THE STRATEGY OF CONSERVATION OF GENETIC RESOURCES

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SUMMARY: Genetic resources contain the natural gene pool responsible for yield, natural pests resistance, adaptation for the environmental stresses and other desirable traits. The approaches of conservation depend on the nature of the conserved material, the objective of conservation, and the scope of conservation, mass reservoir and in vitro conservation. These approaches can be used very effectively for the conservation of the wild communities, forage plant, primitive cultivars, land races, sexual and asexual plants.

Key Words: Genetic resources.

INTRODUCTION

The pressure of rapidly expanding population, overgrazing, overuse of the farm land and the needs for agricultural development are destroying the natural resources at an alarming rate.

The strategy of conservation of the genetic resources depends on: 1) The nature of the conserved material, 2) The objective of conservation, and 3) The scope of conservation. The nature of the conserved material is defined by the length of the life cycle, the mode of reproduction, the size of individuals, and the ecological status (7). The objective of conservation research, introduction, breeding, and others, may determine the degree of integrity, which it is essential or desirable to maintain. The scope of conservation is the time scale over which preservation is projected, and the area, or space, to which it relates a locality, a region, or the world (20)? However, in addition to the practical limits to the scale and scope of conservation, there is no practical way in which plant material can be maintained with complete genetic integrity. Hybridization, mutation and natural selection, changes in the environment and human error, all contribute towards erosion of integrity.

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I. In situ conservation

A. Wild communities

In this sort of conservation, the wild communities should be preserved as far as possible with the genetic integrity of their natural state. A community in balance with a stable environment the ideal model of long-term conservation. However there is one important difference between nature conservation and gene pool conservation. While the former aims to protect areas representing habitats and communities which can be identified, the later goes further: it is concerned with genetic differences which often can only be surmised, but not identified. It is therefore concerned with population sample, possibly along latitudinal or altitudinal transects, often over extensive areas: hence a 'genetic reserve' should include a spectrum of genetic variability. There are two requirements for carrying out natural mass conservation. The first is to provide an inventory of wild and weed communities which urgently need and deserve protection. The inventory is bound to include many of the most important and most threatened sites and species. The second is to find ways to effect protection. However the second requirement should be carried out through an international body.

B. Primitive cultivars, or land races

Forty years ago, ancient land races of wheat and barely were abundant, but now, only traces of the former diversity can be found in Turkey, Iran, Ethiopia and neighboring countries (9,10). The erosion of these germplasm was initiated by introductions from abroad and by selections from indigenous land. Recently this erosion has received enormous momentum through the rapid spread of nitrogenous fertilizer and of highly productive and adaptable varieties which are capable of utilizing the fertilizer; of mechanization and irrigation, and of disease and pest control. The short strewed Mexican wheat and Philippine rice and their derivatives adapted to local conditions of many parts of Asia are now spreading as fast as seeds become available.

The application of hybrid vigor using male sterility is spreading rapidly to ever more agricultural and horticultural crops, superseding the genetic diversity of primary and secondary centers. The production of tobacco resistant to blue mould (Peronospora tabacina) or of a seedless water melon would wipe out important secondary gene centers in Turkey, just as the introduction of hybrid maize to Europe did to the secondary centers of that crop in Italy and Balkan Peninsula.

What can be done about this? Farms cannot simply be preserved, like forests or national park. They involve people which are bound to change. Based on years of experience in Iran and Turkey, Simmonds (20) proposed the establishment of what might be called 'crop reservations' areas of 1 to 2 acres in size where a local crop variety would be maintained under the supervision of a local agricultural officer. The area would be subjected to changes in the environment brought about by agricultural development-fertilizers, cultivation, etc. and to genetic change mediated by hybridization, mutation and natural selection. They would thus form 'mass reservoirs' with opportunities for gradual adaptation to changing environments and with genetic self-renewal through mutation and introgression (11).

II. Ex situ conservation

To form a collection of genotypes or populations representative of a region, or of the world, it is necessary to bring genotypes from an environment in which they are adapted into one in which they are not, an altogether more drastic situation than that contemplated in the preceding section (20). By comparison, the scope for natural selection will be greatly increased as will be the opportunities for natural hybridization with alien materials and even increased mutability has been reported to follow.

A. Long-lived plants

In most respects the maintenance of trees is easier than that of smaller plants. Wide spacing to remove or reduce competition, cultivation, and improve pest control are common practice, and a long life reduces the changes of biological erosion resulting from rapid turnover of generations. Against this, there is a great increase in space and expense per plant, which tends to restrict population size. In fruit trees most of which, importance than in forest tree species where most of them are normally reproduced from seeds. It is therefore both possible and efficient to establish fruit collections on a regional basis, as reported by Bennett (2).

B. Short-lived plants

The collections of individuals of the original entries in 'museum collections' (20) made it possible to study individual gene pools and their components, and to relate their characteristics with the original environments and to integrate environment-heredity relationships of different gene pools in an ecogenetic and evolutionary synthesis of the species as a whole. Such study may include morphological, physiological, genetic, cytogenetic, agronomic and pathological characterization which are of direct value to plant breeders and of great interest to biologists in general (1,12). The problems encountered in maintaining collections are chances in population structure through natural selection and genetic drift, and out crossing, loss of ill-adapted types, management, pest control and cost (20, 23). All these are mitigated by long term seed storage under optimal conditions.

III. In vitro conservation

At present, problem crops are conserved either in the field gene banks (plantations, orchards etc.) or in nature reserves (in situ conservation). Arguments of cost, safety, practicality and adequacy can be leveled against these approaches to conservation. In vitro storage has been proposed as a means of overcoming problems here (5,13, 22). There are various technical approaches to storage. The choice of approach depends on the system and situation in question. This is best done by defining the objectives in using in vitro storage and the likely consequences of so doing. These relate to the time have (short, medium or long-term), facilities available (basic in vitro propagation facilities, a range of environmental variations or dedicated storage equipment), the culture system in use and finally, whether the genotypes here already been stored in vitro with an adequate level of success or not.

The techniques available can be divided broadly into those that reduce the rate of growth and those that suspend growth. As will become apparent, not all of the techniques are fully developed; only slow growth and cry preservation can be considered seriously for adoption.

A. Storage in the growing state

For materials that originate ex vitro and that have a low viability potential in its natural state, e.g. recalcitrant seed embryos, the very act of inoculation into culture provides a storage mode with conventional advantage. However, in general, cultures cannot be considered to be truly 'in storage' unless some modifications are made to the rate of growth. Slow growth can be induced by a reduction in temperature or modification of the culture medium, usually by the addition of osmotic or hormonal retardants.

B. Suspension of the growth

All approaches to the suspension of growth involve modifying the status of water, the mediator of cellular reactions. Three strategies are feasible, namely substitution, removal and inactivation. Substitution of water by organic solvents has been used for pollen storage (14) but has not been explored for other higher plant subjects. Partial substitution of water by cryoprotectant compounds to preserve macromolecular structures and avoid de-naturation is a feature of cry preservation procedures. Removal of water by desiccation has precedents in nature, for example, in seed drying and in survival of xerophytes plants and their propagules exposed to environmental extremes (3,18).

IV. Germplasm storage needs

A. Secondary product synthesis

In recent years there has been dramatic progress in the use of in vitro system to synthesize substances of pharmaceutical and nutritional importance (8). These may take the form of cells, callus, somatic embryos or organs such as roots. All will be special in terms of their synthetic capacity.

B. Crop production

It makes a significant contribution to the mass propagation of a number of horticultural crops (4,16, 21). Storage applications are not limited to material that is conventionally multiplied vegetative. The presence of pathogens, particularly viruses, is a serious problem in the production of some crops, notably those that are vegetative propagated, as they lack the filter of seed production. In vitro techniques such as meristem-tip culture, sometime combined with chemotherapy or thermo therapy, are used to clean up clonal materials (15).

C. Plant breeding

Mass propagation of parental lines for the production of F1 hybrid the use of anther culture (6), somaclonal variation (17,19). The ability to transfer genes from for example, wild relatives with high levels of disease or stress resistance. Improvement of clonal crops that are not amenable to conventional breeding processes. Here, the storage of somatic material will be very important.

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