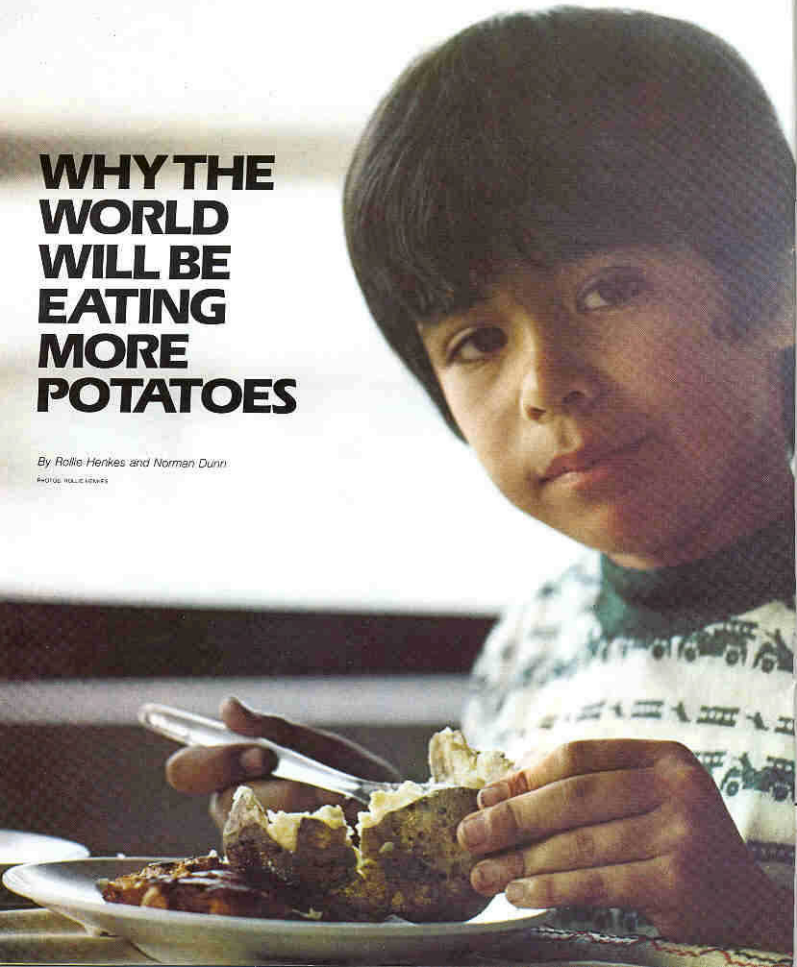
WHY THE WORLD WILL BE EATING MORE POTATOES

By Rollie Henkes and Norman Dunn

PHOTOS: ROLLIE HENKES



The potato may become a crop for more regions as scientists develop new varieties and new ways of growing them

When it comes to filling empty bellies, world attention seems riveted on the major cereal grains—wheat, rice and maize.

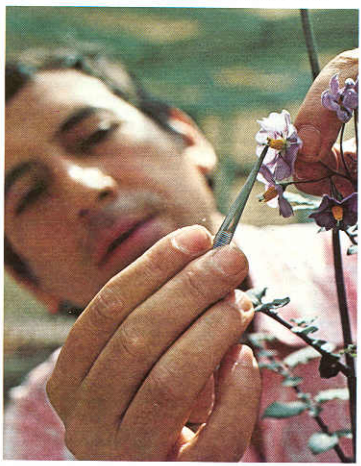
In the future, a tuber may share the spotlight.

"The potato will play a much bigger role in feeding the world, and it will become an important commercial crop for more farmers," declares Orville Page, director of research for the International Potato Centre in Peru. Research at this institution and others, he claims, is laying the foundation for a new wave of expansion for the potato.

The potato is no lightweight as a food crop now. It ranks fourth in world food production, behind the "big three" cereal grains. A look at crop-yield statistics for the '70s shows that the potato produced more food energy per hectare than rice, wheat or maize. More surprising, perhaps, is that the potato produced more protein per hectare than rice, wheat or maize. Moreover, potato protein, which is high in lysine, is of excellent quality. Nutritionally, it is as good or better than soybean protein.

New ground. But potato production is confined primarily to the cooler regions of the world. Many experts think that the potato could expand into other areas, especially those where population tends to outrun food supplies.

In Lima, Peru, 7-year-old Carlo Zelaya polishes off a potato for lunch. If research goals are met, many more youngsters will find potatoes on the menu.



Potato breeder Humberto Mendoza is creating new varieties for the tropics.

The fact that the potato now has its own international research centre, just like rice, wheat and maize, underscores the faith that some governments and private donors have in the future of the potato.

Although headquartered in Lima, Peru, the International Potato Centre has scientists working in 11 other countries in South America, Asia, Africa and the Middle East.

"Our mission," says Page, "is to make the potato a viable crop in countries that need to broaden the base of their food supplies."

One of the centre's boldest plans is to establish the crop in the lowland tropics. Experts at the centre envision farmers in areas such as Southeast Asia or Central America planting potatoes as a commercial crop in rotation with rice, as well as growing potatoes in backyard gardens.

Potatoes are already grown in the tropical lowlands but with extreme difficulty. Temperate-zone varieties such as Red Pontiac can survive the insects, diseases, heat and humidity of the tropics, but generally they must be assisted by pesticides, deep planting, soil mulching, shading and frequent irrigations.

The Philippine Bureau of Plant Industry reports that the fledgling white-potato industry in that country is bogged down by poor yields, high production costs, and snags in post-harvest handling. It's no wonder that the potato is a high-priced luxury food in many countries.

Needed are hardy new varieties that yield well under tropical conditions without requiring lavish care by the farmer.

Even five years ago, the idea of a tropically adapted potato variety seemed far-fetched. Today, Humberto Mendoza, potato breeder with the International Potato Centre, tells of several experimental lines that yield well at lowland tropical test sites. Equally encouraging, according to Mendoza, is that these lines mature early. Some yield 16 tonnes per ha in 60 days.

"Genetic resistance to disease is fundamental to a successful tropical potato," Mendoza adds. "The average tropical farmer can't afford to grow varieties that need heavy amounts of crop-protection chemicals. We already have tropical lines with resistance to bacterial wilt and late blight, and we are also screening for resistance to potato viruses X and Y."

(continued)

COVER: Although some cooks would throw them out, the potatoes on the cover are prized by plant breeders who know them as the Phureja, Stenotomum and Andigena potatoes. Native to Latin America, these groups harbor genes for disease resistance and other traits that are helping scientists develop better commercial varieties.

POTATOES /continued

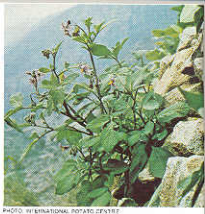


PHOTO: INTERNATIONAL POTATO CENTRE

Naturally selected for hardiness, a wild potato endures rocky terrain in the Andes.

Potatoes from seed. Another thing that will help spread potato farming to the tropics, according to the centre, is the rather revolutionary idea of planting potatoes from true seed rather than from cut-up tubers.

"It takes two tonnes of tubers to plant a hectare of potatoes from cut-up tubers," points out Sidki Sadik, plant physiologist at the International Potato Centre. "The average tropical farmer can't afford to plant that many potatoes or put that much food in the ground."

Going to true seed will also save the cost of sophisticated seed treatment and certification systems to avoid spread of diseases. True seed doesn't transmit major potato diseases, and it is much easier to store. Specialists at the International Potato Centre are working on a system whereby farmers would plant potato seeds in flats, then transplant the seedlings in much the same way they do rice.

Growing potatoes from seed is being tried in many areas, from India to New Zealand. The most spectacular example may be in the People's Republic of China, where it's reported that 8000 ha are grown from true seed.

"We still don't have all the answers on planting from true seed," reports Lindsay Harmsworth, International Potato Centre specialist stationed in the Philippines. "Heat and insects such as thrips are hard on tender seedlings. We are trying to increase survival rates."

Lack of uniformity is another problem with planting potatoes from seed, but breeders say they can solve this problem.

It is too early to tell if farmers in tropical rice-growing areas will adopt potatoes as a major crop. But Harmsworth, speaking of Filipino farmers, says they are as alert as any to making a profit...and potato prices are very high in the Philippines. "Once research comes up with a few more answers, I don't think it will be long before many farmers take up the crop," he says.

But hopes for a major expansion of potato growing rest heavily on the abilities of plant breeders to come up with new varieties. These hopes are kept alive by the remarkable genetic diversity of the potato. Potatoes of many shapes and colors are found in the Andes and other regions of South America, the original home of the potato. Some are wild. Others are cultivated varieties that have been grown by Indian farmers for well over 2,000 years. Types have been found growing at sea level and in the mountains at elevations above 3000 metres.

During their quest for gold, Spanish explorers collected potato specimens and took them to Europe in the 16th century. These selections led to the development of the potato industry in the cooler areas of the northern and southern hemisphere.

Rediscovery. Hundreds of years later, explorers of another kind returned to Latin America, looking not for gold but for fresh sources of potato germplasm to revitalize varieties that rode on a precariously narrow genetic base. They found types that not only tolerated a wide range of temperatures, but also withstood diseases and insects.

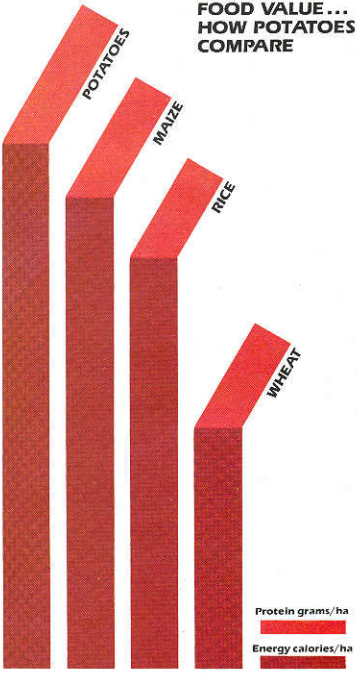
Today, world collections of potato germplasm are maintained at research stations throughout the world including the U.S., U.K., The Netherlands, Germany, Canada, U.S.S.R., Colombia, Argentina and Peru. This genetic stock is used to upgrade local varieties.

One such station in Wisconsin, U.S.A., maintains stocks of about 3,500 potato introductions, more than 2,000 of which are wild species. "Some of these introductions have provided genes for resistance to late blight, scab, certain viruses, and leaf roll," says Robert Hanneman, research geneticist with the U.S. Department of Agriculture, which operates the station in cooperation with the University of Wisconsin Experiment Station.

Breeding breakthrough. But only recently have scientists had the key to get at the full range of the potato's remarkable genetic diversity. The barrier has been a difference in chromosome numbers between the cultivated "tetraploid" varieties, which have 48 chromosomes, and some of the "diploid" lines from Latin America, which contain only 24.

Crosses between the two groups have not been fruitful...that is, not until a group of scientists at the University of Wisconsin, led by S.J. Peloquin, developed a genetic bridge between the tetraploids and diploids. The secret was to grow a plant from an unfertilized egg of a tetraploid. This creation, called a haploid, has only 24 chromosomes, half the number of a tetraploid, but the same number as a diploid. Some of these haploids crossed readily with diploids. The scientists then tried crossing

Potato seed: A cheaper way to plant potatoes. It could catch on first in the tropics.



Relative food values based on average world yields and typical energy and protein composition. Sources: International Potato Centre and U.S. Department of Agriculture.

the haploid/diploid hybrids back to a tetraploid, and found to their delight that most of the progeny of these crosses showed great hybrid vigour, indicating a good mix of genes between the tetraploids and diploids. Just as important, these hybrids had 48 chromosomes, making them true tetraploids.

All of the world's best-yielding potato varieties are tetraploids. Diploids are generally low yielders but rich sources of pest resistance and other traits. The new breeding technique gives geneticists a way to combine the high yields and high quality of the tetraploids with the toughness of the diploids.

The technique has been instrumental in the development of the tropical potato, says Humberto Mendoza at the International Potato Centre. "Combining tetraploid and diploid germplasm gives us parental material of widely divergent backgrounds," he explains. "This in turn imparts the hybrid vigour a potato needs to withstand the stresses of the tropical environment."

Better food. Meanwhile, Sharon Desborough and others at the University of Minnesota, U.S.A., are using the tetraploid/diploid connection to improve potatoes in another way. In screening the world collection for protein, she discovered that one of the cultivated Latin American diploids, the Phureja, contained phenomenally high protein levels of 18 to 20 percent. The average variety runs 5 to 6 percent. Plant breeders at Minnesota have crossed the Phureja with commercial tetraploid varieties and are now testing several hybrids that average 10 to 12 percent protein. Desborough says these new high-protein lines would be close to a perfect food nutritionally.

Examples of trail-blazing potato research are showing up in many parts of the world. In Australia, Clive Hackett and Peter Sands, of Australia's national research organization, CSIRO, have developed a mathematical growth model that can be used to predict how a certain potato variety will yield in various environments. Or, as an aid to plant breeders, the model can be reversed to give an agronomic profile of the ideal potato for a particular set of growing conditions.

It's too early to tell if the new wave of research will trigger another "green revolution" (or an "underground revolution," as some potato researchers like to say). But it does appear that the potato is on its way to becoming a more important world crop.

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"... *For what avail the plow or sail, or land or life, if freedom fail?*"
—*Ralph Waldo Emerson*