Holloway, P. 2012. Horticultural Crop Production for Alaska. Cooperative States Research and Extension Service HATCH report Acc. 0190422

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PROJ NO: ALK-08-01 **AGENCY:** NIFA ALK
PROJ TYPE: HATCH **PROJ STATUS:** EXTENDED
START: 01 OCT 2007 **TERM:** 30 SEP 2013 **FY:** 2011

INVESTIGATOR: Holloway, P. S.

PERFORMING INSTITUTION:
High Latitude Agriculture
UNIVERSITY OF ALASKA
FAIRBANKS, ALASKA 99775

HORTICULTURAL CROP PRODUCTION FOR ALASKA

CLASSIFICATION			
KA	**Subject**	**Science**	**Pct**
205	2120	1060	20
205	2121	1060	20
205	2123	1060	20
205	2160	1060	20
205	1199	1060	20

CLASSIFICATION HEADINGS: R205 . Plant Management Systems; **S2120** . Herbaceous perennials and decorative greens; **F1060** . Biology (whole systems); **S2121** . Cut flowers, foliage, and greens; **S2123** . Bedding/garden plants; **S2160** . Arboreta and botanical gardens; **S1199** . Deciduous and small fruits, general/other

BASIC 000% **APPLIED** 100% **DEVELOPMENTAL** 000%

NON-TECHNICAL SUMMARY: Horticulture is the largest agricultural industry in Alaska amounting to more than 80 percent of cash receipts for all agricultural crops in the state and 40 percent of all agricultural commodities including aquaculture, livestock, and agronomic crops. The value of major horticultural crop plants in the most populated areas of Alaska is estimated at $20 million. Four horticulture specialties are emerging as the most important research focus areas to support commercial enterprises in Alaska: organic and sustainable horticulture; controlled environment horticulture especially season extension and moderation using high tunnels; field-grown cut flower production and Alaska wild berry cultivation and management for food and neutraceutical industries.

OBJECTIVES: The objectives of this research program are three-fold: 1) to evaluate annual flowers. vegetables and perennial landscape plant materials from commercial sources, botanical gardens and wild collections; identify plants suitable for use in the greenhouse/nursery/landscape industry through multi-year trials; 2) to conduct experiments with field-grown peonies for fresh cut flowers for export markets; and 3) to establish cultivated fields for lingonberry and Alaska bog blueberry (Vaccinium vitis-idaea and V. uliginosum, respectively) and evaluate wild-collected germplasm for it value in fruit production in Alaska.

Cooperative species and cultivar testing programs were conducted with the NC-7 Regional Plant Evaluation pgm, the Hardy Fern Fdn, the USDA National Clonal Germplasm Repository and commercial seed companies. Plants included Alaska native and introduced species for home landscapes, roadside revegetation projects and wildflower meadows. Collections were evaluated for hardiness ratings of plants and cultivar. Results were disseminated through annual reports to the cooperators, annual Experiment Station (AFES) variety trial reports and in public display gardens. Propagation protocols for stem cuttings of Alaska native plants was initiated to establish hormone treatments and timing of cutting collection. All data were incorporated into an undergraduate plant propagation class. Data were part of two undergraduate research projects and were presented as posters at the American Society for Horticultural Sciences annual meetings, in a journal article (J Env Hort) and in twelve one-on-one grower workshops. It resulted in established grower protocols for propagation. Data on germination of sedges published in an AFES leaflet and research report, completely changed the protocols for revegetating reclaimed gravel pads in Prudhoe Bay oil fields. Field trials for market gardens were conducted on heated vs unheated irrigation water and on a variety of vegetable and herb cultivars. . Data were shared with growers and in annual public garden tours, through annual AFES trial reports, and numerous discussions with individual growers. It resulted in increased diversity of adapted cultivars and changes in irrigation practices on farms. Research was conducted on peony cultivar evaluation, economics, phonological development, soil amendments, spacing, shading and cut flower productivity and quality. This research resulted in creation of a new industry for Alaska in specialty cut flower exports. Data were disseminated at annual peony grower meetings, at two ASHS meetings, numerous field visits, and numerous public service announcements. One master's thesis was written on the economics of peonies. Selections of wild blueberries were collected from wild stands that had superior fruit yield, size and shape. Cuttings were rooted for further evaluation of these wild selections in cultivated fields for use in commercial bog blueberry production. Pollination biology studies were conducted on the bog blueberry to identify wild pollinators. This research was presented as an ASHS poster as well as direct field work with a commercial blueberry growers. Two masters theses resulted from pollination research.

KEYWORDS: horticulture; herbaceous perennials; annual flowers; peonies; cut flower production; lingonberry; bog blueberry; tissue culture; Alaska; winter hardiness; pollination, insect pollinators,

OUTPUTS: **Vegetables**: 'Provider' snap beans grown on soils with heated irrigation water using a solar water heater did not differ significantly in yield from snap beans grown with unheated water (0.34 lb/ft and 0.28lb/ft, respectively). The slight differences may be due to the relatively few days of irrigation in 2011. No differences were recorded in soil temperature. Recommended vegetables for market gardens include: summer squash, 'Cube of Butter' (13 lb/ft); spinach 'Early Hybrid #7' (1.22 lb.ft) as a replacement for 'Melody'; 'Evergreen Bunching' and 'Parade' onions; cauliflower, 'Goodman' and 'Igloo' (1.25 - 1.35 lb/plant); broccoli: 'Arcadia' carrots, 'Tendersweet' and 'Sweetness II'; 'Varna' and 'King Richard' leek. In trials of heirloom vegetables. there were no significant differences among tested cultivars of beets, broccoli 'January King' type cabbage, cucumbers and Hubbard type winter squash. Recommended cultivars include heirloom 'Boston Marrow' winter squash, modern hybrid cabbage, 'Tobia' and 'Lincoln' pea (modern). Trials with coriander showed that plants could be grown for seed, both using Cilantro-types of cultivars as well as those bred specifically for oil seed production. Three thousand **annual flower** cultivars were rated for quality of flowers and foliage, disease incidence, and display throughout the season. There were 105 top performers, and the list is available at http://www.georgesonbg.org/research/annuals/Bestflowers.html. Two hundred species and cultivars of medicinal and edible herbs were rated for vegetative growth, quantity of harvestable parts, and taste/use. Top performers were 'Kung Pao' hybrid pepper, green perilla (Perilla frutescens), garlic chives (Allium tuberosum), Vietnamese coriander (Polygonum odoratum), and white sun-drop (Oenothera speciosa). Most notable **perennials** worth testing included: Fraxinus mandshurica, Ligularia dentate, Paeonia Early Scout, Hydrangea paniculata, Rosa Jens Munk, Lonicera caerulea 'Blue Belle, Syringa josikaea, S. Agnes Smith, James MacFarlane, Royalty, Donald Wyman, Syringa reticulate Ivory Silk, Gentiana macrophylla, and Amelanchier alnifolia Martin. Of the native species rooted from softwood and/or semi-hardwood stem cuttings, four species rooted poorly (less than 25 percent) regardless of collection date: Siberian alder (Alnus viridis ssp. fruticosa), silverberry (Elaeagnus commutata) , Bebb willow (Salix bebbiana) and shrub birch (Betula glandulosa). Best rooting (greater than 80%) occurred 20 June for: Beauverd spiraea (Spiraea stevenii) , sweetgale (Myrica gale), and thinleaf alder (Alnus incana ssp. tenuifolia). Peak rooting for dwarf birch (Betula nana), feltleaf willow (Salix alaxensis), balsam poplar (Populus balsamifera), Labrador tea (Ledum groenlandicum) and littletree willow (Salix arbusculoides) was early to mid July. During peak rooting times, all successful species developed adequate root quantities for survival following transplanting. At least 8 native Alaska species can be propagated under mist in greenhouses for commercial production for landscape and revegetation work. Carex aquatilis shows significant germination percentages in controlled environments where exposed to light and germinated at alternating 25/15C temperatures. Cold stratification does not improve germination, nor does removal of the perigyneum. Carex aquatilis has potential as a revegetation species for restored oil drilling gravel pads, whereas Eriophorum angustifolium does not. Seeds failed to germinate under a variety of controlled conditions. **Peonies:** Sarah Bernhardt peony cut stems were exposed to 0 – 72 hours of chilling (34F, 1C) to learn how much chilling is necessary for maximum vase life. Hours of chilling up to 12 hoursr did not differ significantly in the days to full bloom (4 days) and petal fall (5 days). Chilling improved vase life after 24 hours. Chilling up to

12 hours is not sufficient to extend vase life to the maximum 14 days experienced in previous studies. Growers who ship peony cut stems should hold peonies at least 24 hours to attain optimum vase life. Peony roots were planted at three different times to determine if there is any difference in cut flower productivity with fall, spring or containerized plantings. Roots of four cultivars were planted in September, held at 34F in wood chips until April, potted and grown in the greenhouse and outdoors until July; or held until mid May and direct planted. Two cultivars, Duchess de Nemours and Dr. Alexander Fleming showed significant bud break and root rot in storage despite an application of dusting sulfur. Many stems died in storage, but the roots remained alive. These cultivars had significantly fewer vegetative stems, flowering stems and shorter stem height in the first year of field growth. Sarah Bernhardt roots and crown buds were weighed, counted and measured prior to planting in order to learn if a correlation exists between root quality and subsequent growth and flowering. Three root attributes were correlated with the total number of stems produced: total number of eyes per plant, total number of roots per plant and root fresh weight. Characteristics such as root length and maximum diameter were not correlated with subsequent growth. In addition, we found no relationship between any root characteristics and number of flowering stems and foliage height in the first year. The attributes that showed correlation could not be fitted to a linear or curvilinear model explaining the nature of the correlation. Best methods of handling peony cut flowers for greatest vase life include cutting peonies dry and storing them dry in a cooler (34F) at 80 percent relative humidity until shipping. Use of water in buckets in the field or pulsing flowers with water in the cooler does not improve vase life of peonies. Under optimum conditions, 'Sarah Bernhardt' peonies lasted up to 15 days in a vase, 8-9 days from bud break to full bloom and an additional 5-6 days in full bloom. Chilling in a cooler is the most important attribute to long vase life. Peony roots were purchased from six commercial sources to study the variation in root size and quality of commercial peonies. Roots were weighed, the number of buds and roots counted, and the length of roots per plant was recorded prior to cold storage at 1C. Roots of Sarah Bernhardt and Duchess de Nemours peonies were planted immediately outdoors, stored at 34F until spring planting or potted into containers and planted as containerized stock. After five years, no treatment showed any significant difference in biomass, vegetative stem growth or yield of fresh cut flower stems. No difference was recorded between fall and spring planting of roots. **BERRIE**S .Seeds of wild blueberries germinated best from frozen berries whose seeds were extracted and never permitted to dry out. Direct sowing yielded greater than 60 percent germination. Dried seeds lost germination capacity with time and did not respond to cold stratification to fulfill a dormancy requirement. A 1000 ppm treatment with gibberellic acid promotes germination. Wild bumble bees were the most important native pollinators of Vaccinium uliginosum. Attempts to attract native bees and increase fruit set using blue vane traps was not successful.

IMPACT: As a direct result of peony research, 67 commercial businesses have planted trial plots of peonies for field cut flower production. In 2012, more than 101,000 peony roots were planted, and 25,000 fresh cut stems were sold in the contiguous United States, Hawaii, Canada and Taiwan. A new specialty cut flower industry has been started in Alaska as a direct result of our research. Kennicott Bros. Co., Chicago, IL has contracted with two growers in Alaska to grow peonies exclusively for their company. We provided

seed and plant materials to 10 commercial horticulture companies in Alaska for commercial propagation and cultivation. The vegetable research is designed for small market gardeners and homeowners. It provides comparative trial information that is useful in developing regional truck farms and expanding produce choices as farmers' markets. The annual and perennial flower trial research is used by seed companies, nurseries, growers, landscapers and home gardeners to identify hardy perennials, disease resistant annual flowers for home and commercial production. Specific trial information was requested by Denali Seed (AK), Territorial Seeds (OR), Pan American and Ball Seed Co.(IL), Goldsmith Seeds (CA), Kieft Seeds (Holland) and American Takkii (Salinas, CA), all of whom donated seeds for the research. Twelve undergraduate students completed research internships in horticulture during the past five years.. One graduate student completed an MS degree in Resource Economics working with peony marketing; two in pollination biology (Pampel and Buxbaum). The information of propagation of Alaska native plants was incorporated into NRM 215 Plant Propagation undergraduate class. Information on bedding plant production was incorporated into NRM 212 Greenhouse management class.

PARTICIPANTS: Individuals: Dr. Patricia S. Holloway, Principal Investigator designed and initiated all research projects and contacted potential partners. Partner Organizations: Alaska Department of Natural Resources Division of Agriculture and the UAF Cooperative Extension Service have agreed to sponsor a joint workshop on peony production for growers. The USDA Agricultural Research Service, Alaska has agreed to continue joint research on diseases, especially viruses of peonies. Training: Mr. James Auer completed his MS Degree in Resource Economics jointly with the SNRAS Natural Resources Management Degree and the School of Management by working on the marketing of peonies. Ms. Tina Buxbaum is completing her MS research on pollination biology of Vaccinium uliginosum. Ms. Rayhanon Pampell is completing her MS degree on bumble bee biology for crop pollination in Alaska.

TARGET AUDIENCES: The following were the target audiences for this project: The Alaska Peony Growers Association and other specialty cut flower growers, national and international commercial seed businesses, Alaska market gardeners and Alaska’s agri-tourism industry. UAF graduate and undergraduate students in natural resources management, Alaska homeowners, commercial horticulture businesses, Alaska Mater Gardeners Association, numerous Alaska garden clubs, agencies including: Alaska Department of Natural Resources Division of Agriculture, UAF Cooperative Extension Service, USDA Agricultural Research Service . Undergraduate students, Mia Peterbur and Katie Kokx completed an research projects on propagation of Alaska native berries and ornamentals. Jessica Guritz completed an undergraduate project on non-native/invasive weeds at UAF.

PARTICIPANTS: Individuals: Dr. Patricia S. Holloway, Principal Investigator designed and initiated all research projects and contacted potential partners. Partner Organizations: Alaska Department of Natural Resources Division of Agriculture and the UAF

Cooperative Extension Service have agreed to sponsor a joint workshop on peony production for growers to be held 1 Feb 2008. The USDA Agricultural Research Service, Alaska has agreed to continue joint research on diseases, especially viruses of peonies. They will also participate in the grower training workshop in February. Training: Mr. James Auer is completing his MS Degree in Resource Economics jointly with the SNRAS Natural Resources Management Degree and the School of Management by working on the marketing of peonies. Mr. Sean Willison is completing his MS degree in Natural Resources Management by working on native plant seed germination/revegetation project. Ms. Allison Peterson is completing her MS degree in Natural Resources Management by working on propagation of Alaska native plants. TARGET AUDIENCES: Target audiences: horticultural trials: all home gardeners, commercial greenhouse/nursery/landscape businesses in Interior, Alaska; berry research: home berry pickers, commercial berry harvesters and cottage industries based upon berry processing, and Extension home economics programs; peonies: commercial Alaska fresh cut flower growers.

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Buxbaum, T. and Holloway, P. 2011. Pollination biology of Alaska bog blueberry, Vaccinium uliginosum**.** Presentation, Poster. American Society for Horticultural Science. 23 Sep. Kailua Kona, HI.

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The research funded by this program resulted in a new horticultural industry for Alaska and the first successful horticultural export – peonies as fresh cut flowers. It provided the baseline information for cultivation, management, post harvest handling, packaging and distribution of this new crop. Combined with the third largest air cargo transport hub in the world in Anchorage, Alaska is poised to enter the competitive world flower trade. There are 67 growers in Alaska; 101,000 peony plants have been planted; 25,000 fresh cut stems were sold in Canada, Taiwan, Hawaii and the contiguous 48 states. Projected yield by 2014 is one million stems.

Research in annuals, flowers, vegetables and herbs diversified the crop offerings for market gardeners and established some new protocols for irrigation of vegetable gardens. It provided support for the largest agricultural industry in Alaska, horticulture.

Research into Alaska native plant propagation established protocols for seed and cutting propagation for the nursery.landscape industry as well as programs working in wildland reclamation. The research on water sedge germination completely changed revegetation protocols in the Prudhoe Bay Oilfields. The previous 30 years emphasized revegetation with grasses. Our research proved that the dominant plant in wet tudra ecosystems, could be propagated by seed and is a viable alternative to grasses for revegetation.

Blueberry research is establishing protocols for domestication of Alaska wild blueberry, the most important wild-harvested berry in the state. We have demonstrated methods of field cultivation and worked with growers to establish propagation protocols through cuttings and tissue culture for large-scale plant production. One grower in Fairbanks has successfully field-grown blueberries, and at least six other growers are taking lessons from that grower. The business is a small cottage industry producing jams and jellies.

This program trained three new graduate students and 12 undergraduate interns who participated fully in applied research from field work to publication.