



Seed collections from nature for *ex-situ* conservation in the 21st century

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Gustave Doré

When Adam and Eve were driven out of Eden and Adam was told to cultivate the soil from which he had been taken and to which he would return, the world was still teeming with plant riches.

Plants have sustained us from time immemorial



But by now, we have reduced these plant riches in many parts of the world to mere residues, on which we operate our search for genes. This is true for much of Breasted's "Fertile Crescent", in which many Old World Crops were first domesticated.



A population of *Aegilops speltoides*, with the Haifa oil refineries in the background

Since only a small fraction of the species can be conserved and we do not want to miss out on valuable genes, we aim at conserving a maximum of variation *per se*. Hence, we sample a maximum of locations and habitats.

In many cases, doomed populations of crop-plant ancestors or relatives offer us a short period of reprieve, in which we can become acquainted with them. During that period, it is wise to abandon the dichotomy between realms of *in-situ* and *ex-situ* conservation. The disposition of collection points for *ex-situ* preservation can then determined by studying the physical and genetic structure of the target population prior to collection. For lack of other illustrations, most of the following examples come from populations of wild tetraploid wheat.



A transect is laid out to encompass topographical variation

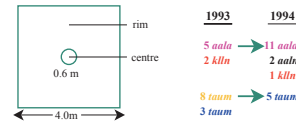


Sampling points for repeat visits are fixed and marked



Different crevices may be sinks for different genotypes

Sampling points can be determined for special niches or special plants. In perennials, collections can be made from previously studied and genetically marked individuals. In a patchy population, the micro-population of the patch is not necessarily homogeneous. Even in selfing annuals with no pollen flow and spatially limited seed dispersal, the small fixed sampling point can be a useful source for different genotypes in the same and in different years.



Different genotypes of high-molecular-weight glutenin subunits were recorded in small "centre" areas in a population of wild tetraploid wheat in the Golan Heights in 1993. Before maturation, all spikes were removed from both the "centre" and "rim" areas, so that both the known and the new genotypes recorded in 1994 had their origin in a soil seed bank.

The reprieve period may even facilitate experimentation. In the picture shown, a fence was erected in a pasture-land population of wild wheat, so as to exclude cattle grazing. Within three years, dicotyledonous species which competed with the grass, established themselves in the fenced-in section. This, presumably, had an impact on the composition of the wheat population within the fence and left the collector with an elite of the more competitive wheat genotypes.



If possible, the reprieve period can be used for molecular characterization as an indicator for variation in desirable traits. In parallel, phenotypic variation may guide the collector, as it has guided the plant hunters of the past. Among visual criteria for selecting individuals that warrant conservation are: size, shape, pigmentation, glabrosity, etc., high fertility, freedom from pests and diseases in an infested population, and variation in phenology.

If there is still room for plants after the habitat has been destroyed, many CWR elements persist as weeds. Among common weeds in my country, which may be with us and should challenge us for a long time to come, are the following:



Avena sterilis L.
Wild Oat



Brassica nigra (L.) Koch
Black Mustard



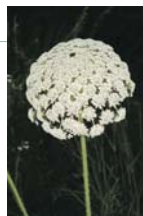
Lathyrus ochrus (L.) DC.
Winged Vetchling



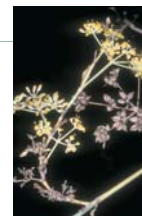
Silybum marianum (L.) Gaertn.
Holy Thistle and *Stapsis alba* L.
White Mustard



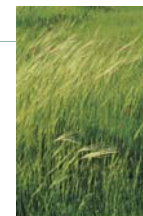
Vicia sativa L.
Common Vetch



Daucus carota L. subsp.
maximus (Desf.) Ball
Wild Carrot



Foeniculum vulgare Mill.
Common Fennel



Hordeum spontaneum C. Koch
Wild Barley



Inula viscosa (L.) Air
Clammy Inula



Lactuca serriola L.
Prickly Lettuce

Of the species shown, Wild Oat and Wild Barley are pillars of cereal breeding. Wild Carrot and Prickly Lettuce have uses in vegetable and salad crop breeding. Wild forms of *Foeniculum vulgare* are potential gene donors to the commercially grown fennel-seed varieties and Fennel-Sweet volatile oil crops, and their manifold folk uses point to a wider future. The mustard-oil crops, for which wild Black and White Mustard are breeding sources, have culinary and medicinal applications. Holy Thistle is the source of the drug silymannin, used in the cure of liver diseases. Medicinal uses are also ascribed to Clammy Inula. Wild forms of Winged Vetchling can contribute to the multiple culinary/medicinal and pasture/forage uses of the cultivated crop. And wild Common Vetch can play a role in the breeding of pasture, forage, and green-manure crops.

Weedy populations are pre-adapted to cultivation and can be a valuable component of CWR. The phenotypic plasticity of such populations and the genetic control of this plasticity should be a challenging topic for students of CWR. Important breeding aims, such as all-year-round fruiting in global crops, neutral response to day-length, and wide-ranging tolerance to diverse environment factors, are served by it. In addition, phenotypic plasticity may have protected valuable genes from selection, so that weed populations may in fact be vehicles for conservation. This question has not been studied, although modern methods for such a study are available.

Photos by O. Fragman-Sapir, Head Scientist of the Jerusalem Botanical Gardens