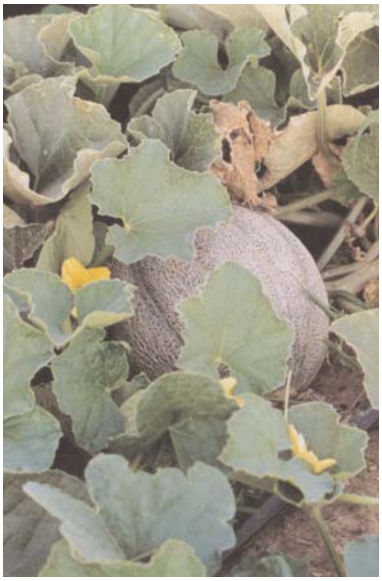
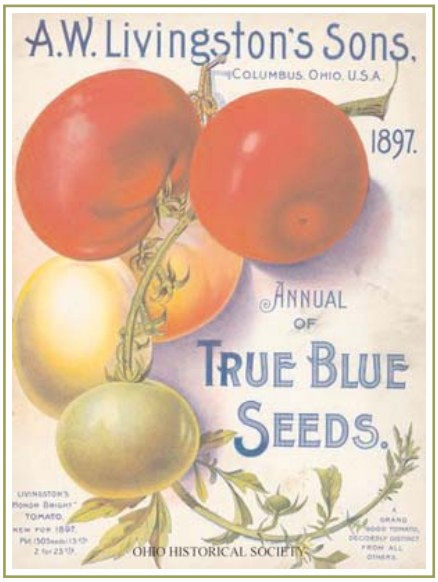
Heirloom Vegetables, Genetic Diversity, and the Pursuit of Food Security





by George Kuepper

The Kerr Center for Sustainable Agriculture
Serving Oklahoma's Farmers and Ranchers since 1965

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Kerr Center for Sustainable Agriculture

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The Kerr Center is a 501c(3) nonprofit educational foundation. The home office, farm and ranch are located in southeast Oklahoma.

Kerr Center Mission

The mission of the Kerr Center is to assist in developing sustainable food and farming systems by:

Supporting farms that provide a perpetual stream of economic goods and ecological/environmental benefits, and which enhance the quality of life of farm families, rural residents and society as a whole;

Promoting markets made up of independently owned and operated farms and firms of a scale appropriate to offer a wide variety of product choices for consumers and economic opportunities for existing and beginning farmers;

Encouraging communities to protect the land from misuse, exploitation, and unfettered urban development, to ensure inclusion and equality of opportunity for all; to promote community food security; and support economic development from within;

Proclaiming the need for a culture that respects the earth and all of its diversity of life, and which recognizes the physical, social and spiritual connections between people within a higher order of things.

Heirloom Plants and Historical Authenticity

In August 2007, I was fortunate to hear a presentation[1] by Wesley Greene, Garden Historian for Colonial Williamsburg in Virginia. He talked about the growing number of living history museums around the country, but lamented that curators, who typically invest hours ensuring period authenticity for furniture, wallpaper, tools, and architecture, often choose 20th-century garden plants that did not even exist at the time. Foods and plants are as much a part of our history and heritage as manufactured artifacts and other constructions, he asserted.

Historical value and authenticity are good reasons for preservation and continued propagation of heritage food and landscape plants; so are their unique characteristics. Grocery stores have conditioned us to believe all tomatoes are either pink or red, and hard-fleshed. In fact, heirloom tomatoes can be orange, yellow, white, purple, zebra-striped, and even green when ripe, and their flavors are just as variable and surprising. Similarly, carrots can be white, deep red, and yellow, as well as orange.

The diversity of our food and landscape plants is enormous. Gardeners and consumers have a world of options to explore. However, historical value and novelty are not the only reasons to take an interest in heirloom varieties, and they are not the most compelling.

Markets, Nutrition and Heirlooms

From 2000 to 2002, Kerr Center staff field-tested a number of heritage vegetable varieties under organic growing conditions. The purpose was to identify varieties that Oklahoma market growers might successfully raise and sell in local markets.[2]

Why would a consumer consider buying heirloom produce? Aside from simply wanting to "try something different," consumers are drawn by the belief that traditional fruits and vegetables either taste better, are more nutritious, or both. How many of us have heard someone say that today's "fruits and vegetables just don't taste like they used to"? Sometimes our memories play tricks on us, but before we discount it, consider the following.

In the late 1970s, the widely-read *Hightower Report* revealed that processing tomatoes—bred for the structural firmness needed for machine harvest—had fewer vitamins than the varieties they replaced.[3] Though these were not fresh-market tomatoes, it caused many to believe that contemporary plant breeders routinely traded off food quality for yield, uniformity, harvestability, and other characteristics prized by industrial agriculture.

In part, this appears to be true.[4] Studies done in Canada[5], Great Britain[6], and the United States found historical reductions in nutrient density of modern fruits and vegetables.

A Brief Glossary

Cultivar: Another term for a plant variety.

Genetic engineering: Applies to the manipulation of genes and implies that the process is outside the organism's natural reproductive process. It involves the isolation, manipulation and reintroduction of DNA. Sometimes genes from unrelated organisms are introduced, e.g. animal or bacterial genes into plants.

Genetically modified organisms (GMOs): Applies to plant varieties, microbes or other living organisms that have been genetically engineered.

Heirloom variety: Heirlooms are typically open-pollinated cultivars that were grown prior to widespread use of hybridization. The terms heirloom seed and heritage seed are used interchangeably.

Hybrid variety: The result of crossing two genetically unlike parents of the same species. Hybrid varieties are typically vigorous plants, though seed from hybrids usually performs poorly and will not resemble the parents. To obtain reliable performance, new seed must be purchased each season.

Landrace: Refers to a plant variety that is adapted to the natural and cultural environment in which it originated. Landraces are developed through selection over generations and/or through other traditional breeding methods. The term refers to older, less modern cultivars.

Open-pollinated variety: A variety from which seeds can be saved. Unlike hybrids, seeds from open-pollinated varieties will produce plants that resemble the parents.

Two studies were conducted in the U.S., both using data collected and published by the USDA's Nutrient Data Lab. The first study, conducted by a nutritionist at the Kushi Institute in Massachusetts, studied nutrient changes from 1975 through 1997. It found vitamin and mineral content declined as much as 25–50% in both fruits and vegetables.[7] The second study, done by a team at the University of Texas at Austin, studied 43 garden crops over a period from 1950 to 1999. Looking at average changes, they found "reliable declines" in six nutrients—protein, calcium, phosphorus, iron, riboflavin, and ascorbic acid. The differences ranged from 6% for protein to 38% for riboflavin.[8]

A number of factors affect the nutritional quality of crop plants. USDA soil scientist Sharon Hornick lists six principal factors, one of which is the crop cultivar used.[9] Dr. Donald Davis, a member of the University of Texas team that conducted the second U.S. study, believes that changes in cultivated varieties accounted for most of the differences they found.[10] If he and others are correct, it suggests that heirloom varieties may well be more nutritious than the modern hybrids that replaced them.

All of this tells us that heirlooms should be a market opportunity for small growers who hand-harvest and sell locally. They can easily rationalize promoting and charging a premium for heritage produce. But it's not as simple as it seems.

A major benefit of modern cultivars is better yields. Emily Oakley, an Oklahoma market gardener, has stated that in her experience it took about five times as many heirloom tomato plants to provide the same quantity of fruit as one modern hybrid variety.[11] The cost to grow a single plant, either heirloom or modern hybrid, is not vastly different. So it might be difficult for a farmer to charge enough to recover the higher costs of producing heirlooms when yields are several times lower than comparable hybrids.

That said, heirloom produce appears to be growing in popularity and it is becoming more available at local market venues. It seems that growers have figured out how to cope with the yield differential!

Genetic Diversity vs. Genetic Erosion

While the reasons cited so far are all important, the most compelling reason for interest in heirlooms these days is the preservation of genetic diversity. The traditional varieties of crops that we call heirlooms emerged through many years of evolution and selection by generations of farmers and gardeners. In most cases they developed at the margins of natural ecosystems and constantly exchanged genes with their wild relatives, making them a rich genetic reservoir.

These thousands of "landraces" collectively contain the genetic material and potential necessary to the development of modern varieties[12] - the genes for dealing with climatic change, disease outbreaks, pest pressure, and the unique needs of organic production, as well as those that promote nutrition and flavor.

Throughout much of the 20th century until today, there has been a progressive decline in the number of landrace and heirloom varieties of crops – a phenomenon called "genetic erosion." Genetic erosion essentially occurs when farmers and gardeners replace their traditional varieties with commercially developed, genetically uniform cultivars.[13]

A few historical events have triggered rapid and large instances of genetic erosion. One was the rapid adoption of hybrid corn in the 1930s; another was the "Green Revolution" that stretched from the 1940s through the 1960s. In the latter case, third-world farmers replaced mixed but hardy landrace varieties with modern high-yielding types that required more fertilizer, pesticides, and irrigation to perform. Yields increased, but genetic resources were lost. Many poor and small farmers were displaced by the few who could afford the costly inputs and seed.[14]

At the moment, we are in the midst of another historical period when vast numbers of crop varieties are in danger of being lost. The driving force is the evolution of the seed industry that more and more controls this critical link in the world's food supply chain.

Plant Variety Protection – Intended and Unintended Consequences

Beginning in the early 1960s, international efforts at plant variety protection (PVP) began to emerge. The goal was to ensure legal rights and income for plant breeders while encouraging development of superior varieties for farmers and gardeners.

Initially, breeders sought to patent their varieties, but serious questions were raised about the rights of farmers to save and plant

their own seed. Saving seed to plant next season is among the most fundamental practices of agriculture. It has long been seen as an unquestioned right for farmers and gardeners.

In 1961, the International Union for the Protection of New Varieties of Plants (UPOV) was formed. It provided a compromise system of protection for both breeders and farmers. It gave breeders control of commercial multiplication and marketing, but allowed farmers to continue saving and using seed on-farm.

The United States essentially signed on to the UPOV system with the 1970 Plant Variety Protection Act (PVPA). The UPOV and PVPA allowed other breeders free access to use any new variety to develop another new cultivar.[15] This was deemed important to the continued rapid development of new varieties, as well as ensuring that germplasm did not become proprietary and locked away from public access. The UPOV system appeared fair and workable, but this was before genetic engineering.

In 1991, with genetic engineering technology in ascendance, PVP laws were expanded. Biotech companies began to receive utility patents on new varieties. A utility patent constrains farmers from saving that seed for replanting. It also prevents another breeder from using the cultivar to develop another new variety. The United States Supreme Court ensured the legal right for plant patenting in the U.S. in late 2001, in the case of Pioneer Hi-Bred International v. J.E.M. Ag Supply.[16]

Restrictions on farm-saved or "bin-run" seed are a potential disaster for farmers internationally and a threat to global food security. Roughly two thirds of all cropland is currently planted with farm-saved seed. The practice is most common in less industrialized countries, where farm-saved seed is used on 80–90% of the acreage.

Even in industrialized nations it is not uncommon for large amounts of cropland to be planted with bin-run seed. Argentina, Australia, Canada, and Poland – all major agricultural producers – reported farm-saved seeds accounted for 65–95% of seeds used.

Not only is the current version of UPOV being pressed on developing nations by the World Trade Organization's TRIPS (Agreement on Trade-Related Aspects of Intellectual Property Rights), but the global seed industry is lobbying to close all remaining loopholes that allow for farm-saved seed and breeder access to patented varieties.[17]

The Global Seed Industry?

So how did a global seed industry come into being? For many decades, the public and private sector roles in the seed industry were rather simply defined. The public sector – represented largely by the USDA and land-grant universities – did most of the

research and varietal development. New varieties were licensed to relatively small seed companies that multiplied the seeds and marketed to farmers and gardeners. Small seed companies, with a few exceptions, seldom had the resources to do the research required to develop their own varieties. The notable exception was the hybrid corn industry, where large companies grew quickly, setting up their own breeding programs.

As plant breeder rights received greater recognition, it became more profitable to develop new varieties, and private entities made increasing investment in research and development. The emergence of plant patenting and genetic engineering boosted profitability for private plant breeding, but often left public breeding programs to stagnate.[18]

These increasing profits led to consolidation and the creation of global seed giants. In 2005, the ETC group reported that the top ten seed corporations controlled around one-half of world seed sales. This essentially means that the world seed industry is, or is rapidly becoming, an oligopoly—a state of limited competition where the market is controlled by a small number of producers or sellers. As such, the world's food supply is increasingly subject to the whims of "market maneuvers." Many fear that these large corporations, driven by the profit motive, will undertake market maneuvers that are not in the interests of the public or global food security.[19]

On the surface it may appear that concerns are limited largely to commodity crops like corn, soybeans and cotton. This is far from true. In 2000, Seminis – then the world's largest vegetable seed corporation – eliminated two thousand varieties from its

commercial line. Many of these were likely acquired as a result of its earlier buyouts of Petoseed, Royal Sluis, and the garden seed division of Asgrow. While Seminis maintained that the germplasm would remain accessible to its own breeders, it would no longer be available to other breeders, or to farmers and gardeners.

The Seed Savers Exchange, which monitors the diversity of non-hybrid varieties in mail order seed catalogs, notes that the number available dropped from about 5000 in 1981, to about 600 in 1998.[20] The United Nations Food and Agriculture Organization (FAO) estimates that, since the beginning of the 20th century, we have already lost about 75% of the genetic diversity among ALL of our agricultural crops.[21]

What Can We Do?

As complex as food security issues are, the options for addressing them always include sound local solutions:

- Farmers and gardeners: Consider growing a few heirloom varieties. Try saving seed for the following season. For more

information, access Kerr Center's *Heritage Vegetables & Seed Saving* information packet online at www.kerrcenter.com or by calling the center. To locate sources for heirloom seed, see ATTRA's *Suppliers of Seed for Certified Organic Production Database* at attra.ncat.org/attra-pub/altseed_search.php. Select "Untreated, Non-GMO, and Open-pollinated Seed" in the options list. A large number of small, heirloom seed companies are featured.

- Consumers: Ask for and purchase heirloom produce. You are most likely to find heirlooms at local venues like farmers' markets and roadside stands.

- Citizens: Educate yourself on the issues and support the organizations and initiatives that promote responsible plant breeding, heirloom preservation, and food security (see box below).

A Short List of Organizations/Resources

Kokopelli Seed Foundation
59 Westland Avenue
Boston. MA. 02115
www.kokopelli-seed-foundation.com

Native Seeds/SEARCH
526 N. Fourth Avenue
Tucson, Arizona 85705
Tel: 520.622.5561
www.nativeseeds.org/v2/

The Safe Seed Initiative
c/o Council for
Responsible Genetics
5 Upland Rd., Suite 3
Cambridge, MA 02140
Tel: 617.868.0870
www.gene-watch.org

Organic Consumers Association
www.organicconsumers.org

Organic Seed Alliance
P.O. Box 772
Port Townsend, WA 98368
Tel: 360.385.7192
www.seedalliance.org

Public Seed Initiative
USDA—ARS,
Plant Genetic Resources Unit
Geneva, NY 14456-0462
Tel: 315.787.2396
www.plbr.cornell.edu/psi/

The No White List Coalition
www.geocities.com/nowhitelist

Seed Savers Exchange
3094 North Winn Road
Decorah, Iowa 52101
Tel: 563.382.5990
www.seedsavers.org

Southern Seed Legacy
Department of Anthropology,
250A Baldwin Hall
University of Georgia
Athens, GA 30602
Tel: 706.542.1430
www.uga.edu/ebl/ssl/

The inspiration for this article came from a visit to Baker Creek Heirloom Seeds, in Mansfield, Missouri. My wife, some friends and I attended their 8th Annual Heirloom Garden Show – a two-day festival, country market, and educational program. We strongly recommend it as an educational outing, or just for fun.

Baker Creek, with its large catalog of heirloom offerings, successful magazine (The Heirloom Gardener), and full season of public programs, is an example of how much interest there is in heirloom gardening. For information, contact: Baker Creek Heirloom Seeds, 2278 Baker Creek Road, Mansfield, MO 65704; Tel: 417.924.8917; www.rareseeds.com.

1. Greene, Wesley. 2007. Under the Knife: A History of Pruning. Heirloom Garden Show 2007. Baker Creek Heirloom Seed Co., Mansfield, MO. August 6.

2. Redhage, David. 2001. The Heirloom Report. *Field Notes* 27(2):14–15. Kerr Center for Sustainable Agriculture.

3. Hightower, James. 1978. *Hard Tomatoes, Hard Times: A Report of the Agribusiness Accountability Project on the Failure of America's Land Grant College Complex.* HarperCollins Publishers, New York, NY. June. 224 p.

4. Note that not all "advances" in plant breeding solely benefit large-scale production. Prime examples are disease-resistant cultivars, which are welcomed by organic growers as well as conventional producers.

5. Picard, André. 2002. Today's foods lack yesterday's nutrition. Bell Globemedia Interactive Inc. 4 p. www.theglobeandmail.com/special/food/wxfood.html

6. Anon. 2005. Mineral depletion in food. *Organic Voice* 9(2): 21.

7. Jack, Alex. 1998. Nutrition under siege. *One Peaceful World Journal* 34(1): 7–9.

8. Davis, Donald R., Melvin D. Epp, and Hugh D. Riordan. 2004. Changes in USDA food composition data for 43 garden crops, 1950 to 1999. *Journal of the American College of Nutrition* 23(6): 669–682.

9. Hornick, Sharon B. 1992. Factors affecting the nutritional quality of crops. *American Journal of Alternative Agriculture* 7(1-2): 63–68.

10. Davis is quoted in: Staff. 2005. Nutrients decline in garden crops. *In Good Tilth* 16(1):21.

11. Oakley, Emily. Comment made during the Kerr-sponsored Direct Marketing Workshop, Three Springs Farm, Cherokee County, Oklahoma. August 2, 2007.

12. Guru, Manjula V. and James E. Horne. 2000. Mourning the Increasing Loss of Biodiversity. The Kerr Center for Sustainable Agriculture, Poteau, OK. 38 p.

13. Cox, T.S. and W. Jackson. 2002. Agriculture and biodiversity loss: genetic engineering and the second agricultural revolution. p. 96–99. In: Eldredge, Niles. (Ed.) *Life on Earth: An Encyclopedia of Biodiversity, Ecology, and Evolution*.

14. Perelman, Michael. 1976. T*he Green Revolution: American Agriculture in the Third World*. p. 111–126. In: Merrill, Richard. (Ed.) 1976. Radical Agriculture. Harper & Row, Publishers, New York, NY. 459 p.

15. Anon. 2007. Plant breeders' rights. Wikipedia. May 13. 3 p. http://en.wikipedia.org/wiki/Plant_breeders%27_rights

16. Guebert, Alan. 2001. Supreme Court blesses plant patents; bye-bye bin-run seed. *The Land*. December 21. p. 3.

17. GRAIN. 2007. The End of Farm-Saved Seed? Industry's Wish List for the Next Revision of UPOV. GRAIN, Barcelona, Spain. 12 p.

18. Fernandez-Cornejo, Jorge, and David Schimmelpfennig. 2004. Have seed industry changes affected research effort? *Amber Waves* 2(1): 14-19. www.ers.usda.gov/AmberWaves/February04/Features/HaveSeed.htm

19. ETC Group. 2005. Global Seed Industry Concentration—2005. Communiqué. ETC Group, Ottawa, Ontario, Canada. Issue #90. September–October. 12 p.

20. Guidetti, Geri. 2000. Going…Going…Gone…Two Thousand Vegetable Seeds Eliminated! *Food Supply Update*. July 2000. The Ark Institute. www.arkinstitute.com/2000/July2000%20Food%20SupplyUpdate.htm

21. Shand, Hope. 1998. Human Nature: Agricultural Biodiversity and Farm-based Food Security. Rural Advancement Foundation International (RAFI) for FAO. Excerpts available at www.fao.org/sd/Epdirect/Epre0040.htm

Other Kerr Center Publications on Biotechnology and Biological Diversity

The Next Green Revolution: Essential Steps to a Healthy, Sustainable Agriculture
By James E. Horne, PhD and Maura McDermott, 2001 Food Products/Haworth Press
Chapter 6: All Creatures Great and Small: Step 5—Encourage Biodiversity
Order at:
www.kerrcenter.com/HTML/green.html

Kerr Center reports on biotechnology are available on the center's Public Policy and Rural Development publications pages: www.kerrcenter.com/HTML/pub2.html

Attitudes Concerning Biotechnology: A Survey (short report) by Manjula Guru, 2000. Results of a ten question survey exploring the attitudes of rural Oklahomans and others towards genetically modified crops and foods.

Biotechnology: A Boon or a Curse? (short report) by Manjula Guru and James E. Horne, 2000. Explores the advantages and disadvantages of biotech in agriculture, and concerns about the loss of biodiversity with the advent of the biotechnological age.

Mourning the Increasing Loss of Biodiversity (report) by Manjula Guru and James E. Horne, 2000. A thorough exploration of the importance of genetically-diverse crops and the threat biotech poses to biodiversity.

Mourning the Increasing Loss of Biodiversity: A Summary (summary of the report) by Manjula Guru and James E. Horne, 2000.

George Kuepper

George Kuepper has close to 30 years of experience with sustainable and organic agriculture. He has worked mostly in the non-profit sector as a researcher, educator, producer, and consultant, including an earlier stint with the Kerr Center in the late 1980s. Before rejoining Kerr Center, he worked for NCAT (the National Center for Appropriate Technology) on the ATTRA Project and served as NCAT's Midwest Office Director in Lewis, Iowa. There he focused on organic agriculture, specializing in compliance, certification, and transition issues. George is currently responsible for developing Kerr Center's intern program, for reviving organic horticultural demonstrations on the ranch, and for reviewing and updating Kerr Center's technical publications and information packets.

George is originally from Wisconsin, where he grew up on a small dairy farm outside of Milwaukee. He earned a bachelor's degree in geography and a master's in agronomy from the University of Wisconsin at Madison. His home is now in Fayetteville, Arkansas, where he lives with his wife, Dee, and an ever-changing number of pets.