Supporting Information

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SI Text

Teosinte Gene Expression. In teosinte, other genes that were differentially expressed in early Holocene vs. modern conditions and not previously identified as domestication candidates nonetheless have functions known or suggested in maize and other grasses to mediate the following key trait differences observed in the experimental growouts (see refs. 27, 59 for further details): (*i*) vegetative architecture: phytohormone genes such as auxins were differentially expressed, and they are known to influence this trait, possibly through interactions with the *tb1* gene; (*ii*) inflorescence sexuality: recently discovered hormones called "Brassinosteroids" that now are known to control this trait partially in maize were differentially expressed; (*iii*) plant height: phytohormones, including gibberellins, and gibberellin regulators called "DELLA" that modulate plant growth and responses to abiotic stressors, such as cold, in maize were differentially expressed.

Studying GA in Maize Domestication. Approaches increasingly used by investigators to study possible incidences of GA use a comparative transcriptome analysis that correlates changes in phenotype with possible differential expression of genes in the inducing and noninducing environment (63, 64). Here we had the advantage of being able to work with both the ancestral and derived plant, because the former presumably would exhibit more plasticity than the latter, and selected traits can be placed in an evolutionary context (e.g., refs. 19, 33). Domestication studies typically will provide this beneficial circumstance, because wild progenitors of many important crops have been identified and are still found on modern landscapes. Therefore, to study GA, we grew traditional land races of Mexican maize in the same early Holocene and modern conditions of atmospheric CO_2 and temperature used for teosinte. RNAseq analysis was carried out on the maize to determine if DE genes in teosinte were invariant in expression in maize in the contrasting environments; we inferred such invariability would represent GA at those loci. The comparative gene expression results do suggest that a substantial loss of plasticity occurred during maize domestication, because numerous genes that were differentially expressed in teosinte were not differentially expressed in maize, including 83 with previous evidence of selection and that mediate diverse traits. Moreover, a number of genes that were differentially expressed in teosinte (discussed in part above), that were not previously identified as targets of selection but that nonetheless have relationships to vegetative architecture, inflorescence sexuality, plant height, and yield, were invariant in maize, thus also suggesting GA.

Other Current Examples of Crop Plant Plasticity. The plants discussed thus far exemplify examples of trait plasticity that was lost during domestication; it may turn out that plasticity was lost in a majority of cases, because farmers would be expected to decrease environmental sensitivity in their crops. However, there were instances in which plasticity was maintained in the domesticated species, reducing fitness in some environmental contexts. For example, manioc (*Manihot esculenta* Crantz) retained plasticity from its wild ancestor in growth form (shrub or liana depending on savanna or forested environment), but stem brittleness, which apparently was favored by farmers for ease of harvesting, limits growth of the liana form in abandoned fields (109). Another less well-documented example of plasticity in traditional cultivars concerns fruit bitterness, considered a premier wild trait in the Cucurbitaceae, a family that gave rise to many Old and New World domesticates (squashes, gourds, cucumbers, and others) including some of the earliest crops of the Americas. However, recent evidence indicates the trait is plastic in some varieties of domesticated cucumber (*Cucumis sativus* L.), because nonbitter fruits become bitter when exposed to cold temperature stress, a process controlled in part by a newly discovered transcription factor (110). Bitterness in all economic cucurbits is conferred by the triterpenoids cucurbitacins. Therefore, a possible association of plasticity and temperature variability in the evolution of nonbitter fruits would lend itself to study in other Cucurbitaceae, including *Cucurbita* spp. squashes, which in Mesoamerica and South America were domesticated at the beginning of the Holocene.

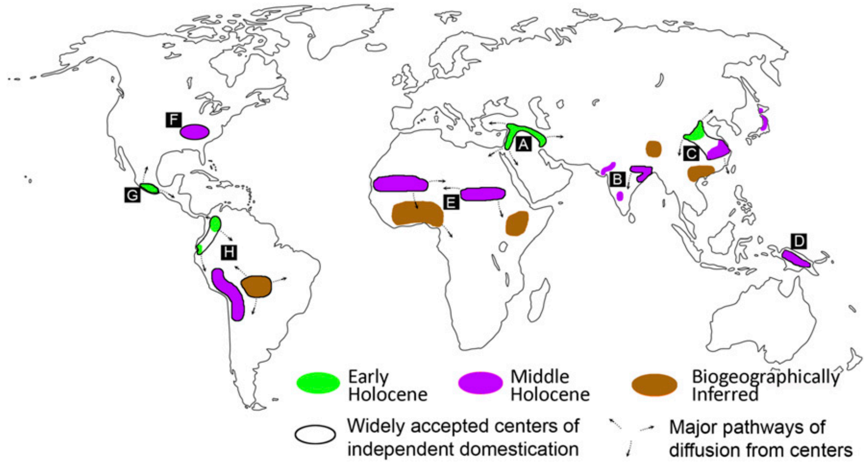

Fig. S1. A map depicting known or likely centers of plant domestication. Black outlines surround the most widely accepted independent centers of domestication, and sources of major diffusions of domesticates are indicated by arrows. Green and purple regions are those where the domestication process took place during the late Pleistocene to early Holocene transition (12,000–8,200 y B.P.) and in the middle Holocene (8,200–4,200 y B.P.), respectively. Brown regions represent areas where, at present, the evidence for domestication is interpreted based on the presence of domestic forms indigenous to these regions found outside their native distributions. The letters A–H correspond to the following: A, Southwest Asia (wheat, barley, lentil, pea, chickpea); B, India [rice (indica), millets, mungbean]; C, China [broomcorn millet, foxtail millet, rice (japonica), soybean, melon]; D, New Guinea (banana, taro, yam); E, Africa (date palm, sorghum, pearl millet, African rice, oil palm); F, Eastern North America (acorn and spaghetti squash, sunflower, sumpweed, goosefoot); G, Mexico (maize, pumpkin squash, common and lima beans, avocado, chili pepper); H, South America [chili peppers, peanut, cotton, squashes (butternut and Hubbard), common and lima beans, manioc, sweet potato, white potato, yam, quinoa]. Reproduced from ref. 2.

Fig. S2. Maize's wild ancestor teosinte in its natural habitat in Guerrero, Mexico growing in poor, shallow soils. It responded with plasticity to produce maize traits in vegetative architecture and inflorescence sexuality as described in the legend of Fig. 1 caption. Image courtesy of Anthony J. Ranere.

Table S1. Some known and potential examples of plasticity for important domestication traits in domesticated plants and wild ancestors

Species	Plastic change	Environmental factor (refs.)
Zea mays ssp parviglumis (wild maize)	Vegetative architecture, flower sexuality	Shade, poor soils, little moisture (55, 58) Past low CO_2 and temperature (experimental) (27)
Triticum monococcum (einkorn wheat)	Seed size increase	Enriched soils of early cultivation? (69)
Hordeum vulgare (barley)	Seed size increase	Enriched soils of early cultivation? (69)
Cucumis sativa (cucumber)	Fruit bitterness	Temperature (110)
Chenopodium berlandieri (goosefoot)	Seed dormancy traits	Age at flowering related to soil moisture? (66, 67)
Polygonum erectum (erect knotweed)	Seed morphology	Unspecified growing conditions (28)
Manihot esculenta ssp. flabellifolia (Pohl) Cifferi (wild manioc)	Growth form (shrub vs. liana)	Savanna vs. forest (109)
Manihot esculenta ssp. *esculenta* (domesticated manioc)	Growth form (shrub vs. liana)	Cultivated field vs. forest (109)