Chinese Academy of Agricultural Sciences
QPM Ceremony

COMMENTS BY
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I am delighted to participate in this Ceremony honoring the scientific teams responsible for the release of several new Quality Protein Maize (QPM) hybrids. QPM has been one of the most unheralded achievements in plant breeding of the past three decades. Its much higher levels of lysine and tryptophan than traditional maize, gives it protein quality approaching that of skimed milk, and distinct nutritional advantages over normal maize, especially for all monogastric animals, including humans.

QPM Research in the 1960s, 1970s, and 1980s

The nutritional importance of the Opaque-2 gene was discovered by Dr. E.T. Mertz and his colleagues at Purdue University in 1963—some 36 years ago. I recall well that period of great enthusiasm, when maize scientists around the world incorporated the Opaque-2 gene into their breeding programs with the aim to improve the nutritional quality of maize as a food and feedstuff. Since both lysine and tryptophan levels were known to be tightly linked, and both controlled by the Opaque-2 gene, this goal appeared to be achievable rapidly and at low cost.

The original hypothesis proved to be incorrect. Unfortunately, the mutant Opaque-2 gene, which contributed to the higher levels of lysine and tryptophan, also produced a number of negative pleiotrophic effects, including poor agronomic type; susceptibility to foliar diseases; soft endosperm that was highly susceptible to fungal ear rots and insect weevils, in both the field and in storage; slow grain dry down time; and greater kernel breakage during drying and shelling. Worst of all, it became apparent after five-to-eight years of breeding that the best experimental Opaque-2 materials yielded 15-20% less in grain weight that their best normal-protein counterparts.

To further confuse the Opaque-2 debate, a FAO/WHO report on human protein and caloric requirements revised down the previous estimate of protein requirements. This lower recommended protein requirement set off a heated debate between groups of nutritionists, which continued until 1987, when a research team from three American universities reported that human requirements for lysine, leucine, valine, and threonine were two-to-three times higher that had been proposed in the 1973 FAO/WHO report. These new findings were widely accepted within the scientific community.

In 1971 CIMMYT Maize Director, Ernest W. Sprague, organized an interdisciplinary Opaque-2 research team, led by plant breeder Surinder Vasal and biochemist Evangelina Villegas, to correct the many defects of the original soft-endosperm Opaque-2 material. It took the better part of two decades of painstaking research to correct these many defects. By the late 1980s, a number of high-yielding, hard-endosperm QPM varieties were developed, with grain type and yields comparable to the best conventional maize materials, and with added protein quality coming as a plus.

I wish to acknowledge the three consecutive grants (1972-84) from the UNDP's Global Projects Division, so ably led by the late William Mashler, that financed QPM research at CIMMYT. Without UNDP's generous support it is unlikely that CIMMYT would have persevered with its QPM research.

QPM Research in the 1990s

When poised to make a commercial impact, a lamentable decision was taken at CIMMYT in 1993 to discontinue QPM research and development. With the exit of CIMMYT from OPM research, only a few national research programs continued, most notably in China, Brazil, and South Africa.

China—China embarked on QPM research in the mid-1970s, under the leadership of the late Professor Li Ching-Hsiung, of CAAS, which has been continued up to the present by a new generation of breeders working QPM improvement, at CAAS and 9 provincial research centers. A half-dozen QPM hybrids were released during the 1990s, and collectively are now grown on about 350,000 ha.

In China, where nearly 80 percent of maize is fed to livestock, QPM can significantly improve feed conversion rates, especially for swine. I am very encouraged by the work currently underway in Longli county, Guizhou province, in south China to use QPM as part of a rural poverty-reduction program. Participating smallholder farmers with technical advice from extension workers and, access to the new QPM hybrids, rice middlings, and green "chop," will produce sufficient QPM to feed 8-10 pig, whose higher weight gains will, in turn, add more money to their pockets.

Brazil—Ricardo Magnavaca at EMBRAPA's National Maize and Sorghum Research Center (CNPMS), Sete Lagoas, initiated QPM research in the 1980s, which has been carried forward by a new generation of CNPMS scientists and several outstanding yellow grain (cateto, semi-dent) QPM hybrids and open-pollinated varieties have been released. It is estimated that 50,000 ha are currently planted to QPM materials.

South Africa—In South Africa, University of Natal Maize Breeder, H.O. Gevers, initiated QPM research in 1965 and has worked continuously since then to develop soft and hard endosperm hybrids with excellent agronomic characteristics. QPM hybrids are currently grown commercially on about 75,000 ha.

Ghana—Through the Sasakawa-Global 2000 program, funded by the Nippon Foundation of Japan, QPM research was restarted in 1990 in Ghana by scientists at the Crops Research Institute (CRI). This work led in 1994 to the release of the outstanding QPM variety, Obatanpa, which is now the most widely grown improved maize variety grown in Ghana, perhaps covering 400,000 ha. CRI continues a vigorous QPM research program. Three QPM hybrids were released in 1997 and are entering commercial seed channels. CRI prepares and distributes a QPM nursery to interested maize research institutes in other countries.

QPM Spreads in Sub-Saharan Africa—Other SG 2000 project countries have commenced QPM research activities, including Guinea, Ethiopia, Mali, and Mozambique. Obatanpa is also commercially grown in Benin, Burkina Faso, Guinea, and Mali, perhaps covering 25,000 ha in total area.

Latin America—I am particularly pleased that, Mexico—the home of QPM research and development—is now aggressively pursuing its introduction among farmers. Several new hybrids will be released this year by INIFAP, and the Secretary of Agriculture, has set a target of 2.5 million ha to be planted with QPM within the next 3-4 years. Achieving this ambitious target will hinge on the production of large quantities of high-quality seeds.

I also understand that QPM is being commercially produced on about 50,000 ha collectively in Paraguay, Venezuela, Ecuador, and Bolivia; and the area planted to QPM in Central America is expected to accelerate rapidly with the release of several new QPM hybrids in Guatemala and El Salvador, and soon in other countries.

CIMMYT's Resumes QPM Research—Motivated by the QPM successes in Ghana—the Nippon Foundation of Japan agreed to provide CIMMYT modest funding in 1996 to restart its QPM breeding improvement program. Since then, a new generation of promising QPM varieties and hybrids has begun to flow toward small-scale farmers in Asia, Africa, and Latin America. CIMMYT runs regional QPM breeding programs from its research center in Harare, Zimbabwe; and from its regional maize programs in Asia (Thailand) and Latin America (Colombia). CIMMYT maize scientists work closely with national QPM research programs.

Feeding Future Generations

Since Neolithic man—or most probably woman—domesticated the major crop and animal species some 10 to 12 millennia ago, agriculture has been a struggle between the forces of natural biodiversity and the need to produce food under increasingly intensive production systems to feed explosive population growth.

Thanks to advances in science during this century—which is when the population bomb really went off—global food production has kept ahead of population growth and, in general, become more reliable. Through the application of a continual stream of productivity-enhancing technology—all along the food chain—the real price of cereals and other food products has declined steadily, which has especially benefited the poor, who spend a much larger portion of the available income to feed their families.

Twenty-nine years ago, in my acceptance speech for the Nobel Peace Prize, I said that the Green Revolution had won a temporary success in man's war against hunger, which if fully implemented, could provide sufficient food for humankind through the end of the 20th century. But I warned that unless the frightening power of human reproduction was curbed, the success of the Green Revolution would only be ephemeral. I now say that the world has the technology—either available or well-advanced in the research pipeline—to feed a population of 10 billion people.

The more pertinent question today is whether farmers and ranchers will be permitted to use this new technology. Extremists in the environmental movement from the rich nations seem to be trying to stop scientific progress in its tracks. Small, vociferous, well-funded, and highly effective anti-science and technology groups are slowing the application of new agricultural technology, whether developed from biotechnology or more conventional methods. They also oppose the appropriate use of fertilizers and crop protection chemicals.

I am particularly alarmed by those who seek to deny small-scale farmers of the low-income countries—and especially those in sub-Saharan Africa—access to the improved seeds, fertilizers, and crop protection chemicals that have allowed the affluent nations the luxury of plentiful and inexpensive foodstuffs. While consumers in the affluent nations can certainly afford to pay more for the so-called "organically" produced foods, the one billion chronically undernourished people of the low-income, food-deficit nations cannot.

Concluding Comments

Over the past 35 years it has been amply proven that quality protein maize is nutritionally superior to normal maize. After years of selective breeding, high-yielding QPM materials (soft and hard endosperm) have been developed that are competitive in yield to the best normal-protein genotypes. There is no reason why this improved maize grain should not replace normal-protein maize as a food and feed.

In closing I want to congratulate and thank CAAS, provincial research institutes, and the cooperating central, provincial, and local governments for their determination to establish QPM as a commercial crop to improve livestock and human nutrition. Since the family benefits stand to be great, I hope that the experience in Guizhou to promote QPM as part of a high-yielding smallholder swine production package to increase family income will be well-documented and widely communicated.

My greatest wish before I die is to see quality protein maize grown on millions of hectares around the world. Those of us who are convinced that this goal is scientifically and economically achievable are still too few in number. Thus, it will take great determination and leadership on our part to get this research innovation into farmers' fields. Let us all join forces to convert the "potential benefits" of QPM into reality within the next five years. That is the challenge! We can **make it happen**, if we have the ***will* to do so**!