NCERA-101 Station Report April - 2011
University of Alaska Fairbanks
Meriam Karlsson, Jeff Werner

**Impact nugget**

Research activities address emerging local needs for energy efficient greenhouse and controlled environment production. Outreach efforts provide information and training opportunities to experienced growers as well as those with limited or a recent interest in commercial greenhouse production.

**New Facilities and Equipment**

A forty year old Lord and Burnham greenhouse used for research and teaching on the University of Alaska Fairbanks campus, was demolished in March of 2011. A replacement greenhouse facility is under construction. The new 4,500-square-feet greenhouse will consist of 7 sections on two levels adjacent to the south side of an existing building. A local construction company (Ghemm Company Inc.) is building the greenhouse in consultation with the Nexus Greenhouse Systems (Northglenn, Colorado). The facility also includes 1,000 sq ft dedicated to growth chambers and a headhouse/teaching lab of 1,700 sq ft. The anticipated completion date is December of 2011.

**Accomplishment Summary**

Blackeyed susan (*Rudbeckia hirta* 'Toto') and butterhead lettuce 'Charles' were grown under high-pressure sodium (HPS) lamps (1,000W), metal halide (MH) lamps (1,000W), T5 fluorescent tubes, and three types of LED panels (300W). The R/B panel consisted of red LEDs (peak emission at 665 nm) supplemented with 10 percent blue LEDs (456 nm), the tri-band panel used 40 percent red LEDs (660 nm), 40 percent orange-red LEDs (630 nm) and 20 percent blue LEDs (460 nm), and the white LED panel provided peak emissions at 458 nm and a curve distribution around 560 nm. PPF (400 to 700 nm) at plant height was 150 μmol $m^{-2}s^{-1}$ for all lamp types. The net photosynthetic rate (Pn) response to PPF was measured at 400 ppm $CO_2$ and to intercellular $CO_2$ concentrations at PPF of 150 μmol $m^{-2}s^{-1}$. The Pn capacity of lettuce, based on light and $CO_2$ response curves, appear similar independent of the light source suggesting PPF is more important than the spectral energy distribution for rate of photosynthesis. Despite comparable Pn rates and capacities for plants grown under the various light qualities, plant morphology and dry matter differed. Lettuce grown under MH for four weeks had highest above ground plant dry weight followed by lettuce in fluorescent light. The R/B and tri-band LED panels resulted in similar size lettuce while HPS and white LEDs supported the least amount of top dry weight. For blackeyed susan, plants under HPS produced the largest amount of above ground dry weight. The least amount of dry weight partitioned to stems was observed under the R/B and tri-band LEDs (12 percent) while HPS (19 percent) and MH (16 percent) lamps resulted in taller plants. Additional studies are necessary to fully understand the impact of limited LED spectra on crop growth.

**Impact Statement**

With concerns for a continuous supply of high quality food, the demand for information to expand and improve local production systems is increasing. The far north location requires knowledge and information that is adapted and suitable for these growing conditions. More

energy efficient lighting technologies for instance, will have large impacts on the economics of operating local greenhouses as supplemental lighting is an ongoing controlled environment expense. We are continuously communicating with producers and individuals interested in pursuing greenhouse and other types of production systems. Training opportunities in agriculture topics related to various environments including greenhouses, high tunnels and field conditions are regularly offered and presented. Other examples of events used for information transfer are Fairbanks sustainable agriculture conference with 150 participants, the energy fair at Chena Hot Springs Resort (CHSR) attracting 2,000 attendants, and the Tanana Valley Fair with attendance of 70,000. These types of gatherings attract people of variable and diverse educational, financial and demographic backgrounds who may not be reached through conventional extension and outreach activities. Our partnerships with the local greenhouse operations at CHSR and Pike's Waterfront Lodge in Fairbanks, are additional methods for reaching large and diverse groups. These collaborations allow for interactions with the general public and visitors from various regions along with training and apprenticeship opportunities for students and interested individuals. Daily educational programs on greenhouse operation and management are conducted year round at CHSR. Each guided tour has a minimum of 15 participants from local populations, residents from various parts of Alaska, and visitors from all over the world. At Pike's, techniques suitable for northern greenhouse production are used and demonstrated to local and visiting individuals and groups during the summer months. Formal and self-guided tours attract at least 50 daily visitors during June, July, August and September. In addition to running Pike's greenhouse and managing the grounds, high school- and college students provide daily educational programs and answer questions related to greenhouse production, Alaska agriculture and their summer employment experience. Pamphlets describing the greenhouse operations at CHSR and Pike's support the educational programs and are widely distributed.

**Published Written Works**

Neely, H.L., R.T. Koenig, C.A. Miles, T.C. Koenig and M.G. Karlsson. 2010. Diurnal fluctuation in tissue nitrate concentration of field-grown leafy greens at two latitudes HortScience 45:1815-1818.

Werner, J., Y. Okada and M. Karlsson. 2011. Using light emitting diodes in high latitude greenhouse production. Acta Horticulturae (in press).

Karlsson, M. and J. Werner. 2011. High tunnel covering materials for northern field production. Acta Horticulturae (in press).

Karlsson, M. and J. Werner. 2010. Light emitting diodes for greenhouse production. HortScience 45(8):S274. (Abstract.)

Waters, W. 2011. Viability of thermoelectric power generation in Alaska. Senior thesis Natural Resources Management, SNRAS, University of Alaska Fairbanks.

Beard, T.L.M. 2010. Impact of arsenic contaminated irrigation water on accumulation in tomatoes. Senior thesis Natural Resources Management, SNRAS, University of Alaska Fairbanks.

Bue, J. 2010. Arsenic absorption in vegetables. UAF Campus Research Day. Center for Research Services, University of Alaska Fairbanks. (Abstract.)

Bures, J.W. 2010. Reducing the Alaska summer day length to increase growth and yield of tomatoes. Senior thesis Natural Resources Management, SNRAS, University of Alaska Fairbanks.

Ward, J.R. 2010. Economic considerations for commercial greenhouse production during interior Alaskan winters. Senior thesis Natural Resources Management, SNRAS, University of Alaska Fairbanks.

**Scientific and Outreach Oral Presentations**

Werner, J. 2011. Local food production: adding to the economy and community. Southwest Alaska Municipal Conference (SWAMC), Anchorage. February 11.

Karlsson, M. and J. Werner. 2010. Light emitting diodes for greenhouse crops. Western Region of the International Plant Propagators Society, Bellingham, Washington.

Karlsson, M. and J. Werner. Raspberries, strawberries and rhubarb pie. 2010. Chena Renewable Energy Fair, Chena Hot Springs Resort. August 15.

Karlsson, M. 2010. High tunnels for peonies. Peony conference. Fairbanks, July 22.

Karlsson, M. 2010. High tunnel research at UAF. Ag day and Legislative tour, Fairbanks. July 21

Karlsson, M. 2010. High tunnels, hoop houses and retractable roofs for improved field production. Alaska Greenhouse and Nursery Conference, Juneau, Alaska. February 25.

Karlsson, M. 2010. Are LEDs the future of greenhouse lighting? Alaska Greenhouse and Nursery Conference, Juneau, Alaska. February 26.

**Other Relevant Accomplishments and Activities.**

In 2010 (July 21 to 23), we hosted a conference in Fairbanks on the potential to produce peony cut flowers in Alaska and the United States. A SCRI (specialty crops research initiative) proposal was developed and submitted in response to the interest and needs for information shared among the participants.

We have ongoing partnerships with Chena Hot Springs Resort and Pike's Waterfront Lodge. These associations offer opportunities for effective information dissemination to the public, out-of-town and out-of-state visitors, and commercial producers. These establishments and greenhouse operations also offer training and summer job opportunities for high school and college level students.