



Assessing maize genetic erosion

Dyer et al. (1) report a rapid decline in maize varieties grown by Mexican farmers, arguing that their results are in contrast with previously reported work. We believe that the support for this rapid decline is weak, and that the contrast with previously reported work is false.

Dyer et al. (1) set up a straw man: they show that average household maize diversity reported in case studies has increased over time and then argue that their own finding is flawed because of the nonrepresentative nature of these studies. Indeed, these studies were not designed for that, and any such interpretation is spurious. Methodological differences between case studies, such as the sample size and survey effort, are very important, but Dyer et al. did not investigate these. Differences between studies explain 69% of the variance in diversity ($P = 0.003$), much more than is explained by time (12%).

Dyer et al.'s (1) paper subsequently presents an analysis of household varietal richness based on survey data from 2002 and 2007. The authors argue that their Mexico National Household Survey (ENHRUM) is a consistent data-collection effort that can be used to investigate maize genetic erosion. However, it is not clear how the survey effort was kept constant within and between the 2002 and 2007 surveys. This aspect is important because interviewees often mention varieties sown in smaller quantities only after being prompted in different ways or during a visit to the field. In the ENHRUM manual (2), there are no instructions for surveyors to assure that interviewees list all varieties.

Differences in survey effort may also explain the low number of varieties of ENHRUM compared with case studies more narrowly focused on maize diversity.

Dyer et al. (1) focus only on household-level data, arguing that community level data are less reliable. However, because crop genetic erosion is a process that occurs in (meta)populations, community-level data are critical. The ENHRUM data do not reveal whether varieties discarded by a particular household still survive in the community. Households may be able to regain discarded varieties if seed is still grown and exchange networks keep functioning (3). The household-level analysis is unable to capture this crucial element of crop diversity dynamics.

On the other hand, the reliability of community-level analyses should benefit from recent methodological progress. The challenge of community definition in diachronic studies can be overcome by accounting for the spatial distribution of knowledge in and across communities (4). Varietal identity problems can be overcome with genetic data (5).

Dyer et al. (1) address an important question. We emphasize the need for better-designed research to assess the current status and the dynamics of crop diversity. We need a new generation of crop diversity monitoring studies at multiple scales of observation that draw from multiple methods in the social and natural sciences.

Stephen B. Brush^a, Mauricio R. Bellon^b, Robert J. Hijmans^c, Quetzalcoatl Orozco Ramirez^d, Hugo R. Perales^e, and Jacob van Etten^{f,1}

^aDepartment of Human Ecology and ^cDepartment of Environmental Science and Policy, University of California, Davis, CA 95616; ^bBioversity International, 00057 Maccarese (Fiumicino), Rome, Italy; ^dCentro de Investigaciones en Geografía Ambiental, Universidad Nacional Autónoma de México, Morelia, Michoacán, 58190, Mexico; ^eEl Colegio de la Frontera Sur, Carretera Panamericana y Periférico Sur s/n, San Cristóbal de Las Casas, Chiapas, 29290, Mexico; and ^fBioversity International, c/o CATIE 7170, Turrialba, 30501, Costa Rica

1 Dyer GA, López-Feldman A, Yúnez-Naude A, Taylor JE (2014) Genetic erosion in maize's center of origin. *Proc Natl Acad Sci USA* 111(39):14094–14099.

2 Dyer G, et al. (2002) *Guía del Cuestionario a Hogares PRECESAM-ENHRUM*. Available at precesam.colmex.mx/ENHRUM/PAG%20PRIN_ENHRUM_.htm. Accessed December 10, 2014.

3 Louette D, Charrier A, Berthaud J (1997) In situ conservation of maize in Mexico, genetic diversity and maize seed management in a traditional community. *Econ Bot* 51(1):20–39.

4 van Etten J (2006) Changes in farmers' knowledge of maize diversity in highland Guatemala, 1927/37–2004. *J Ethnobiol Ethnomed* 2:12.

5 van Heerwaarden J, Hellin J, Visser RF, van Eeuwijk FA (2009) Estimating maize genetic erosion in modernized smallholder agriculture. *Theor Appl Genet* 119(5):875–888.

Author contributions: J.v.E. analyzed data; and S.B.B., M.R.B., R.J.H., Q.O.R., H.R.P., and J.v.E. wrote the paper.

The authors declare no conflict of interest.

¹To whom correspondence should be addressed. Email: j.vanetten@cgiar.org.