Conservation of wild vs. crop species

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Abstract

Gómez-Campo, C.: Conservation of wild vs. crop species. — Bocconea 7: 213-217. 1997. — ISSN 1120-4060.

The conservation of wild relatives of crops is basically similar to that of wild species although there are important differences in detail. For wild species, conservation within their native habitats i.e. *in situ* is normally to be preferred, with *ex situ* approaches playing a complementary role, for example to provide material for research or for raising plants for reintroduction into the wild. An account is given of methods of collecting, sampling, storing and characterizing germplasm of wild plants.

Wild relatives are wild plants. They may be genetically close to crop species, may resemble them and may be of economic interest, but they remain essentially wild plants. This is important to emphasize because the methods used to preserve crop and wild plant species – although basically similar – may be very different in detail. Such differences should not be ignored because they are common and often important.

Dealing with vanishing cultivars of staple crop species, such as wheat or beans, does not by any means involve the same problems as dealing with rare wild species with no apparent economic value for example *Naufraga balearica* from the island of Mallorca or *Artemisia granatensis* from Sierra Nevada. With these two extreme situations in mind, below we will briefly analyze their analogies and differences for every step of conservation.

The field of wild relatives is not the only one where a crop specialist or a plant breeder may find himself dealing with wild material (Fig. 1). Those so-called 'marginal' or 'abandoned' crop species may still persist at the margins of crops, but they often appear as escapes, that is, naturalized in wild habitats. So-called 'promising' species are basically wild species which are susceptible of domestication as sources for different products. In turn, domestication is by no means a process that was already completed in the Neolithic, but it is perhaps one of the most important and active fields in applied plant science nowadays.

MODERN CULTIVARS

BREEDING LINES

LAND RACES

MARGINAL CROPS

ABANDONED CROPS

cultivated

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wild

PROMISORY SPECIES

WILD RELATIVES

COMPANION WEEDS

WILD SPECIES in GENERAL

RARE and THREATENED SPECIES

Fig. 1. Phytogenetic resources can be found in crop and in wild material as well, covering a wide array of situations where the economic value and the risk of extinction are combined in different proportions. Appliable strategies are basically similar but they may differ deeply in detail, so that plant conservationists and users should manage to use the most adequate methods for each case. Criteria to establish priorities should balance economic aspects with singularity and risk.

In situ and *ex situ*

The two conservation approaches, *in situ* and *ex situ*, are basically different. For wild species, *ex situ* conservation should be merely a complement to *in situ* conservation. It must be made very clear that threatened wild plants should with preference be conserved within the ecosystems in which they naturally grow. National or natural parks, genetic reserves, etc. are the main tools for this objective, while the role of seed banks or plant collections, consists of avoiding possible extinction in the long term, and also provision of living material for research or for reintroduction in nature wherever necessary.

For crop diversity, *ex situ* conservation (either in seed banks for orthodox seed species or in living collections for fruit trees or plants with recalcitrant seeds) may be the only practical solution. What might *in situ* mean such a case? 'Natural' habitats are here non-existant, unless we consider as such a number of traditionally maintained farms that should be heavily subsidised so as not to vanish themselves. But they would only provide an interesting possibility for fruit trees or species with recalcitrant seeds, as well as for multiplication or regeneration of grain species. They would certainly be impractical as substitutes for the highly efficient services that a seed,bank can provide.

Collecting

Preparing the itinerary for a mission to collect germplasm of wild plants involves the consultation of relevant botanical literature, herbarium specimens, etc. As a rule, none of these sources will be especially useful for the collection of crop species. Some specialized literature may be found but the information from local agricultural agencies, agricultural yearbooks, reports from previous similar missions, etc. would probably be of better help.

A long walk across a shrubby field, a slope or a river valley, a visit to a summit, a cliff or a mountain system, are all common methods for those aiming at the collection of germplasm of wild species. On the contrary, a stop at the roadside besides a cultivated field, a visit to a local market or to the private barn of a farmer, etc., are the methods used to procure germplasm of crop species; the help and know-how of local agriculturers or local agricultural extension officers would be available and almost compulsory in many occasions.

Sampling

Anybody who collects wheat, for instance, would be usually interested in obtaining as many accessions of cultivars or landraces as possible. On the contrary, for many rare wild plants, a few samples might be enough to cover the infraespecific variability of a given species – or perhaps only one when a unique population exists. A crop seed bank may not contain many species, but usually a large number of samples – hundreds or thousands – of each. A seed bank for wild species contains, as a rule, a higher number of species, but the total number of samples is usually lower.

The collection of crop species requires a minimum of one thousand viable seeds per sample, whenever possible (FAO/IBPGR 1992). In the collection of wild plants – mostly for rare or endangered ones – that figure cannot always be attained.

Sometimes this is because of the small size of the population, sometimes because of its inaccessibility, or also sometimes for ethical reasons, to avoid overcollecting and further endangerment. Also, as a rule, the seeds of crop species tend to be larger than those of wild plants.

Seed preservation

Many more samples, larger in size, require much more storage capacity and involve higher installation costs and higher expenses in maintaining such space under proper conditions. This is only one of the reasons why crop seed banks are usually much more expensive facilities. Setting up a seed bank for wild species is usually much cheaper: to begin with, a single domestic refrigerator could prove very effective in preserving material of threatened wild species.

Such economic factors have prevented large crop seed banks from using some of the highly efficient methods available for the long term storage of seeds. Most crop seed banks use complex laminated foil envelopes or 'twist-off' glass containers. Our experience with a collection of weed seeds kept in 'twist-off' glass containers is dissapointing: after a decade, a large proportion of them had absorbed moisture from outside. A good degree of hermetism in the containers is essential because there are many reasons why the installation of humidity control in the cold rooms themselves is discouraged. As for foil envelopes, mostly when they are vacuum-sealed, the situation is no better (Tao 1992). Considerable concern has developed in recent years about the possibility of serious 'genetic erosion' taking place in in many crop seed banks.

On the other hand, a new breed of small seed banks has been developed since1966 in the West Mediterranean region, devoted entirely to wild species and, using sealed glass capsules with silica gel inside (Gómez-Campo 1969). The role of silica gel is not only to keep a constant low humidity within the sealed container; it also means a permanent and efficient monitoring for a good hermetism. The efficiency of this procedure, tested on 25 year-old samples from our laboratory (Ellis & al. 1992), is entirely satisfactory.

Though sealed glass containers have traditionally been considered impracticable for the large and numerous samples of crop species, enclosures using silicagel is gradually becoming a common practice. Future improvements might well be based upon finding truly hermetic containers or designing larger glass containers that can be sealed.

Routine germination tests to estimate the initial viability of each sample are done in every seed bank. Again, the recommended size of subsamples to be taken cannot always be met with wild material. Stored samples are sometimes too small and it is a nonsense to seek to obtain accurate percentual figures while the seeds themselves are becoming exhausted. Thus, indicative or sequential methods are frequently used.

Another sharp difference lies in the relative importance of dormancy. Crop species have been largely selected by humans for the absence of dormancy, but wild species have not. Tests to check the existance and type of dormancy in wild plants are fundamental, because supplying dormant seeds to a prospective user without any previous notice or advice, will mean losing work, time, money and valuable plant material.

Other activities

Crop seed banks usually have a responsability for the characterization and evaluation of the material they store. This means high staff and other costs. On the contrary, wild plant characterization coincides with botanical research itself, and thus might be done elsewhere. This is another reason whereby seed banks for wild species are comparatively cheaper. The distribution policies and the final use of botanical material is also deeply affected in many ways by its nature, i.e. whether it is wild or cultivated.

Priorities

The risk of extinction is the main criterion for the protection of wild plants, either *ex situ* or *in situ*. As it is difficult to estimate, chorological criteria are usually employed, and lists of local or single-country endemics provide a good approach for the selection of taxa to be protected. On the contrary, economic factors often play the strongest role in the protection of crop plants.

Responsibilities

Agricultural crop research institutions are the most suitable organizations to keep crop material. In fact, they were leaders in the development of seed banks. For their part, botanic gardens and institutions have been traditionally responsible for the care and distribution of wild material and they are now rapidly developing so as to be able to cope with modern conservation techniques. Intermediate cases exist, since situations where wild material is stored in crop seed banks are relatively frequent.

Conclusions

After emphasizing the differences, it may appear paradoxical if we conclude that there is a strong need for a closer relationship and a better reciprocal knowledge between scientists dealing with wild and with crop species. But it is obvious that each side could learn many useful things from the other, and both could make their efforts converge much more succesfully in areas of interface, such as that of wild relatives.

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