

### **Impact nugget**

Research information is effectively disseminated and demonstrated to commercial producers and the public at tours with a minimum of 50 participants daily through partnerships with two greenhouses during the summer months.

### **New Facilities and Equipment**

A Varian ICP-OES (inductively coupled plasma optical emission spectroscopy) 720-ES was acquired in 2008. We anticipate using this instrument for water samples, tissue and soil samples.

### **Accomplishment Summaries**

High tunnels covered with K50 Clear, K50 IR/AC, KoolLite380© and Solatrol, were used for producing strawberries and raspberries. The temperature pattern in the K50 Clear and K50 IR/AC covered tunnels were similar although K50 IR/AC maintained warmer temperatures during cooler periods. The KoolLite380© on the other hand, kept a cooler environment compared to K50 Clear during the warmest part of the day. Daily air temperatures averaged over the month of August in 2008, were approximately 3°C higher than outside in tunnels covered with K50 Clear, K50 IR/AC and KoolLite380©. Average temperature under the Solatrol material was a slight 0.5°C cooler. August soil temperatures were similar under all coverings and averaged 3°C higher than the corresponding outside soil.

Excellent growth and pollination resulted in high yields of top quality fresh market raspberries in all environments including the field. More than 100 high quality marketable raspberries were harvested from each single cane plant. Compared to traditional raspberries established and grown under field conditions in a multi-year system, the container grown 'Tulameen' had larger berries with excellent fresh market taste. The average size of 'Tulameen' raspberries was 4 to 5 gram compared to the 2 to 3 gram of traditional multi-year field grown raspberries. The lowest harvest (392 gram) was attained in the field while the raspberries in the high tunnel covered with K50 IR/AC produced the significantly highest yield (487 gram).

A protected environment also resulted in significantly higher strawberry yields than the field. Below average temperatures and above normal precipitation resulted in poor 2008 growing conditions. Plant development was slow and satisfactory harvest was not recorded until late in the season. During the three final weeks, 'Tristar' produced significantly more at 125 gram of berries per plant in the K50 IR/AC and K50 Clear tunnels. The harvest was reduced to 80 gram under Solatrol and KoolLite380© while the yield in the field averaged 50 gram.

A LI-6400 portable photosynthesis system (LI-COR, Lincoln, NE) with a clear top leaf chamber was used to measure net photosynthetic rate (Pn) at 400 ppm CO<sub>2</sub> in a field environment for 24-h during July 6 and 7, 2008. Sunset on July 7 is at 00:23 with sunrise at 03:29 Alaska daylight saving time and the sun remains above civil twilight limits. The average temperature one meter above ground was 18.7 ± 5.75°C with a high of 28°C at 15:00 and a low of 10.5°C at 05:00. Photosynthetic photon flux (PPF, 400 to 700 nm) averaged 433 μmol·m<sup>-2</sup>·s<sup>-1</sup>. Pn generally correlated to available PPF. Peak Pn was 10.6 μmol CO<sub>2</sub>·m<sup>-2</sup>·s<sup>-1</sup> at 13:55 for snap

bean 'Provider'. In comparison for sweet corn ('Yellow Supersweet'), peak Pn was 28.3  $\mu\text{mol CO}_2\cdot\text{m}^{-2}\cdot\text{s}^{-1}$  at 13:35. Pn dropped to zero or less from approximately 23:00 to 06:00 in both beans and corn under ambient PPF of 2 to 30  $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ .

### **Impact Statement**

Information from research studies is quickly disseminated as research is conducted, field tested and implemented in commercial production through the partnership with Chena Hot Springs Resort. Opportunity to view practical applications stimulates interest and encourages Alaskans to develop greenhouse projects for production and education. Tours with participants from the local population, visitors from various parts of Alaska, and tourists from all over the world, are given daily at Chena Hot Springs Resort. Suitable techniques for northern production are also demonstrated in the greenhouse at Pike's Waterfront Lodge, a local hotel and restaurant establishment. Open to the public, daily formal and self-guided tours illustrate commonly used techniques to local and visiting individuals and groups during the summer months. A minimum of 50 daily visitors toured Pike's greenhouse throughout the months of June, July, August and September.

### **Published Written Works**

- Karlsson, M. and J. Werner. 2009. High tunnel covering materials for northern field production. *Acta Horticulturae* (in press).
- Karlsson, M. and J. Werner. 2009. Hydroponic greenhouse lettuce production in subarctic conditions using geothermal heat and power. *Acta Horticulturae* (in press).
- Karlsson, M. and J.W. Werner. 2009. Snap bean yield and photosynthesis during twilight extended field conditions. *HortScience* 44: (in press).
- Karlsson, M. and J.W. Werner. 2008. Early day length sensitivity in sunflower. *HortScience* 43: 1262-1262.
- Maxwell, C. 2008. Growth of hydroponic leaf lettuce after pre-treating seedlings with carbon dioxide. Senior Thesis, School of Natural Resources and Agricultural Sciences, University of Alaska Fairbanks.

### **Scientific and Outreach Oral Presentations**

- Karlsson, M.G. 2008. Plastic film considerations for greenhouses and fields. Alaska Greenhouse and Nursery Conference, Fairbanks, Alaska. January 31.
- Karlsson, M. Controlled environment applications in agriculture. University of Alaska Fairbanks. February 7, 2008
- Karlsson and Werner, 2008. Modified environments for field production. Potato and vegetable days, Palmer, Alaska. February 13.
- Karlsson, M. 2008. Sustainable greenhouse production in the Arctic. Pike's Waterfront Lodge, Fairbanks. Legislative update. May 16.
- Karlsson, M. 2008. Update on using geothermal resources to produce greenhouse tomatoes and lettuce. Chena Hot Springs Resort. Western Integrated Pest Management Annual Meeting. May 21.

- Karlsson, M. and J. Werner. 2008. Opportunities to produce greenhouse crops in remote and high latitude locations. Camp Denali Lodge. Kantishna, Denali National Park and Preserve. May 23-24.
- Karlsson, M. and J. Werner. 2008. Pike's Greenhouse Update and Open House for Alaska State Legislatures. June 12.
- Karlsson, M. 2008 Alternative energy for controlled environment production. Joint Meeting of the Directors of Western Agricultural Experiment Stations, Cooperative Extension Service and land-grant schools and colleges of agriculture and natural resources. July 7.
- Karlsson, M. and J. Werner. 2008. Opportunities to produce greenhouse crops in remote and high latitude locations. Ilisavik land-grant university and the community of Barrow, Alaska. July 15-16.
- Werner, J. and M. Karlsson. 2008. Educational opportunities at UAF and progress in K-12 outreach efforts. Chena Fest October 4.

#### **Other Relevant Accomplishments and Activities.**

We have developed partnerships with Chena Hot Springs Resort and Pike's Waterfront Greenhouse. These associations offer opportunities for more effective information dissemination to the public, out-of-town and out-of-state visitors, and commercial producers. These greenhouse operations also offer training and summer job opportunities for high school and college level students. Practical hands-on training is now often missing in higher education although students taking advantage of these opportunities are better prepared and more successful in their careers.