Widening the representation of bean wild relatives from El Salvador into genebanks

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The potential of wild relatives for crop improvement is progressively gaining due recognition in bean, cassava, rice (Porch et al. 2013; Carabalí et al. 2010; Moncada et al. 2001, respectively). Crop wild relatives (CWRs) have been found of critical importance for disease resistance (Singh et al. 2013), pest resistance (Osborn et al. 1988), tolerance to abiotic stresses (Bayuelo-Jiménez et al. 2002), and traits for nutritional quality (Espinosa-Alonso et al. 2006.). One bottleneck in using CWRs is availability, and thus invites to check representation of *ex situ* collections.

CWRs of *Phaseolus* beans are mainly distributed in Mexico and Central America, less in the Andes and the Caribbean (Freytag & Debouck 2002). For El Salvador, the study of dried plant specimens in 81 Museums of Natural History and Herbaria (Debouck 2013a) indicates that seven *Phaseolus* species exist (or existed) as wild plants, namely *Phaseolus coccineus* L., *P. leptostachyus* Benth., *P. lunatus* L., *P. microcarpus* Mart., *P. oligospermus* Piper, *P. vulgaris* L. and *P. xanthotrichus* Piper. This study results in the identification of populations that can be georeferenced (Table 1, top line). Prior to this field work, the number of accessions existing in ex situ facilities (CIAT) was quite low (Table 1, bottom line).

Table 1 – Top line: number of populations identified to date for the different bean species (as wild) from El Salvador (Debouck 2013b,c,d,e,f,g; Debouck 2012). Bottom line: Wild bean accessions from El Salvador existing as seed germplasm and available from the genebank of CIAT (CIAT 2012).

Coccineus	*leptostachyus*	*lunatus*	*microcarpus*	*Oligospermus*	*vulgaris*	*xanthotrichus*
2	9	31	2	2	3	3
0	0	1	0	0	2	0

Results and Discussion

A field exploration was carried out in December 2012 focused in the central western part of El Salvador (departments of Ahuachapán, La Libertad, Santa Ana and Sonsonate). It results in the finding of 17 new populations for 4 species with seed germplasm for 8 populations (Table 2). The voucher specimens were all deposited at LAGU Herbarium.

Table 2 – Wild bean accessions collected in El Salvador in 2012 and existing as seed germplasm in the genebanks of CENTA and CIAT.

coccineus	*leptostachyus*	*lunatus*	*microcarpus*	*oligospermus*	*vulgaris*	*xanthotrichus*
0	1	2	0	0	3	2

During the seed increase at CIAT in March-August 2013, with day temperature often well above 30° C in June-August, significant differences were observed among the three new accessions of wild *P. vulgaris* (Figure 1). While # 3226 was already at pod filling and seed setting phase, the other two collections were not yet flowering. Because bean breeders are nowadays looking for heat tolerance (Porch et al. 2013), this experiment is being repeated.

Poster presented at the IX SIRGEALC, San Salvador, El Salvador, 25-27 November, 2013.

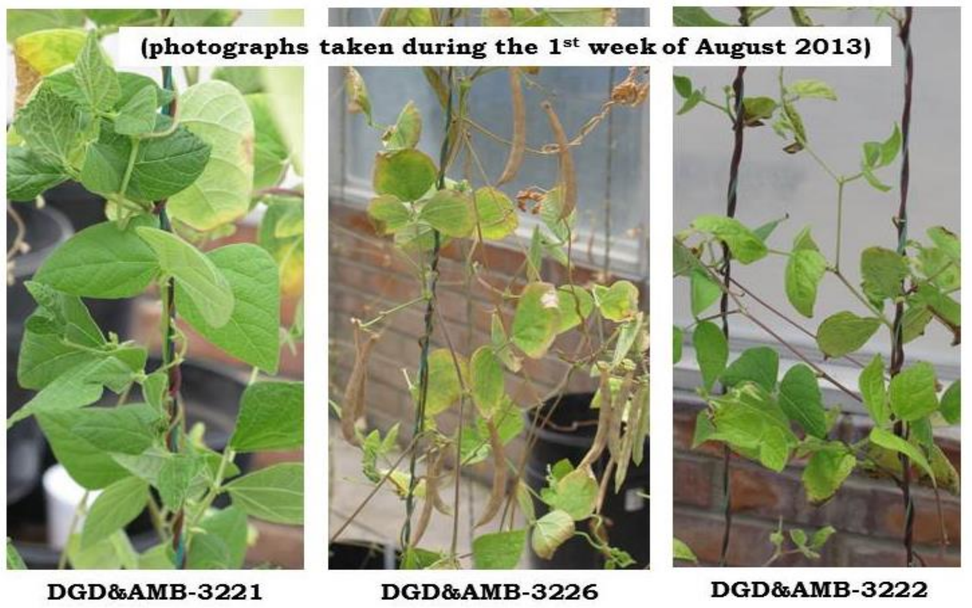

Figure 1 – Main stems at 1m50 of three collections of wild *P. vulgaris* grown in glass-house at CIAT Palmira.

These results elicit the following points for discussion. First, in spite of significant changes in land use even in national parks (also noted by Vreugdenhil et al. 2011), it is still possible to find novel populations of wild bean in El Salvador. This work thus adds to the former records (Table 1), widening our knowledge of species distribution. Second, the different bean species thrive in contrasting habitats (Freytag & Debouck 2002), wild common bean being mesophytic (Delgado-Salinas et al. 1988), albeit with phenological differences as revealed by the 3 collections (Fig. 1). These results await additional confirmation but are positive enough to justify additional explorations in El Salvador and further evaluation against risks associated with climate change (Lobell & Gourdji 2012).

Acknowledgments

This work has been possible thanks to a grant by the Global Crop Diversity Trust the support of which is fully acknowledged, in the framework of the Project on Crop Wild Relatives. The authors thank Ministerio de Medio Ambiente y Recursos Naturales of El Salvador, and the authorities of CENTA and CIAT for the research permits and continuing interest. They also want to express appreciation towards LAGU for granting permission to study its collections.

Literature Cited

Bayuelo-Jiménez, J., D.G. Debouck & J. Lynch. 2002. Salinity tolerance in *Phaseolus* species during early vegetative growth. Crop Science 42 (6): 2184-2192.
Carabalí, A., A.C. Bellotti, J. Montoya-Lerma & M. Fregene. 2010. *Manihot flabellifolia* Pohl, wild source of resistance to the whitefly *Aleurotrachelus socialis* Bondar (Hemiptera: Aleyrodidae). Crop Protection 29 (1): 34-38.
CIAT. 2012. Database about *Phaseolus* germplasm. International Center for Tropical Agriculture (CIAT), Cali, Colombia. Accessed at http://www.ciat.cgiar.org/urg, on 2 June 2012.
Debouck, D.G. 2012. Cahiers de phaséologie: section *Xanthotricha*. International Center for Tropical Agriculture (CIAT), Cali, Colombia. Consulted in http://www.ciat.cgiar.org/urg on 28 August 2013. 33p.
Debouck, D.G. 2013a. List of Museums of Natural History and Herbaria studied, and dates of visit. International Center for Tropical Agriculture (CIAT), Cali, Colombia. Consulted in: http://www.ciat.cgiar.org/urg, Program Files, on 28 August 2013. 2p.
Debouck, D.G. 2013b. Cahiers de phaséologie: section *Brevilegumeni*. International Center for Tropical Agriculture (CIAT), Cali, Colombia. Consulted in http://www.ciat.cgiar.org/urg on 28 August 2013. 64p.
Debouck, D.G. 2013c. Notes sur les taxons. *Phaseolus coccineus*. International Center for Tropical Agriculture (CIAT), Cali, Colombia. Consulted in http://www.ciat.cgiar.org/urg on 28 August 2013. 108p.
Debouck, D.G. 2013d. Cahiers de phaséologie: section *Falcati*. International Center for Tropical Agriculture (CIAT), Cali, Colombia. Consulted in http://www.ciat.cgiar.org/urg on 28 August 2013. 152p.
Debouck, D.G. 2013e. Cahiers de phaséologie: *Phaseolus microcarpus*. International Center for Tropical Agriculture (CIAT), Cali, Colombia. Consulted in http://www.ciat.cgiar.org/urg on 28 August 2013. 46p. Debouck, D.G. 2013f. Cahiers de phaséologie: section *Paniculati*. International Center for Tropical Agriculture (CIAT), Cali, Colombia. Consulted in http://www.ciat.cgiar.org/urg on 28 August 2013. 371p.
Debouck, D.G. 2013g. Cahiers de phaséologie: section *Phaseoli*. International Center for Tropical Agriculture (CIAT), Cali, Colombia. Consulted in http://www.ciat.cgiar.org/urg on 28 August 2013. 189p.
Delgado-Salinas, A., A. Bonet & P. Gepts. 1988. The wild relative of *Phaseolus vulgaris* in Middle America. *In*: "Genetic resources of *Phaseolus* beans", P. Gepts (ed.), Kluwer Academic Publishers, Dordrecht, Holland. Pp. 163-184.
Espinosa-Alonso, L.G., A. Lygin, J.M. Widholm, M.E. Valverde & O. Paredes-López. 2006. Polyphenols in wild and weedy Mexican common beans (*Phaseolus vulgaris* L.). J. Agric. Food Chem. 54(12): 4436-4444.
Freytag, G.F. & D.G. Debouck. 2002. Taxonomy, distribution and ecology of the genus *Phaseolus* (Leguminosae-Papilionoideae) in North America, Mexico and Central America. Sida Bot. Misc. 23: 1-300.
Lobell, D.B. & S.M. Gourdji. 2012. The influence of climate change on global crop productivity. Plant Physiol. 160 (4): 1686-1697.
Moncada, P., C.P. Martínez, J. Borrero, M. Chatel, H. Gauch Jr, E. Guimaraes, J. Tohme & S.R. McCouch. 2001. Quantitative trait loci for yield and yield components in an *Oryza sativa* x *Oryza rufipogon* BC2F2 population evaluated in an upland environment. Theor. Appl. Genet. 102 (1): 41-52.
Osborn, T.C., D.C. Alexander, S.S.M. Sun, C. Cardona & F.A. Bliss. 1988. Insecticidal activity and lectin homology of arcelin seed protein. Science 240: 207-210.
Porch, T.G., J.S. Beaver, D.G. Debouck, S. Jackson, J.D. Kelly & H. Dempewolf. 2013. Use of wild relatives and closely related species to adapt common bean to climate change. Agronomy 3: 433-461.
Singh, S.P., H. Terán, H.F. Schwartz, K. Otto, D.G. Debouck, W. Roca & M. Lema. 2013. White mold-resistant, interspecific common bean breeding line VRW32 derived from *Phaseolus costaricensis*. J. Plant Registr. 7(1): 95-99.
Vreugdenhil, D., J. Linares, O. Komar, V.E. Henríquez-Cisneros, J. Meerman, J.E. Barraza & M. Machado. 2011. Mapa de los ecosistemas de El Salvador. Ministerio de Medio Ambiente y Recursos Naturales, San Salvador, El Salvador, C.A. 122p.