Seeds in Need: The VAVILOV INSTITUTE

World's oldest collection of plant diversity threatened with extinction

By GABRIELLE STROBEL

When the U.S. soybean crop fell prey to a parasitic worm 10 years ago, Soviet scientists came to the rescue. Researchers in the United States had searched in vain for domestic beans that could resist the destructive cyst nematode. Finally, they turned to the Soviets, who supplied beans with the desired resistance.

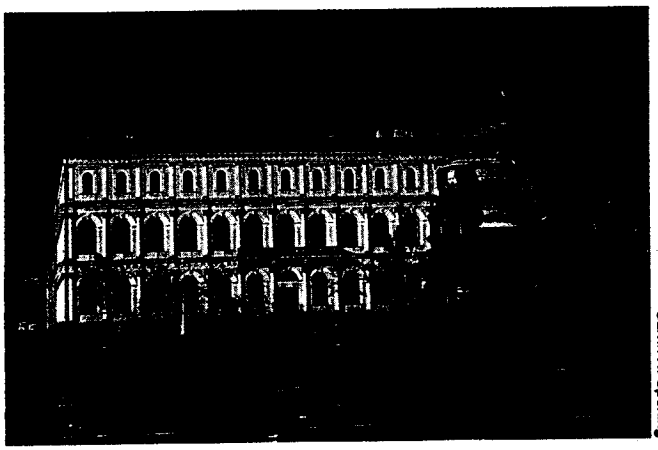
Such help may not be possible in the future, however.

The N.I. Vavilov Institute of Plant Industry, keeper of one of the world's largest collections of plant genetic material and source of the nematode-resistant soybeans, has fallen on hard times. With Russia's government in turmoil over reforming the economy, funding for the St. Petersburg-based institute is drying up, while the cost of labor is soaring. Operating on a shoestring, the institute may soon be unable to sustain its priceless collection of 380,000 varieties of seeds, warn researchers at the U.S. Department of Agriculture (USDA).

"We can't let a resource like this just drift off," says Henry L. Shands, a scientist at USDA's Agricultural Research Service (ARS) center in Beltsville, Md. Encouraged by Shands and his colleagues, public and private donors from various countries are now rallying support to ensure the continuity of the largely unique seed stock.

Maintaining the collection is crucial not only because it helps preserve the global diversity of plant species, says Shands, but also because it represents a huge reservoir of genetic traits that breeders can tap to produce hardier crop strains with higher yields.

In the United States today, a mere 2 percent of the population grows enough food to meet the nation's consumption and export needs. The USDA attributes more than 60 percent of this productivity to breeding. To achieve higher yields, breeders need access to the thousands of slightly different traits that plants have developed in response to particular climate, soil, parasite, and other environmental conditions.



Calvin R. Sperling

Yet access to this wealth of plant traits depends on curators such as those at the Vavilov institute. These scientists gather crop plants and their wild relatives and keep the plants' hereditary material, the germ plasm, viable for future needs.

"Many wild species that have evolved over thousands of years were shoved aside for improved types that contain very narrow germ plasm," says James H. Elgin Jr., a geneticist at the ARS in Beltsville.

The Vavilov institute, the only seed repository in the former Soviet Union, has compiled and studied genetic resources since 1894 — longer than any existing seed bank in the world.

The vast ecological expanse covered by the institute stretches from the Arctic circle to subtropical Central Asia. It contains plant traits that fit "needs for all degrees of latitude in the U.S.," explains Shands. "The fact that they have all this material makes a nice match for our breeders. We need each other as sources for new varieties. That's what their and our [germ plasm collections] are all about."

Some of the institute's riches have vanished already. Before the breakup of the Soviet Union, the Vavilov network consisted of 19 experimental stations, six of them located outside Russia. One of these, the Sukhumi station in Georgia's contested western province of Abkhazia, was destroyed in this year's civil war.

Alexey Fogel, an 83-year-old botanist and 50-year veteran of the Sukhumi station, rescued seeds as he fled Abkhazia through mountain paths in the Caucasus range, says Sergey Alexanian, a spokesman for the Vavilov institute. Fogel, his son Vladimir, also a scientist at the Sukhumi station, and two other botanists succeeded in evacuating 226 precious samples of subtropical fruit plants and almost the entire lemon collection to the Russian town of Sochi.

There the samples will be kept permanently, hopes Alexanian, provided the Russian government absorbs the cost. The institute does not plan to move them to the St. Petersburg collection because the city's climate is not conducive to growing and studying subtropical plants. The 2,000 samples left behind in the Sukhumi station are probably spoiled, Alexanian says.

The other outposts severed from the Vavilov network — those in the now-independent countries of Uzbekistan, the Ukraine, Kazakhstan, and Turkmenistan — hold 25 percent of the entire Vavilov collection. Yet they do not receive funds from Russia or their respective governments, Alexanian adds. Given their precarious situation, "we try to negotiate the transfer of unique germ plasm stored there and duplicate it in Russia," he says.

The current cash crunch is not the first crisis to threaten the institute. During the two-year siege of St. Petersburg in World War II, scientists guarded the seeds from famished townspeople. At least nine botanists starved to death in the midst of rice, wheat, corn, and peas.

Under Stalin, the institute suffered repression from the Communist regime, which misinterpreted and dismissed genetics as a science that supports "inborn

class differences" among people.

One of Stalin's victims was Vavilov himself, the founding director of the institute. Vavilov scoured five continents for wild and cultivated plants and developed theories about plant evolution, genetics, and geography that are still accepted today. After being denounced by a former student, Stalin's protgégé Trofim Lysenko, Vavilov died in prison in 1943.

"Vavilov was the son of a wealthy merchant family, whereas Lysenko's parents were poor peasants," recounts Alexanian. "Stalin wanted to demonstrate that peasants made just as good scientists as members of the upper class."

Vavilov still inspires today's staff, Alexanian says. Despite poor pay and work conditions, "we have not experienced a brain drain yet. The scientists are very loyal."

At the St. Petersburg center, the staff has been cut from 700 to 400 since 1991 and will soon shrink another 10 percent, says Alexanian, mainly in order to free up money for the salaries of the remaining scientists. Currently, a senior scientist takes home 45,000 rubles each month (about $38), and a technician earns 15,000 rubles per month (about $13).

"We will ask scientists to take early retirement," Alexanian says. "Losing these experienced specialists is dangerous, though, because in the current situation it is difficult to recruit young scientists. We cannot offer them conditions that would encourage them to stay."

The government promised to earmark 62 million rubles to raise staff salaries, but as of late October that money had yet to arrive, he adds.

What have arrived are 14 computers from the USDA, complete with CD-ROM drives, printers, software, and training. Thus armed, the Vavilov researchers are collaborating with USDA colleagues to generate an electronic database for the information accumulated since the late 19th century.

In 1920, Vavilov set up a standardized system to keep track of the material gathered during plant-collecting expeditions. Scientists entered into big ledgers the so-called passport information of each plant — who picked it, where, when, and in what environment.

"That's the way the data were until recently, handwritten in Russian and inaccessible for us unless we specifically knew what questions to ask," says Elgin, who visited the institute last year.

The emerging electronic database will be compatible with its U.S. counterpart, the Genetic Resources Information Network (GRIN). GRIN ties together data from the 25 locations in the United States that collect genetic material from plants, including the National Seed Storage Laboratory in Fort Collins, Colo., which maintains backup samples of the 400,000 varieties kept in this country.

These compatible databases will promote future cooperation, says Elgin. "Cucumber and alfalfa data are computerized already; now they are working on the wheats. There is still a long way to go."

Though the Vavilov seeds promise many treasures, such as genes for disease resistance or adaptability to drought, there is no way of assessing the institute's stock before the electronic inventory is complete. "Most of their collections in storage we have never seen," Elgin says. "Not knowing their potential, we can only guess it's huge. The Russians don't know it either, because so far they've had little means to evaluate their resources."

Making these hidden genetic riches available for study will not benefit solely Russia and the United States. In developing countries in particular, plant diversity has shrunk over the years as farmers have used increasingly uniform, high-yield crops. "Having such an old bank for future generations to draw upon is fabulous, especially for developing countries, which for the most part have not had gene banks until very recently," Shands notes.

For now, however, the Vavilov institute struggles with leaking water pipes, corroding and outmoded equipment, and failing refrigeration.

Lacking means of adequate long-term seed storage, institute staff must replant and harvest new seed more frequently than USDA officials think is economical or scientifically wise. "Their 50,000 wheat [strains] have a shelf life of three years, so they plant a third of those every year," says Elgin. "Their alfalfa stays viable for 10 years, but the potatoes they must regrow yearly."

In addition to the labor costs of cultivating hundreds of thousands of plants every year, regrowing also alters slightly the genetic constitution of a plant variety found in, say, 1922 in Peru. This happens because people "automatically select the best plants in every regrowing cycle," says Shands, thus gradually adapting the original genetic composition to the plant's new environment.

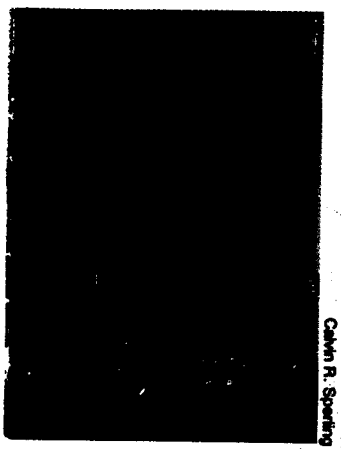
Long-term storage preserves seeds for 50 to 100 years, but that requires moisture-controlled conditions at below-freezing temperatures. For example, in Fort Collins, many seeds lie in liquid nitrogen at −273° F to minimize decay.

The Russian long-term storage facility near Krasnodar, 600 miles south of St. Petersburg, however, has no freezing equipment. Even refrigeration is notoriously unreliable. "Only one out of four cooling fans is working. If one more thread breaks, the whole garment will fall off," Shands warns. That would jeopardize the seeds of the 220,000 plant varieties currently kept there. In St. Petersburg, seeds are stored under even worse conditions — at room temperature and without air conditioning.

Installing modern refrigeration units enjoys top priority on a $1.5 million list of necessary repairs that USDA researchers drew up last year. Next come drying and vacuum-packing machines and plastic bags to prepare the seeds for proper storage. Shands says that small contributions make a big difference. "They need ribbons for their printers, journal subscriptions, lab supplies."

In addition to the U.S. government, several European governments, private foundations, and individuals are chipping in money for the institute. Ongoing discussions at the World Bank indicate that part of the bank's agricultural loans to Russia might be designated for the institute, Shands says.

He adds that USDA will continue its six-year involvement with the institute. "When we first made contact, they still were under tight Communist doctrine. But we bridged those barriers, and working with them has been a really good experience for us." □



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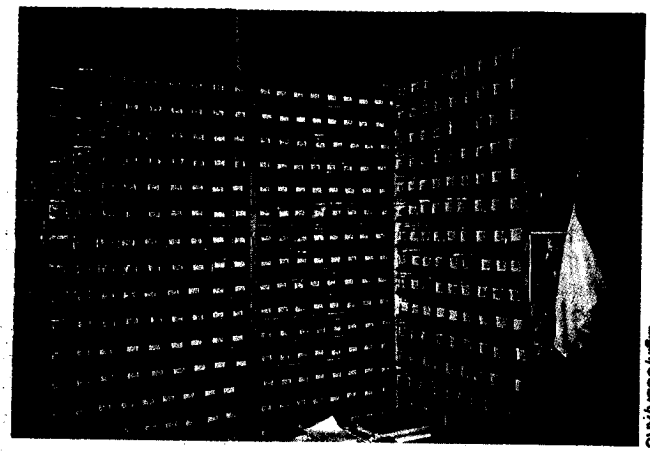

Elgin/USDA/ARS

The Vavilov Institute in St. Petersburg (left). Nikolai I. Vavilov's office as it was when he worked there from 1920 to 1940 (center). Seeds are stored at room temperature (right), though refrigeration and moisture control are needed.