion of a seed conditioning plant, *Skagit Seed Services* was formed as a new business venture. Skagit Seed Services now offers a full line of seed services including treating, coating and pelletizing, and seed cleaning. The primary seed crops are beet, cabbage, spinach, Swiss chard, and radish.

**International Seed Services, Inc.** began business in 1989. Although originally headquartered in Salem, Oregon, the company's main office now is located in Corvallis, Oregon. The company has been contracting acreage in Washington since its inception. International Seed Services' principal Washington seed crops are daikon radish, onion and carrot. In Oregon, some pea and flower seed is produced as well. International Seed Services does not operate a seed conditioning plant in Washington. Crops produced here are either contract cleaned at a local facility or are trucked to Oregon for processing.

**Kapa Seed Services** originated as Valley Grain in 1979. The company was involved initially in grain crops but began in 1986 to contract acreage for vegetable seed production. The name change, to Kapa Seed Services in January 1995, was made to reflect the change in emphasis from grain to vegetable seed production.

With headquarters in Quincy, Washington, Kapa confines its vegetable seed business to eastern Washington, producing mainly carrot, onion, turnip, and radish seed crops. Kapa operates a seed conditioning facility in Winchester, Washington, near Quincy.

**Northwest Seed, Inc.** began 6 years ago in Quincy, Washington. The company, operating exclusively in eastern Washington, contracts mainly for carrot, radish, and onion seed. Northwest has no seed conditioning plant of its own. Seed is cleaned under contract at a local facility.

**PetoSluis Seed Co.** originated in California in 1951 and now operates in 11 countries outside the United States. PetoSluis was purchased in 1995 by E.L.M. In the United States, PetoSluis contracts acreage in Oregon, Idaho, California, Arizona, and Washington. Seed production operations began in Washington in 1973. The primary crops now grown in the state are onion, cabbage, spinach, beet, radish and carrot seed. In California, squash, cucumber, cantaloupe, and watermelon are the primary seed crops; onion and carrot are the main seed crops produced by PetoSluis in Oregon and Idaho. PetoSluis has no seed conditioning plant of its own in Washington. These services are, for the most part, provided by Skagit Seed Services. Some seed is trucked to California for conditioning.

**Pioneer Seed**, founded by Henry Wallace in 1926, specializes in hybrid corn seed. While this remains the company's primary business, small-seeded vegetable seed is now also grown by Pioneer in Idaho, California, Washington, and locations outside North America.

**Quincy Farm Chemicals**, initially selling fertilizer and other agricultural chemicals, began business in the 1950s. In the early 1960s, the company expanded to include vegetable seed production. Quincy Farm Chemicals' vegetable seed production is limited to Washington and centers on radish and carrot seed. The company also produces wheat and barley seed; however, its primary business remains the sale of agricultural chemicals. Quincy Farm Chemicals operates a seed conditioning facility in Quincy, Washington.

The **Rogers Seed Company**, as Northrup King, began in 1884 in Minneapolis, Minnesota. Operations in Washington began in the 1930s with cabbage and beet seed. In 1993 the parent company, Sandoz, consolidated its small-seeded vegetable seed business under the name Rogers Seed Company with headquarters in Boise, Idaho. Northrup King, once a full service seed company, is now involved primarily with field corn and soybean seed production. Rogers produces vegetable seed in Idaho, Oregon, California, Washington, and Arizona, as well as in France, Italy, Chile, New Zealand, and China. The main Rogers crops grown in western Washington are cabbage, Brussels sprouts, radish, spinach and cauliflower (all hybrids). In eastern Washington, Rogers contracts for hybrid carrots and open-pollinated radish seed. Rogers sold its La Conner seed conditioning facility in 1994. Crops grown in western Washington are still scalped and dried under contract at this facility; however, they are now shipped to a Rogers facility in California for final cleaning. Seed crops grown in eastern Washington are conditioned at the Rogers facility in Othello.

The **Shamrock Seed Company** has been headquartered in Salinas, California, since the company was founded in 1983. Shamrock contracts for seed production in the United States in California, Idaho, Arizona, Oregon, Washington, and Colorado,

and worldwide in China, India, Taiwan, Australia, Italy, Argentina, Chile, Mexico, and France. Operations in Washington began about 1985. Major crops in the state now include carrot, parsley, onion, and radish seed. Shamrock has no seed conditioning plant in Washington; crops grown in the state are either trucked to California to be conditioned or, more commonly, are cleaned under contract with a local seed conditioning plant. Shamrock Seed Company, for the most part, specializes in carrot, melon, and onion seed production.

**Sunseeds** operates in California, Oregon, Idaho, and Colorado and has been contracting acreage in Washington since about 1985. While Sunseeds has not contracted acreage in Washington since 1993, its primary crops previously were onion and carrot seed. Sunseeds has no seed conditioning plant in Washington. Crops produced in the state are trucked to either California or Idaho for cleaning.

The **Waconda Seed Company** was formed in 1979 in Oregon and expanded its operations to include Washington in the mid-1980s. Waconda contracts acreage in western Washington but is not active in the Columbia Basin. Primary Washington crops for the company are lettuce and carrots. Other small-seeded vegetable seed production in Oregon includes cabbage, radish, and parsnip. Seed crops produced in Washington are shipped to Waconda's Oregon facility for conditioning.

**Weaver Seed** was founded in 1980 in Shedd, Oregon. Weaver now contracts for vegetable seed production in Oregon, Washington, Idaho, California, and New Zealand. Weaver's Washington operations began in 1983 or 1984. The primary crop grown in Washington is turnip seed. In general, Weaver contracts for brassica seed in Oregon, radish in Idaho, and peas and oats in California and New Zealand. Because Weaver does not operate a conditioning plant in Washington, seed crops are transported to Oregon for cleaning.

**Wilbur-Ellis** is an agricultural chemical business founded approximately 60 years ago. The seed production portion of the business originated in Washington in the late 1970s; however, this remains a limited part of the company. Currently, the only seed crop produced by Wilbur-Ellis in Washington is radish seed. Additional radish seed production occurs in Oregon. Wilbur-Ellis has no seed conditioning plant of its own. Seed conditioning is done under contract with other companies.

No information is available regarding **Vikima's** Washington vegetable seed operations at this time.

**Zwann Seeds, Inc.** was founded by John Zwann in 1934. The company was originally based in Pennsylvania but moved to New Jersey in 1979, when company ownership changed hands. Zwann operates in California, Oregon, and New Jersey, and has been contracting acreage in Washington since the early 1970s. The major vegetable seed crops grown in Washington are the brassicas, radish, onion, and spinach. All Zwann's Washington seed crops are cleaned in its Mt. Vernon seed conditioning plant.

---

Prepared by Jane Thomas, M.S., Washington State University Pesticide Notification Network coordinator,

Pesticide Information Center, WSU Tri-Cities Food and Environmental Quality Laboratory;  
Alan Schreiber, Ph.D., WSU Agrichemical and Environmental Education Specialist, WSU Tri-Cities Food

and Environmental Quality Laboratory; Gary Pelter, M.S., WSU Cooperative Extension area agent,

Grant and Adams counties; and Dyvon Havens, M.S., WSU Cooperative Extension agent, Skagit County.



College of Agriculture and Home Economics

© 1997 by Washington State University Cooperative Extension.

You may reprint written material, provided you do not use it to endorse a commercial product.

Issued by Washington State University Cooperative Extension and the U. S. Department of Agriculture in furtherance of the Acts of May 8 and June 30, 1914. Cooperative Extension programs and policies are consistent with federal and state laws and regulations on nondiscrimination regarding race, color, gender, national origin, religion, age, disability, and sexual orientation. Evidence of noncompliance may be reported through your local Cooperative Extension office. Trade names have been used to simplify information; no endorsement is intended. Published April 1997. Subject code 260. B. EB1829