Chapter 5

HERBACEOUS ORNAMENTAL PLANT GERMPLASM CONSERVATION AND USE
Theoretical and practical treatments

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Abstract: Preservation of herbaceous ornamental crop germplasm has been traditionally accomplished by private and public sector flower breeding programs, rather than through a publicly funded government agency. The recent founding of the Ornamental Crop Germplasm Center by the U.S. Department of Agriculture, as part of the U.S. National Plant Germplasm System, has brought attention to the critical needs of preserving floricultural crop germplasm for worldwide research and development. Preservation of a crop’s germplasm in toto is a complicated but critical scientific endeavor, which will ensure future flower crop development. There are numerous challenges in germplasm preservation and accessibility, including collection of germplasm, determining crop centers of origin, conservation methodologies, genepool creation, conservation concepts, genebank procedures, adherence to governing international conventions for germplasm collection & conservation, and use of plant protection mechanisms. Future development possibilities and global networking opportunities are important for continued ex situ and in situ conservation of floriculture crop germplasm.

Key words: Conservation, genebanks, genepools, genetic diversity, priority genera.

1. INTRODUCTION

Crop germplasm is any genetic material that can be used by plant breeders for the improvement of a crop. The International Plant Genetic Resources Institute (IPGRI) defines plant germplasm as ‘a set of genotypes that may be conserved and used’ and plant genetic resources as ‘the genetic material of plants, which determines their characteristics and hence their ability to adapt and survive’ (IPGRI,
The total genetic diversity of a crop, therefore, includes its related wild species, weedy companion species, subspecies, botanical varieties, landraces, ancient and heirloom cultivars, genetic stocks, inbred lines, obsolete and modern cultivars that make up the total genepool of the crop. In some cases, such as the Orchidaceae where intergeneric crosses are possible, this variability is extended to genera level. These genetic materials, therefore, could be a gene and its alleles, a series of loci, quantitative trait loci (QTLs), linked genes, an epistatic set of gene combinations, a combination of different genomes, an addition or lack of whole chromosomes (polyploidy and aneuploidy series), and their combinations. The task of a flower breeder is to combine these building blocks into marketable cultivars.

Plant germplasm provides the genetic variability and the essence of a crop improvement program. Without adequate germplasm a plant breeder’s successes will be deficient. In flower breeding this could mean the development of a new crop, e.g. New Guinea impatients (*Impatiens hawkeri*); a new innovative form, e.g. the ‘Wave™’ petunia (*Petunia x hybrida*); new uses of existing crops; insect- or disease-resistant cultivars that require lesser pesticide application; cultivars with resistance and tolerance to physiological and environmental stresses.

Harlan (1975) divided a crop total genepool based on the ease of natural (sexual) gene exchange from the donor plant to the crop into three categories: primary, secondary and tertiary genepool. The primary (1°) genepool consists of all taxa including related wild species that can readily hybridize and are fully inter-fertile with the concerned species. There is also no hybrid breakdown in the F$_1$ and later generations and, thus, are equivalent to the concept of biological species. The secondary (2°) genepool consists of taxa that can be hybridized using conventional breeding methods but the F$_1$ and/or later generations are subjected to hybrid breakdown where some of the progenies are sterile or would not come to maturity. Whereas in the tertiary (3°) genepool, intercrosses are difficult to make and might only be achieved with special techniques such as embryo rescue or bridging species. The hybrids are usually non-viable or sterile, but gene transfer may be achieved through such techniques as amphidiploid breeding.

With the recent advancements in molecular genetics and gene-transfer technology, flower breeders/geneticists are able to isolate genes and transfer them to unrelated species. For example, genes of microorganisms and animals have been successfully introduced into plants, such as *Bt* genes from bacteria to maize and cotton; a jellyfish fluorescence gene to different plants in gene expression research, respectively. Thus, Harlan’s 3° genepool boundary of a species expands to encompass other species and organisms due to our ability to introduce genes of one species into the genome of another. The scope in plant germplasm conservation suddenly broadens creating a need to collect and conserve a wider range of species in order to capture greater genetic diversity. In ornamental plants where taxonomy is not well documented, the application of the genepool concept in germplasm collections will significantly complement the selection of taxa for breeding.