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Wheat Domestication: Archaeobotanical Evidence

Genetic evidence of Manfred Heun *et al.* (Reports, 14 Nov, p. 1312) for einkorn wheat domestication in southeast Turkey has been countered by Martin K. Jones *et al.* (Letters, 16 Jan., p. 302). Jones *et al.* cite evidence that agriculture began earlier in the southern Levant and that einkorn was one of the original domesticates there. Recent archaeobotanical work does not support the picture presented by Jones *et al.*

Archaeological plant remains from four pre-pottery Neolithic A (*1*) sites are said by Jones *et al.* to indicate domestication of einkorn, emmer, and barley in the southern Levant at about 8000 to 7700 years B.C. (radiocarbon-dated). Einkorn is absent from all four sites and from the earlier site of Ohalo II (17,000 B.C.) in the same region (*2*). There is no evidence for domesticated plants in the PPNA levels of Jericho, Netiv Hagdud, and Gilgal (*3*). The earliest level (IA) of Aswad (7800 to 7600 B.C.) contains emmer and barley that may be domesticated (*4*). Domesticated einkorn does not appear in the region until the PPNB, at Jericho (7300 B.C.) and level II at Aswad (6900 B.C.).

In contrast, both wild and domesticated einkorn and emmer are present at early agricultural sites in the northern Fertile Crescent of southeast Turkey and northern Syria dating from 7700 to 7500 B.C. (*5*). Wild einkorn is also present in pre-agricultural levels of sites in this region, including Mureybit (8500 B.C.) (*6*), phase 1 of Abu Hureyra (9500 to 8000 B.C.) (*7*), Dja'de (9600 B.C.), and Jerf al Ahmar (9800 BC) (*8*). This fits well with the current-day distribution of wild einkorn, abundant in the northern Fertile Crescent, but virtually absent from the southern Levant (*9*). Study of seeds and charcoal from early Holocene sites in southwest Asia confirms that vegetation at this period was similar to current-day potential vegetation(*10*).

In view of the small number of excavated sites and the large error limits associated with Neolithic radiocarbon dates, current archaeobotanical evidence does not allow localization of agricultural origins to any one subregion within the fertile crescent. However, the genetic evidence for domestication of one crop, einkorn, in southeast Turkey agrees well with archaeobotanical evidence. Whether other crops were domesticated in the same part of the Fertile Crescent remains to be established.

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References and Notes

1. The earliest Neolithic of southwest Asia is divided into the PPNA (8300 to 7600 B.C.) and the PPNB (7600 to 6000 B.C.) periods.
2. M. E. Kislev, D. Nadel, I. Carmi, *Rev. Palaeobot. Palynol.* **73**, 161 (1992).
3. Plant remains from the PPNA levels at Jericho consist of fragmented grains of emmer and barley of undetermined wild or domesticated status, dating to about 7500 B.C. [M. Hopf, in *Jericho*, K. Kenyon and T. A. Holland, Eds. (British School of Archaeology in Jerusalem, London, 1983), vol. 5, pp. 576–621]. The only cereal remains at Netiv Hagdud (7700 to 7400 B.C.) are of wild barley [M. E. Kislev, in *An Early Neolithic Village in the Jordan Valley*, O. Bar-Yosef and A. Gopher, Eds. (Peabody Museum of Archaeology and Ethnology, Harvard Univ., Cambridge, MA, 1997), pp. 209–236]. Plant remains from the nearby site of Gilgal are unpublished and therefore of uncertain status.
4. W. van Zeist and J. A. H. Bakker-Heeres, *Palaeohistoria* **24**, 165 (1982).
5. Domesticated einkorn, emmer, and barley are reported from Cafer Höyük at 7500 BC [D. de Moulins, *Cah. Euphrate* **7**, 191 (1993)] and from Abu Hureyra at 7700 B.C. (phase 2A) [D. de Moulins, *Agricultural Changes at Euphrates and Steppe Sites in the Mid-8th to the 6th Millennium B.C.* (Britsh Archaeological Reports, Int. Ser. 683, Oxford, 1997)].
6 W. van Zeist and J. A. H. Bakker-Heeres, *Palaeohistoria* **26**, 171 (1984).
7. G. C. Hillman, S. M. Colledge, D. R. Harris, in *Foraging and Farming: The Evolution of Plant Exploitation*, D. R. Harris and G. C. Hillman, Eds. (Unwin Hyman, London, 1989), pp. 240–268.
8. G. Willcox, *Veg. Hist. Archaeobot.* **5**, 143 (1996).
9. D. Zohary and M. Hopf, *Domestication of Plants in the Old World* (Clarendon, Oxford, 1993).
10. G. C. Hillman, in *The Origins and Spread of Agriculture and Pastoralism in Eurasia*, D. R. Harris, Ed. (Univ. College London, London, 1996), pp. 159–203.

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HIV Vaccine Trials

Barry R. Bloom (*Science*'s Compass, 9 Jan., p. 186) provides an insightful analysis of ethical issues in human immunodeficiency virus (HIV) vaccine trials. The implicit ethical imperative to provide the "best proven preventive" methods to trial participants, however, should include social and behavioral interventions to reduce HIV risk behavior, a topic not covered in Bloom's discussion. The 1997 National Institutes of Health (NIH) Consensus Development Conference on "Interventions to Prevent HIV Risk Behavior" (*1*) can be used as a summary of current "best proven preventive" methods.