Better Beans From ARS Breeders

It's relatively easy to carry crops from one part of the world and plant them in other hemispheres.

But even though they may have some extremely useful characteristics, such new introductions rarely thrive in their new environments—mainly because they aren't adapted to different day length or other environmental conditions. The real challenge is to cross the exotic line with domestic cultivars to develop new varieties that effectively handle local environmental stresses, while producing excellent yields and resisting attack from insects and diseases.

Thanks to productive breeding programs, beans originating in Central America are now an important crop in the United States. Today, U.S. farmers annually produce nearly $1 billion worth of fresh snap beans and dry edible beans.

"We can state with confidence that our agency has contributed significant amounts of germplasm to breeding programs across the country," says ARS' Matt J. Silbernagel. "For example, almost all of beans' resistance to major diseases in the United States came from our labs or resulted from federal or state public research programs.

"The fact that we can't find any commercial bean varieties that don't have any disease resistance factors is a positive reflection on how much cooperation there has been over the past 60 years among scientists in the federal, state, and private sectors," adds Silbernagel, a plant pathologist in the ARS Vegetable and Forage Crops Production Research Unit at Prosser, Washington.

Of all dry bean varieties currently grown in the United States, probably 70 to 75 percent—and 98 percent of snap beans—contain some germplasm that was incorporated from ARS releases.

Annual U.S. edible dry bean production has exceeded a million tons for the past several years. Included in this total are the pinto, navy, Great Northern, kidney, lima, small white and red, black, and pink beans that are eaten after they have matured and dried. In 1990 and 1991, production reached nearly 1.7 million tons—around 33 million hundredweight. Value of these dry bean crops usually ranges between $600 million and $750 million annually.

Whereas harvested dry bean acreage in 1993 was about 1.6 million, the U.S. snap bean production area ranges from 300,000 to 350,000 acres. These beans include the string, stringless, and wax beans that are eaten when they are immature pods. Their annual value is from $150 to $200 million.—By **Dennis Senft,** ARS.

Matt J. Silbernagel is in the USDA-ARS Vegetable and Forage Crops Production Research Unit, Rte. 2, Box 2953-A, Prosser, WA 99350-9687; phone (509) 786-9258, fax (509) 786-9277. ◆

Proteins Protect Insects From Cold

One of the major reasons insects are so successful is because they have many physiological and biochemical mechanisms that protect them against environmental stresses—especially, freezing temperatures.

Many insects, including the common house fly and the seemingly ever-present fruit fly, produce specific proteins that offer them protection when temperatures dip below freezing. Scientists have yet to piece together exactly how these proteins function but have linked the accumulation of low-molecular-weight compounds with increased cryoprotection.

ARS scientists in Laramie, Wyoming, have identified seven unique proteins that *Culicoides variipennis sonorensis* produces in response to cold temperatures.

This tiny biting insect, known as a "no-see-em," transmits bluetongue virus. Bluetongue disease causes about $120 million in annual losses to domestic livestock producers, mainly in lost exports to countries that do not have the disease.

"The quantity of proteins the insects produce is proportional to the severity and duration of the cold," says Richard A. Nunamaker, an entomologist at the Arthropod-borne Animal Diseases Research Laboratory in Laramie.

Scientists say that *C. variipennis* produces the proteins during a process called cold-hardening. This pre-conditions the insects to withstand temperatures that would ordinarily prove fatal. *Culicoides* usually die after a 2-hour exposure to 14°F, but if the insects are first acclimated for 1 hour at 41°F, 98 percent of the adults survive—some for as long as 3 days.

"The cold-hardening that we performed in our laboratory is similar to weather conditions in a large portion of the United States. It is possible that adult *Culicoides* could survive cold weather for longer than anyone thought possible," says Nunamaker.

Some winter survivors may have been infected with bluetongue virus the previous warmer season, thus providing a possible source of infection among livestock the following spring. This potential for virus overwintering poses significant problems for people who are trying to halt its transmission among U.S. livestock.

"However, interrupting cold-hardening through genetic manipulation of *Culicoides* may be an effective strategy to reduce the probability of bluetongue virus survival through cold weather," says Nunamaker.—By **Dennis Senft,** ARS.

Richard A. Nunamaker is at the USDA-ARS Arthropod-borne Animal Diseases Research Laboratory, P.O. Box 3965, University Station, Laramie, WY 82071-3965; phone (307) 766-3624, fax (307) 766-3500. ◆