Salad at the South Pole

Growth chamber will house vegetable and fruit crops

By Susan McGinley

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Phil Sadler (left) and Gene Giacomelli inspect lettuce plants in small prototype of food growth chamber.

Fresh produce doesn't come to mind when you hear the word "Antarctica." Researchers living there usually eat packaged food year round indoors. They can suffer from seasonal affective disorder (SAD), a health malaise brought on by a lack of full spectrum natural light, and they long for the sight, taste and touch of plant life in the most isolated place on earth. They've also learned that having access to plants can raise morale and increase productivity.

For these reasons, personnel based at the new Amundsen-Scott research station at the South Pole will be growing and harvesting their own salad vegetables by 2004 in a special high-technology facility designed, built and tested by the University of Arizona. Scientists from the Controlled Environment Agriculture Center (CEAC) in the College of Agriculture and Life Sciences are collaborating on the project with Phil Sadler, of Sadler Machine Company in Tempe, Arizona.

"The main purpose for including the food growth chamber in the new station is the psychological effect that it has on the station personnel," says Gene Giacomelli, UA professor of agricultural and biosystems engineering, and director of the Controlled Environment Agriculture program at the UA. "They are totally isolated in a frozen, 9,000-foot elevation desert of snow, 800 miles from the coast of Antarctica, where temperatures can reach lows of minus 118 degrees Fahrenheit. For seven to eight months of the year, temperatures are so low that aircraft cannot land and no one can come or go."

The self-contained unit will feature a food growth chamber equipped for raising leafy greens and fruiting vegetable crops hydroponically, separated by a transparent wall from a sitting room where researchers can relax and enjoy the sight of lush green plants. Lettuce, herbs, tomatoes, cucumbers, and sweet and hot peppers will be grown in a recirculating nutrient solution. Automated controls for air temperature, light, humidity, watering and nutrients will enable researchers to raise and eat their vegetables year-round.

The chamber is part of a new South Pole research station that will be officially commissioned in 2004 by the National Science Foundation (NSF), which directs activities of the United States Antarctic Program. The NSF is constructing a replacement for the existing station with the assistance of its civilian contractor, Raytheon Polar Services Company (RPSC). The South Pole Food Growth Chamber Project was initiated by the NSF, which RPSC com-

petitively bid, and the UA ultimately won. The UA must build and deliver an operable unit to the South Pole and provide training for RPSC engineers who will be managing it.

Not only does the team want a diet they are accustomed to that includes fresh salads, they also need the visual and sensory stimulation offered by green plants, which are absent at the South Pole. The 20-by 30-foot chamber will give them the chance to see, feel and smell vegetable and herb plants year-round, and also provide them with a bright environment of enhanced spectrum lighting, according to Giacomelli. The crop yields will be adjusted to the size of the current station population, which will include 200 people during the Antarctic's 3-month summer, and 30-40 people the remainder of the year.

The UA is no stranger to development of food production facilities within environmentally hostile areas, according to Giacomelli. In the early 1970s controlled environment vegetable production greenhouses were successfully operated by the university in the deserts of the Middle East and northern Mexico using technological advances in horticulture and engineering. In Antarctica, the UA is combining its innovations in hydroponic food production and controlled environment agriculture with the engineering and manufacturing abilities of Sadler Machine Company.

The design of the sitting room in particular was based on the suggestions and experience of Phil Sadler, a former Antarctic construction worker and current designer of controlled environment facilities, together with Raytheon and other government engineers, scientists and technicians. By having a room with a big window where people can sit and look at growing plants while they play cards or socialize, Giacomelli says, they'll be able to experience the healthy effects of being around growing plants in a lighted environment that helps them flourish. Aside from the intensive hydroponic crops in the food growth chamber, station personnel will also have the opportunity to assist in caring for other plants in the sitting area.

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Lettuce plants thrive in small-scale growth chamber.

Sadler's expertise as a former biologist and current engineer and manufacturer, coupled with his experience in Antarctica, make him a natural partner with the UA on the project, Giacomelli notes. "Phil's got the experience 'on the ice' because he has lived and worked at the pole, and he built the first successful food growth chambers and greenhouse in Antarctica. He can build top quality, long lasting and capable equipment to furnish the food growth chamber." The current project will be the first officially commissioned food growth chamber for the NSF, replacing a small test greenhouse that proved successful.

"The lighting source he has designed — a water-cooled lamp — is of particular value. Phil makes lamps that are more than 10 times as powerful as a 40-watt light bulb, but are so cool you can touch them with your hand," he says. "They are practical to use in the confined space of a growth chamber where plants can get close to them and not be damaged by excessive heat."

The ultimate goal of the food growth chamber is to provide a better quality of life for researchers who live and work at the South Pole, and to help others understand how people can adapt to living in seclusion without seeing the sun for months on end.

"For five-and-a-half months there is no sunshine, just total darkness," Giacomelli says. "The benefit is not only for fresh food at that time, but also for the high intensity light that mimics the sun, the high humidity, the aromas and flavors that remind us that we're alive and that we enjoy eating. Psychologically it's very important."

CEAC

The **CEAC** is an interdisciplinary research and training facility located on the University of Arizona's Campus Agricultural Center. Students and faculty from the College of Agriculture and Life Sciences, including Agricultural and Biosystems Engineering, Agricultural Education, and Plant Sciences currently participate in its programs.

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