Jala Maize is Small

Karl, J. R.

Allegany, New York, USA

jrk36@cornell.edu

The maximum scientifically alleged measurement of cob (kernel row) length in the maize subspecies has been 24 inches. It occurred in Jala ("Hah Lah;" Aztecan, meaning very sandy place, Anonymous, *Jala, Nayarit*, Wikipedia.org, 2007), Olotón, and Galinat's hybrid (Kempton, J Hered 15 (8):337-344, 1924 b, Weatherwax files, Lilly Library, Indiana University, Bloomington, IN, 1950, by the generosity of N. Robinson; Wellhausen, *Races of maize in Central America*, National Academy of Sciences, Washington, DC, 1957; Fussell, *The story of corn*, University of New Mexico Press, Albuquerque, NM, 1992; Galinat, MNL 47:104-105, 1973, Sprague, *Corn and Corn Improvement*, American Society of Agronomy, Madison, WI (chapter 1), 1977; Hanes, The Christian Science Monitor, Boston, MA, September 20, p. 1, 1989; a greater claim of "ear" length was once made by the fraudulent (in the author's analyses) entity Guinness, though there is no scientific context for the claim, and no means to investigate it). However, the length seems to have left Jala and possibly Oloton.

As to Jala, instances of Kempton's material grown outside the valley (California, Maryland, Guam: Kempton, J Agric Res 28 (11):1095-1103, 1924 a, b, J Agric Res 32 (1):39-50, 1926; Anonymous, Guam Agric Exp Sta report, p. 8, 10, 1926, gratitude to USDA NAL), collected for this article, offer some explanation for the genetic impasse to recovering the cob length.

The following list is a quick reference of key points that identify when and why the loss occurred.

1907: 22-inch cob length
1910-1920: War in Mexico, and change in Jala cultivation since the conquest when Jala was made by bringing Comiteco north
1923: 24-inch cob length - 13 rows (no Tampiqueño)
10 years (lapse)
1935: Baker cannot obtain any long cobs
1940: Kempton does not have any long cobs for Mangelsdorf
1943: Baker still trying to receive a long cob
1944: Wellhausen finds Jala short - 15 rows (Tampiqueño was there and was dominant, which it must have been for years)
1948: Weatherwax finds Jala short; Tampiqueño was fully there and had been for a good while; 15 inches longest cob length
1981-1992: 18 inches is maximum cob length, despite cob contest

Elaboration of the Timeline

1900

On Kempton's visit to the valley, which happened presumably in the fall of 1923, the locals said (Kempton 1950) that the cobs had previously been longer (than 24 inches) and the plants taller (appreciably taller than 20 feet; cf. Kempton 1924 b). It seems that this anecdote refers merely to Pepitilla's effect in the 1800s (Anderson, Annals Missouri Bot Garden 33 (2):147-247, 1946), or perhaps to the deterioration of ash from the 1870 eruption.

Kempton mentioned "unusual uniformity" (cf. Eyster, J Hered 16:185-190, 1925) of total plant morphology from plant to plant in the two fields (towns Jala and Jomulco; Jomulco from Rice, personal communication 2007). The uniformity must have been the result of an effective selection for uniformity.

Obtaining 22-inch Jala cobs was easy in the early twenties (Kempton 1950). Outside the valley, the longest cobs (shank excluded; in California and in Guam) were 15 inches (Kempton 1926, Anonymous 1926).

1930

Within 10 years of Kempton's collection in the valley, there was no luck in obtaining long cobs (Baker, Baker files, Parks Library, Iowa State University, 1938 (1935-1938 correspondence with P. Khankhoje of Mexican Experimental Station, 1941 correspondence with E. Limon, 1943 H. Varela), tremendous gratitude to B. Kuennen; also Kempton, Paul C. Mangelsdorf Papers, Harvard University Archives, 1940 (Jenkins to Mangelsdorf, May 27, Kempton says that the storage facilities for that kind of material are extremely limited; Barbour to Mangelsdorf, Oct. 10, Kempton doesn't have any extra cobs worth exhibiting - get it from the Tepic consul).

1940

When Hernandez, Harrar, or Mangelsdorf entered the valley in the new year of 1944, their record (presumably being the monograph, Wellhausen, *Races of maize in Mexico*, Bussey Institute, Cambridge, MA, 1952) states that not only was the grand cob length purged, but so was the size of the maize in general (firstly plant height). The plant used to be 20 feet with a 20-inch cob and now the plants were 15 feet with a 15-inch cob.

Two new kernel rows were present.

1948

Weatherwax was in the valley, presumably in 1947 (Weatherwax, MNL 22:22-23, 1948). He revealed that a second type of maize was dominant in the valley.

1952

Tuxpeño is introduced into the valley, and begins intercrossing with the Jala long-eared race (Wellhausen, Proc. 20th Annu. Hybrid Corn Industry Res. Conf., 1965).

1992

Rice (Genet Resour Crop Evol 54 (4):701-713, 2006) confirmed that it was Tampiqueno (Tampiqueño, "Tampiquenyo;" Listman, Diversity 8 (1):14-15, 1992).

DISCUSSION OF THE LOSS

No loss outside the valley

Although the stand of maize of the race Jala in the valley was several hundred acres in 1920 and presumably a similar size in 1947, and the number of plants in any other grow-out outside the valley was likely starkly lower (Chula Vista, Guam, Maryland, Chapingo), Jala's extreme size (+ 10 inches for the cob, + 5 feet for the plant) only occurred in the valley, and likewise, the loss only occurred in the valley (presumably the 22-inch Tepic cobs did not grow in Tepic).

The maize was the same size outside the valley in 1923 as it was in 1940 (e.g. the cob averaged approximately 12 inches). The cob was ~12 inches in 1920, Chula Vista, and 12 inches in 1940, Chapingo (Kempton 1924 a; Wellhausen 1952). Neither the cob length nor the plant height changed. This is what isolates the valley as the source of the size and loss.

The loss was in the valley

Now the maize in the valley was as small as it was outside the valley. It averaged 12 inches, just as it did in Chapingo (based on 15 inches being the longest for Weatherwax, and on 1992-2007 reports). The longest cobs were now 15 inches and the plants 15 feet (Wellhausen 1952), down from 24 inches and more than 20 feet, respectively (average 20 inches, 20 feet, Kempton 1924 b), the same as in Guam and in California, both in 1920 (California being influenced by a short night length).

Environmental loss

Obviously, if the loss was only in the valley, then at least one source of the size had to have come from some rare element in the environment of the valley. It was rare because the phenomenon generally did not occur elsewhere, even when Jala was grown elsewhere – the same Jala (Kempton's) that exhibited the extreme size in the Jala valley.

There were other places where the phenomenon occurred: (1) Central America, reported in 1894, where maize plant height was allegedly 24 feet (Sturtevant, Bull Torrey Bot Club 21 (8):319, 1894); (2) the home of Tehua, where the plant height of the race was 20 feet (Wellhausen 1952); and (3) Alta and Baja Verapaz, where cobs of Oloton reached 20-24 inches (Kempton 1924 b, Wellhausen 1957, Kempton 1950; also cf. Sturtevant, USDA Off Exp Sta Bulletin 57:8, 1899, 30 feet "in" the West Indies).

Thus, the giantism of tropical maize can indeed range beyond the general imperious dimensions of the plants in comparison to that of modern monoculture maize of temperate areas, which is seemingly dictated by a definite and unusual allele or gene, or multi-gene or multi-locus profile (cf. Eyster 1925). These few instances of extreme giantism must have been manifested by a rare second – and even greater – phenomenon.

The effect appears as a plant-size phenomenon, often from a grand root mass that is stimulated by deeply pulverized soil. That the deeply pulverized soil (CEC) can be responsible for at least some of this mysterious effect is suggested by the stunning size of occasional maize plants growing from ant hills adjacent to other less fortunate plants in a field.

Simultaneous with the loss was a change in the valley environment. In the 1920s and 1930s (Anonymous, *Ejido*, Wikipedia.org, 2007), farms in Mexico were changed. Portions of private farm lands were coalesced and then managed as a single large public tract of farmland. In light of Kempton's report (1924 b), this change had oddly already happened in the valley by 1923. A growth agent in the culture of the maize population in the valley could have ended with the change.

Thus, the locals and Kempton could, by chance, also be right – positing an association between Jala's size loss and the deterioration of the 1870 ash, in which case the fertility of this ash lasted for 50 years. Incidentally, there are no volcanoes (B. Survil of Senahu, Alta Verapaz, personal communication) to explain Oloton's possible cob-length diminution. Given Bilderberg's program of global spraying, weather engineering, economic manipulation, etc., more than Jala's size may become lost from the subspecies.

With the significant change in agriculture across Mexico, genetic changes happened as well. In the first year of the change, the Jala race was not even grown (Rice, Ph.D. dissertation, Cornell University, Ithaca, NY, 2004). Instead, a red/purple maize was used from an adjacent valley.

Genetic loss

Kempton's Jala was different from Wellhausen's because of the two kernel rows (13 vs. 15). The two new rows correlate with the loss of size in the valley. The two new rows were from Tampiqueno, and Tampiqueno could have purged a rare genetic element from Jala that made Jala interact with an equally rare element in the environment of the valley. The genetic element would not have been directly for size, but for interaction with the environmental element.

Other types of maize were always grown in the valley and they were not giant (Rice 2004, 2006). Only one became giant, presumably as a result of a mutation. The mutation enabled the variety to exploit the element in the environment for extreme size. The fact that the other valley varieties were not giant suggests that genetics were indeed involved.

Together, these anecdotes of giantism throughout the tropics lead to an obvious conclusion: that the effect was of such a magnitude as to be equal to that of the short-night reaction of these tropical maizes, at least in reference to their trait of plant height (also, night-length reaction involves cob length and tassel size, just as it does leaf quantity). There is indeed variation in the night length at the latitudes of Central America, and though the variation is small, the maizes there likewise appear to have at least a minor quantitative response to this variation (cf. Karl, MNL 86:3-4, 2012). A large qualitative response may be the effect that is the very subject of this article – the effect that has been lost by the purging of a genetic element from the genomes of giant maizes. This element may be a gene, or possibly two or three genes responsible for a generally qualitative short-night reaction. Perhaps this represents a hypersensitivity to a generally insignificant variation in tropical night length.

Concerning Jala, it is as if the race in the valley had a short-night response before 1923, but by the 1930s, it was back to its long-night tropical size, which it had always been everywhere else. Again, this points to a genetic element being lost. The phenomenon seems to be the genetic or physiological equivalent of a "crossed wire," providing short-night-size maize plants at a latitudinal region of the world where a short night never occurs. Perhaps the genetic element was similar to a wild-type indeterminate allele that operated independently of night-length sensitivity, as ear length is affected by an indeterminate gene (e.g. Galinat, MNL 54:121, 1980; Shaver, personal communication 2002), just as plant height is.

RECOVERY

Germplasm

Ironically, despite the means to maintain Kempton's germplasm in the greenhouse (cf. Jenkins, USDA Yearbook of Agriculture, p. 472, 1936, gratitude to J. Labate for copy; Collins, J Hered 7:106-118, 1916), in subtropical California, and in cold storage at Glenn Dale (G. Dale, Goodman, personal communication 2005), and despite the multiplicity of inherent enthusiasts around the world (Anonymous 1926, Kempton 1950), there is no trace of it.

Extant material

Notwithstanding the careful seed keeping, selections from recombinations, and biased ecology, extant Jala germplasms in the valley have not yielded more than a near-fluke 18 inches (Listman 1992), even with 25 years of a cob contest (Rice, personal communication 2001-2007). The evidence that the loss was not a simple genetic element, but rather both a rare genetic and a rare environmental element, indicates why there has been no recovery. Otherwise, the cob length might have been expected to yield to the minor efforts to regain it.

CONCLUSION

With new facts in place, it seems clear that the trigger for the size was in the environment of the valley and that the maize possessed a genetic component to interact with it.

Likewise, it appears that either Tampiqueno purged the genetic component, or the environmental feature in the valley was lost and the genetic component remains only vestigially – impotent without the environmental feature to react against.

Although the size plainly appears to have been eliminated genetically by Tampiqueno, two additional realities – the specific change in agriculture and the absence of a recovery – may point toward the loss of a feature of the environment.

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