Agriculture: African origins may go south

Carbonized seeds discovered at an archaeological site in the Sahara Desert provide preliminary evidence that prehistoric inhabitants of the African savanna cultivated plants 8,000 years ago, much earlier than previously thought.

The finding, published in the Oct. 22 NATURE, challenges a long-standing theory that African agriculture first sprouted in Egypt about 6,400 years ago with the domestication of wheat and barley, then spread southward.

By contrast, investigators suspect plant cultivation first arose in southwestern Asia around 12,000 years ago (SN: 2/18/89, p.101).

"We have evidence for the intensive use of wild plants at an African site where they were undoubtedly harvested in great quantity," says archaeologist Fred Wendorf of Southern Methodist University in Dallas, who directed the excavation. "But it's premature to suggest that the domestication of wild plants definitely took place."

Even in the absence of domestication, massive seasonal harvesting represents an immediate precursor of planting and protecting crops, Wendorf asserts.

His team investigated a site in southernmost Egypt, just north of Sudan, that attracted initial excavations in the mid-1970s. At the time of its occupation, the desert site was located in a savanna and experienced seasonally heavy rains.

Further excavation of the site in 1990 and 1991 by Wendorf's group uncovered four houses and 12 large storage pits. The floors of the structures contained traces of 15 hearths, as well as 122 shallow depressions, or "cooking holes."

In ashy sediment piled up around some of the cooking holes, the researchers found several thousand carbonized seeds from more than 40 different plants, including sorghum, millets, legumes, fruits, nuts, and tubers. Prehistoric residents apparently placed food containers in the cooking holes and spread hot ashes around the vessels to heat their contents, Wendorf says. The contents sometimes boiled over or fell into the ash, contributing seeds for preservation, he maintains.

Radiocarbon dates for the seeds cluster around 8,000 years ago.

Although the ancient sorghum remains look much like modern wild sorghum, the chemical makeup of fats encased in the carbonized seeds more closely resembles that of modern domestic sorghum, the scientists contend.

Their chemical analysis relied on a recently developed technique in which researchers deliver a dose of infrared light to a seed and obtain data on its fat composition through a light-sensitive spectroscope. Other scientists have found that the technique distinguishes between wild and domestic forms of wheat and barley, Wendorf says.

His team compared the fat chemistry of five carbonized sorghum seeds to that of seeds from three cultivated forms of sorghum and four wild sorghum species. They plan to conduct the same analysis on hundreds of additional ancient seeds.

"We've got a long way to go before we understand the process of plant domestication in Africa," Wendorf says. "But I'd bet we eventually find a pattern of intensive plant use at many Saharan sites from the same time period." — *B. Bower*

Big fullerene clusters form an onion shape

A scientist investigating recently discovered microscopic carbon tubules (SN: 7/18/92, p.36) has inadvertently created yet another form of this common element.

Carbon soot, when subjected to intense high-energy beams of electrons, transforms into nested layers of spheres, says Daniel Ugarte, an electron microscopist at the Federal Polytechnic School of Lausanne in Switzerland.

This onion-like structure represents the latest twist in the developing story of hollow, all-carbon molecules called fullerenes, and it challenges the notion that graphite represents the most stable configuration for carbon, Ugarte reports in the Oct. 22 NATURE.

Electron microscopists typically use electron beams instead of light to image their samples. But for this study, Ugarte turned up the intensity of the beam and irradiated soot samples for up to one-half hour. Periodically he adjusted the beam so that he could see how this irradiation affected the carbon particles.

"I was sure I would get just disordered graphite," Ugarte told SCIENCE NEWS. "Instead I saw I was getting spherical, shelled particles."

He observed that the beam causes the carbon atoms to move about. Tubules break apart and rearrange as concentric spheres. "The higher the [energy] dose, the quicker the transformation," Ugarte adds. Some spheres contained approximately 70 shells and measured 47 nanometers in diameter.

Theorists have asserted that graphite — in which atoms arrange like chicken wire, in a flat sheet of hexagons — represents the most stable form of carbon. But that may hold true only for infinitely large graphite sheets, says Harold W. Kroto of the University of Sussex in Brighton, England. Sheets with a finite number of atoms have edges with dangling bonds: The carbon atoms along these borders need to attach to something else in order to become stable.

Thus, when 60 to 600 carbon atoms link up, the dangling bonds encourage the formation of hollow fullerenes, Kroto says. Ugarte's work now shows that collections containing millions of carbon atoms also curl and seem most stable in the form of multilayered spheres, he adds.

"[The new results] cast light on the mechanism by which carbon atoms can rearrange themselves," Kroto says.

Ugarte hopes researchers will eventually learn to manipulate the spacing between these concentric layers of carbon by putting other atoms between the layers. The resulting materials would have new properties, he says, "but we are not yet at the point that we can control this very well." — *E. Pennisi*

Tests flunk, study finds

Tests administered to most elementary and high-school students in the United States exert a strong detrimental influence on science and math teaching, according to a new $1 million study performed for the National Science Foundation. And because schools with high minority enrollments generally place a greater reliance on scores from these tests, the study finds, there tends to be "a gap in instructional emphases between high- and low-minority classrooms that conflicts with our national concern for equity in the quality of education."

George F. Madaus and his colleagues at Boston College analyzed not only the six most widely used national standardized tests, but also the tests designed to accompany the four most commonly used science and math texts in fourth-grade, eighth-grade, and high-school classrooms. Though curriculum experts argue that schools should place greater emphasis on problem solving and reasoning, the new study indicates that the tests focus on lower-level skills — primarily rote memorization and application of routine formulas.

That's a serious problem, the authors charge, because these tests inadvertently set the agendas of many teachers.

Researchers surveyed more than 2,200 math and science instructors, interviewing in depth some 300 teachers and administrators. Especially in schools with high minority enrollments, teachers reported feeling pressured to help students perform well on these tests. Some states judge schools and some schools determine teacher assignments based on students' test scores.

With so much at stake, Madaus says, teachers feel compelled to focus their instruction on drilling what the tests will measure — at the expense of the more valuable, higher-level skills. □