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Horticultural highlights

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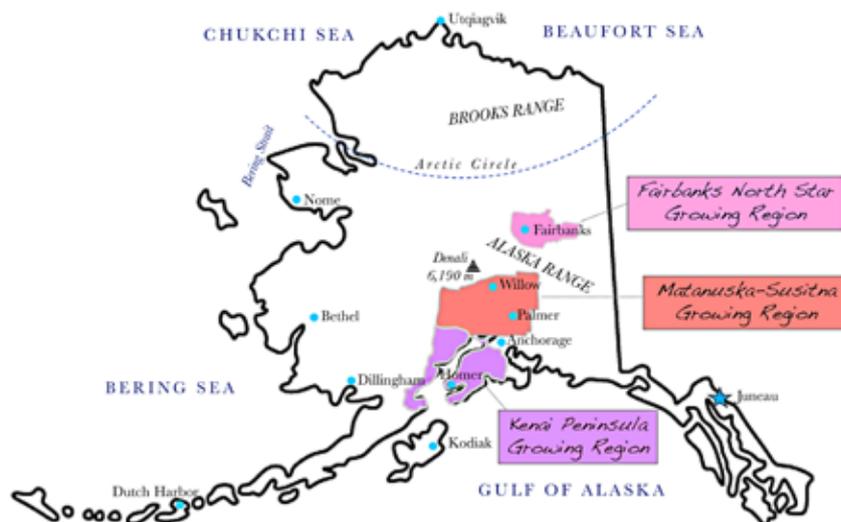
› Peonies as field grown cut flowers in Alaska

Patricia Holloway

Alaska is known more for its oil, fisheries, and tourism industries rather than horticulture. Our tiny population of 740,000 people scattered over nearly 172 million ha of land, yields a patchwork of small farms, market gardens and greenhouses whose markets are mostly local sales, farmers markets, and limited sales to grocery stores and restaurants. However, since 2004, Alaskans have joined the ranks of horticultural exporters based on a most unlikely crop for a subarctic climate – peonies as fresh cut flowers! Here is our story.

The industry

Peonies have been grown as a garden flower in Alaska since the early 1900s, after the Klondike and Alaska Gold Rush brought thousands of people North to seek their fortunes. Peonies were planted occasionally in home gardens, but the roots were difficult to keep alive during transport to Alaska. Once planted, they often were killed by lack of snow cover, severe cold, winter freeze-thaw cycles, and soils that sometimes remained permanently frozen year-round. Not until the 1970s were formal ornamental research trials conducted at the Fairbanks Agricultural and Forestry Experiment Station, University of Alaska Fairbanks (UAF), to identify hardy species and cultivars as home landscape plants. *Paeonia tenuifolia*, *P. anomala* and cultivars mostly in the Lactiflora Group were found to be hardy, at least



› Alaska peony growing regions. Source: Alaska Department of Natural Resources, Division of Agriculture.

with snow cover. The early trials showed that species peonies bloomed in late May and early June, but many of the Lactiflora and Herbaceous hybrids did not bloom until July and August. In the Alaskan cool southern coastal regions, bloom season extended into late September. Because Alaska had no horticultural exports of any kind, researchers and growers were unaware of the unique bloom time of peonies and how it might be used to support an

industry. Only after Oregon peony grower and cut flower exporter, Mr. Paul Sansone, visited Alaska in the mid 1990s, did we learn of this unique, potentially rich niche market for Alaska growers. In 2001, our first research plots were planted at the UAF Agricultural and Forestry Experiment Station to learn if peonies could be grown as cut flowers, discover how to grow them, explore potential markets, and help develop the infrastructure for Alaska's first horticultural export crop. Early field studies were promising, so much so that orders for peony stems began to arrive even before there were farmers to fill them. One buyer in London offered to purchase 100,000 stems per week for the entire summer season, only to find out peonies existed solely in research plots at UAF. Alaskan growers were skeptical about trying peonies, because no one had experience in an export flower market, and startup costs to establish a peony farm in Alaska were substantial (root prices alone averaged \$3.00 per plant with desirable cultivars listed at \$10-25 wholesale). Growers and researchers alike needed to learn how to grow peonies as cut flowers, identify locations in the state where they might grow, and which environmental and economic parameters might challenge the success of this industry.

In 2004, four growers planted the first trial gardens. Based upon their success, interest



› Interior Region – Far North Flowers, Fairbanks, Alaska. Submitted by Nate & Krista Heeringa.



› Kenai Peninsula Region – Frosty Acres Peonies, Homer, Alaska. Submitted by Robert Klemke.



› South Central Region – Wasilla Lights Farm, Wasilla, Alaska. Submitted by Kelly Dellar.

expanded, and new growers organized the Alaska Peony Growers Association to share successes and failures. Early communication among researchers and growers provided a critical link to success especially considering the size of the State and the distances among farms. The number of farms steadily grew, and currently, there are 136 peony farms in Alaska. They range in size from 0.10 to 6 ha.

Farm locations

Farms are located primarily in three regions: Fairbanks (64.8378°N, -147.7164°W) and vicinity in the Interior Region; the South Central Region near Palmer (61.5997°N, -149.1128°W); and the Kenai Peninsula Region with the southernmost farms located in Homer (59.6425°N, -151.5483°W). The major population centers of Anchorage and Fairbanks occur within these regions, and are the center for ground, air and rail transportation. They are connected to the third largest air transport hub in the world through Anchorage, which provides easy access to world markets in Europe, the Middle East and Asia. Cut flower production ranges from 100 to 70,000 harvestable stems per farm. Growers must wait 2-5 years after planting before harvesting their first crop, and many growers are still in the early stages of field establishment. Other farms are expanding slowly after early successes. In 2018, 350,000 fresh cut stems were sold. In 2023, predicted sales will approach 2 million stems. Although tiny compared to well established agricultural regions of the U.S., Alaska is poised to become a major player in the multi-billion-dollar fresh cut flower industry. The industry has overcome major obstacles in growing a commercial crop where none had existed previously. Progress has been slow

and steady as growers identify field management practices appropriate for Alaska, work to identify disease, weed and insect pest pressures, develop marketing plans and educate buyers of this new availability. Alaska already has earned a reputation for high quality, huge flower buds with a superior vase life.

Production

Climate and weather

The three peony producing regions are composed of distinct climate zones. The Interior Region is continental: warm and dry in summer with long, cold winters (average temperature 12.7°C, May-September, -10.7°C in winter). Summer high temperatures often reach into the 20 to 30°C range, while winter temperatures occasionally drop into the -40 to -50°C range. Peony production is possible only with ample snow cover (average annual snowfall, 1.65 m) or other winter protection such as straw mulch. In the past 40 years, 100% of peony roots were killed twice at UAF due to a combined lack of snow and very cold temperatures. Growing seasons are dry (average annual precipitation, 276.8 mm with 180.3 mm summer rainfall) necessitating season-long irrigation.

The Kenai Peninsula Region is a maritime climate: cool in summer and moderately cold in winter (average temperature 9.6°C, May-September, -1.7°C in winter). Summer high temperatures reach into the 15 to 25°C range in Homer. Snowfall can be heavy (average annual snowfall, 1.2 m) but also periods of freezing and thawing in winter can cause problems with peony production especially if the soils are too wet. Site selection in this region is critical to prevent winter kill from root rot.

Soils often freeze, but a mid-winter warm spell can cause surface soils to thaw with saturated soils above a layer of ice. Roots in the upper layers will rot in winter. Repeated freeze-thaw actions also cause frost heaving of roots. Most precipitation occurs during the winter months (average annual precipitation, 645 mm with 233 mm average rainfall in summer). Like other regions, all fields are irrigated.

The South Central Region has a cold, temperate climate, warmer in summer than the Kenai Peninsula, but cooler than the Interior Region (average temperature 10.9°C, May-September, -5.5°C in winter). Some areas have deep winter snows (average annual snowfall, 1.4 m), whereas others have very strong winds that remove snow cover and desiccate the fields. The same freeze-thaw problems and frost heaving that occur on the Kenai Peninsula are common. Average annual precipitation is 406.6 mm; 286 mm in rainfall in summer. Like the other regions, nearly all peony fields are irrigated at least for the first part of the summer. This region also hosts Alaska's major commercial vegetable production.

The greatest number of peony farms is in the Interior Region, in part because of the availability of farmland. The Kenai Peninsula Region has the oldest peony farm, but appropriate land for peony farming is limited, and they tend to be quite small in size. In the early years, cut flower harvest began in the warm Interior Region (late June – mid July) followed by South Central Region (early July – mid August) and the Kenai Peninsula (mid July – September) with slight overlap among the regions. More recently, summer conditions have been unpredictable with the Kenai Peninsula showing warmer, drier con-

ditions and a greater overlap with Interior cutting seasons.

Production systems

Most peony roots are imported from the Netherlands or from distributors, growers and breeders in the contiguous United States. Some root suppliers in the U.S. purchase starter roots from the Netherlands, grow them two years, then re-sell them to meet the 3- to 5-eye standard for bud quantity.

'Sarah Bernhardt' is the most frequently planted cultivar followed by 'Duchess de Nemours', 'Festiva Maxima', and 'Felix Crouse'. 'Sarah Bernhardt' is one of the few peonies requested by name by florists and other direct consumer outlets. 'Duchess de Nemours' is a standard white cultivar, but it has a very short harvest window once buds begin to soften. They also continue to open easily in cold storage if low temperatures are not maintained. Many other cultivars, particularly full double, semi-double, bomb and Japanese cultivars, are sold in smaller quantities as experiments. Most Intersectional (Itoh) hybrids have a very short vase life and are not grown as cut flowers. Single petaled peonies release copious quantities of pollen in late bloom and are not as desirable as flowers with fewer anthers. Originally, growers believed that the double and semi-double cultivars would have a longer vase life than Japanese or singles, but vase life is more related to cultivar rather than type.

Summer sales volume ranked by color include: white, 'Sarah Bernhardt' pink, red, blush pink, bright pink (fuchsia), cream and coral. Coral-colored peonies would rank higher by volume, but they are susceptible to winterkill in many parts of the State and are grown only in certain geographic locations. Demand for corals far exceeds supply.

Field planting

Peonies are planted in single or double rows with a minimum spacing between plants of 60 cm. Between-row spacings depend on the harvest method. All harvesting is by hand, and growers use everything from garden carts to tractor-pulled trailers to move flowers from the field to cold storage. Growers strive to allow no more than one hour between cutting and placement of flowers into cold storage.

Growers use flat or raised beds (15-25 cm) with sufficient spacing between rows to allow picking from two rows at once. Rows spaced 2 m apart or closer often are trellised to allow easier harvesting especially for the robust 'Sarah Bernhardt'. In large producing regions, rows can be hundreds of meters in length with runners employed to transport hand-held bundles of flowers to waiting trailers and trucks. On small Alaska farms where

labor is in short supply, rows often are shortened to 8-10 m sections with aisles bisecting the rows. A single harvester can cut and hold a bundle of flowers the length of these short rows, then place the flowers in carts at the end of the short rows, thus eliminating runners.

Many organic farms use woven or spun-bonded landscape fabric to cover rows for weed control. Irrigation is accomplished with trickle tape placed beneath the fabric or larger emitters spaced at each planting hole. The tapes can last for years, but can be destroyed by vole chewing the tapes or moose stepping on them any time of year. Plants up to five years of age do not often show water stress except in very dry years or on sandy soils. As the plants mature and increase in size, water deficiencies in the form of stunted stem growth and curled leaves (lengthwise with the midrib) become common especially in the Interior Region. Summer irrigation significantly increases stem length, but has no effect on eventual vase life.

Soils in all regions vary significantly in pH and many require additions of agricultural lime before planting and occasionally thereafter. Fields are fertilized once in early summer and again only if the plants show deficiency symptoms. Most Alaska soils are infertile and require complete fertilizers for optimum production. Dr. Mingchu Zhang (Soil scientist, University of Alaska Fairbanks, Fairbanks, AK) has developed tissue diagnostic tests for evaluating the health of peony plants.

Growth and harvesting

Peony growth is quite rapid depending on the air and soil temperatures. In the Interior Region, flowers reach harvest date approximately 30 days after buds emerge from the soil. The season is longer in coastal areas with a cooler climate. Besides hand or chemical weeding, the first important labor demand is disbudding. Many cultivars of peo-

nies produce a single large terminal bud, but the majority of cultivars also produce two or more lateral buds. Some growers are experimenting with leaving the side buds in place, but most side buds are removed as soon as they can be reached and before they leave an unsightly stub.

Peonies are harvested by hand using knives or clippers. With a few exceptions, stems exceed 60 cm in length at harvest. Depending on the vigor of the plant, up to two-thirds of the stems with buds are cut from each plant. Removing too many stems, especially on cultivars that produce fewer than 10 stems per plant, can lead to a reduction in yield in subsequent years.

The most challenging part of harvesting peonies is learning the correct stage for each cultivar. Most references describe cutting at the "marshmallow" stage, which is not a very helpful description. Two things determine proper cutting stage: cultivar and market. Harvest flowers too early when sepals completely cover the petals, and the flower will not open. Wait until the petals have begun to separate, and buds may blow open in cold storage, and vase life may be shortened. Growers identify stages based upon environmental conditions at their farm as well as the cultivar, then test the stages by performing vase life evaluations to make sure they cut at the optimum stage. Red cultivars usually have softer buds than pink or white cultivars. Some cultivars such as 'Ann Cousins' are notorious for being difficult to harvest, relying on slight color changes and softening of the petals.

In general, when sepals separate, peony petals show true color, and the buds begin to soften, harvest begins. In the North, where daylight can reach nearly 24 hours, harvesting occurs nonstop for 12-14 hours per day. If the markets are wholesale distributors or if they require long distance transport, buds



▶ Alaska's oldest peony farm, Alaska Perfect Peonies. Submitted by Rita Jo Shultz.



› Peonies from Pioneer Peonies, Wasilla, Alaska. Top to bottom, right: ‘Dr. Alexander Fleming’, ‘Boule de Neige’ and ‘Sarah Bernhardt’. Submitted by Denise Bowlan.

are harvested tighter than if sold to local farmers markets.

Peonies should never be sold in full bloom even for local markets because vase life will be very short.

Diseases, insects and other challenges

In other parts of the world, peony fields remain productive for ten or more years. The oldest fields at the University of Alaska are 18 years old and continue to yield well. As fields become established, several pests and diseases emerge even in areas where agricultural crops have never been grown before. The most significant problem is *Botrytis* gray mold diseases that impact young emerging shoots, maturing foliage and flower buds, as well as cut flowers in cold storage. Early assessments identified *B. paeoniae*, *B. cinerea*, and *B. pseudocinerea* as common disease-causing species, but recent research by Drs. Gary Chastagner and Andrea Garfinkel (Plant pathologists, Washington State University, Puyallup, WA) revealed an amazing genetic diversity including up to 16 phylogenetic species in the Pacific Northwest alone. The pathogenicity of these species as well as the efficacy of current control measures are being studied.

Control measures include fungicides, wide plant spacings to promote air circulation and reduce leaf wetness, and field sanitation. One often overlooked method of transmission of *Botrytis* in a field is during petal fall. If old flowers are not removed, petals landing on leaves can provide food for germinating spores that can, in turn, infect the

leaves. Fields are also cleaned of all foliage and stems at the end of the season, and stubble is often burned to prevent disease resting structures from persisting in the field over winter.

Tobacco rattle virus (TRV), also known as peony ringspot or peony mosaic, appeared early in Alaska peony fields – imported on infected rootstock. The brilliant yellow rings, spots and chevron-type patterns that show up on the leaves usually appear seasonally after harvest. Depending on the air temperature, they can appear early and significantly impact cut flower quality. Cool air temperatures promote the symptoms. Plants are not inspected for TRV, and there is no existing quarantine. In some commercial fields, up to 50% of the roots imported to Alaska have shown TRV depending on the root supplier. Some TRV isolates are transmitted by nematodes that are not known to survive in Alaska. However, TRV persists in the plant. Besides striking color patterns in the leaves, nothing is known about TRV effects on yield or plant longevity. Dr. Chastagner found that TRV did not affect vase life of ‘Sara Bernhardt’ peonies. The only management is to rogue out the affected plants.

Three other fungal pathogens were found by Drs. Chastagner and Garfinkel in Alaska, but they are not as common or as widespread as *Botrytis* and TRV: red spot or licorice spot disease, *Mycocentrospora acerina*, white mold or leaf spot, *Sclerotinia sclerotiorum*, and *Phoma* sp. Very little information is available regarding the biology, spread, and management of these pathogen on peonies. They are managed with fungicides and sanitation.

Peonies and nectar flow

Approximately two weeks before anthesis, nectar flow begins on peony buds. There are no well-defined extra-floral nectaries on peonies, but the sugary exudate oozes from the red edges of the sepals. The nectar beads up along the edges of the sepals, spills out over the buds, covering all surfaces and collects at the base of the sepals. In seasons with no rainfall, the buds can become so sticky, they make harvesting very difficult. Even walking through the closely-spaced field can be a challenge. The nectar also attracts a variety of insects including ants, honey bees, bumble bees, wasps, hornets and aphids. Most do no harm to the peonies but can be a nuisance for workers.

In humid and rainy parts of Alaska, a black, sooty mold fungus grows on the nectar, especially the quantities that collect at the base of the flower bud. The buds must be pre-treated with a fungicide or individually washed after harvest to remove this mold before sale. Some growers include honey bee hives in their peony fields, and they are very efficient at collecting the nectar and minimizing the mold problem. Sooty mold is a problem in the South Central and Kenai Peninsula Regions, but not Interior Region. Occasionally, aphids will appear on peonies but mostly in fields surrounded by birch trees (*Betula alaskana*). Two significant insect pests are thrips and lygus bugs. Thrips cause bud distortion, bud abortion, flower drop and bruising on petals. Up to 12 species of thrips have been identified including western flower thrips that can cause flowers to be rejected during inspections for foreign shipments. Dr. Beverly Gerdeman (Entomologist, Washington State University, Mt Vernon, WA) has shown



› Peonies in on-farm refrigerator. Fox Hollow Peonies, Nenana, Alaska. Submitted by Wanda Haken.

that thrips migrate from weedy areas at the edges of the fields beginning in mid-May when plants are only 7-10 cm tall. Thrips first settle between the bracts and sepals or between sepals and petals of early stage buds. From these protected locations, thrips lay eggs and progressively move further into the bud as the bud slowly opens. Damage is early in the life of the flower and internal making control very difficult. Although the damage to peonies is most visible on white-flowered cultivars because of the bruising and scarring caused on petals, thrips do not discriminate based on color.

Lygus bugs appear in early May, but the greatest infestations begin in June. They have piercing, sucking mouth parts that can cause bud deformities and bud abortion. Both thrips and lygus bugs are managed with insecticides, weed control, use of fabric weed barriers and field sanitation.

Other losses to fresh cut peonies may be caused by hail especially during end-stage bud development, crooked stems due to weak or rapid shoot elongation; and a physiological disorder called cabbage heads where the guard petals are shorter than normal and flowers are flattened. The cause of cabbage heads is unknown, although cultivars vary in susceptibility.

Storage and postharvest handling

Peonies are harvested and immediately placed into cool rooms (approximately 10°C) to remove field heat. As soon as possible, stems are cut to length depending on the buyer (~60 cm) and graded according to bud size (AAA: 45 mm, AA: 40 mm or A: 35 mm diameter). The lower two or three leaves are removed. Stems are stored dry in buckets or crates or stacked on shelves in cold rooms (0.5-1.0°C; >80% relative humidity). Cut stems stored in water will continue to open in the cold room. Herbaceous peonies do not release large quantities of ethylene, and chemical preservatives such as sucrose, citric acid, do not extend vase life.

They can be stored up to four weeks without losing flower quality, although leaves will dehydrate even at high humidity. Research with controlled atmosphere storage is occurring in France, the Netherlands and the United States to learn if longer term storage is possible.

Prior to shipment, stems are re-hydrated in warm water for 15-30 minutes. Stems may be bundled into sets of five, or held in large upright bundles for transport depending on market demand. Flowers are packed into boxes lined with newsprint or dacron® sheets. Ice packs are often included, but temperature effects only last a maximum of 10 hours in transit.



› Peony field with landscape fabric for weed control. Funny River Peonies, Soldotna, Alaska. Submitted by Denise Carey.

Peony markets

Fresh cut peonies in Alaska sell for \$1.00 to \$7.00 per stem depending on the market. The highest dollar value is for coral colored peonies. Alaska growers either work independently or sell as part of a pack house or cooperative. Pack houses have a single owner who may or may not be a grower. The owner buys directly from nearby farms to increase volume, but sales are from the owner's company. Cooperatives are collectively owned by member farms, and they work together to sell, pack and distribute flowers. There are six pack houses/cooperatives in Alaska with five to 20 participants in each.

The markets are diverse and include farmers markets, direct sales to consumers, florists and funeral planners, bulk sales through grocery stores, regional wholesale houses, floral distributors, and event planners. Some growers work with a single buyer, however most work with a mixture of buyers such as local farmers markets, floral distributors and florists. Although an export is most commonly considered a foreign market, Alaska distinguishes foreign and domestic exports to other regions of the United States, because the distribution and handling are often similar. With the exception of California, Alaska peonies move freely among States with no inspection or permit requirements. Like many cut flower growers worldwide, a major concern is maintaining a cold chain from field to buyer. Shipping peonies during the hottest part of the summer with carriers that don't always respect the perishability of cut flowers, is always a challenge.

Both domestic and foreign exports are critical to the continued growth of this industry because Alaska's population and local markets are very small. Presently, all domestic and foreign exports are carried by air transport. As the volume of flowers increases, growers will employ barge shipments with

refrigerated vans from Anchorage as well as refrigerated truck shipments through Canada. The grower's biggest challenge is educating domestic and world markets that field grown, fresh cut peonies from Alaska truly are available in July, August and September. In 2018, Dutch sales exceeded 78 million peony stems, and Alaska sales have not reached one million. There is definitely room to grow! 🍀



› Patricia Holloway

› About the author

Patricia Holloway is Professor Emerita of Horticulture at the University of Alaska Fairbanks. She conducted horticultural research in Fairbanks for more than 30 years on a diversity of crops, especially Alaska wild berries. Her research with peonies was instrumental in providing the foundation for the cut flower industry in Alaska. Presently, she is a horticultural consultant for the peony industry and book publisher through her company, A.F. Farmer, LLC. E-mail: psholloway@alaska.edu