

SEED REGENERATION IN CROSS-POLLINATED SPECIES

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Taxonomic aspects of the germplasm conservation of cross-pollinated cultivated plants

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ABSTRACT

In Genetic Resources Centres (GRCs) documentation about accessions is standardised by means of descriptors, e.g. place of collection, morphological features, agricultural value. Botanical and/or fancy names are also considered to be descriptors.

However, there is one essential condition for the usefulness of names as descriptors, namely the check on whether names are correct. If not regulated by the International Code of Botanical Nomenclature, 1978 (ICBN, 1978), the nomenclature of cultivated plants is directed by the International Code of Nomenclature for Cultivated Plants, 1980 (ICNCP, 1980).

For cultivars, including land races, however, ICNCP, 1980, does not contain rules concerning any typification. So, in these cases there is no well-defined connection between a plant material and its name. Particularly where it concerns the variation and the need for stability of cultivars of cross-pollinated plants, the lack of this connection is even more striking.

The rapidly increasing amount of accessions of cultivated plants in GRCs is one of the main reasons for focusing attention on this problem.

This paper proposes a general procedure for checking cultivar names, based on living and conserved standards, descriptions and memory. The possible incorporation of the proposed procedure into a list of descriptors is discussed.

NOMENCLATURE

The International Code of Botanical Nomenclature, 1978 (ICBN, 1978) regulates the nomenclature of plants by principles, rules and recommendations. For each rank, the notation of the Latin name of the corresponding taxon is ruled, e.g. by a fixed suffix. This means that it can be derived from the name, whether the taxon is a genus, a species or a botanical variety. Before a name is legitimised, the following conditions have to be fulfilled:

- Latin diagnosis and description;
- valid publication;
- designation of a type.

By the principle of priority the ICBN governs which of the legitimate names is correct for the same taxon. In cases of homonymy, the same principle guides the decision as to how a legitimate name has to be correctly applied.

By the type method, the connection between plant material and its name is made. The type of a genus is a species which is designated as such by the author. In other words, the type species always belongs to the genus to which it is assigned. In the case of a species or a taxon of lower rank, the type is a well conserved specimen, or, when this is not available, an illustration. Type, diagnosis, and full description, illustrations included, form the protologue, the starting point for a definitive identification of plant material. If not regulated by the ICBN, the nomenclature of cultivated plants is directed by the International Code of Nomenclature for Cultivated Plants, 1980 (ICNCP, 1980). In the latter Code, the cultivar (cultivated variety) has been defined in Article 10 as follows:

"The international term cultivar denotes an assemblage of cultivated plants which is clearly distinguished by any characters (morphological, physiological, cytological, chemical, or others) and which, when reproduced (sexually or asexually) retains its distinguishing characters."

Dependent on mode of reproduction, the following categories of cultivars can be distinguished:

- Vegetatively propagated
 - clone
 - multiclone, mixture of closely resembling clones
- Generatively propagated
 - line
 - multiline, mixture of closely resembling lines
 - F_1 hybrid
 - entity of cross-pollinated plants

Comparing both definitions of cultivar and land race, it should be apparent that according to the ICNCP a land race has to be considered as a cultivar (Harlan, 1975). Consequently, the nomenclature of a land race is also directed by the ICNCP:

- After 1st January, 1959 only fancy names within brackets or after the abbreviation cv. are admitted. Latin names, given before this date and derived from botanical varieties, are also admissible. The cultivar name is placed after the botanical name of the taxon with the lowest possible rank.
- Translated synonyms in other common languages than the original are allowed.
- Later homonyms, generally accepted and widely used, are preferred to original names, which are afterwards re-discovered.

As to the cultivars, the ICNCP does not rule any typification. In order to be legitimate, the ICNCP states that a cultivar name has to be validly published. Names given before 1st January, 1959 which have not been validly published, can be legitimised by a registration authority. The publication and registration list must contain a description of the cultivar.

Cultivars are often adapted to a small range of environments. The expression especially of quantitative characters is greatly influenced by locality and time. Although quantitative characters (for example yield and earliness) are often of great economic importance, they have a restricted descriptive value for the above mentioned reason. For an adequate description it is useful to look for qualitative characters, which do not necessarily have to be of economic importance.

Cultivars do not form a closed classification as in botanical classification under the ICBN (Figure 1). Between cultivars of the same botanical taxon certain gaps, containing non-cultivated plants, can exist (Figure 2). Consequently, not only description, but circumscription, based on any representative element, should be considered essential.

In connecting a cultivar with its name, the type method in the conception of the ICBN cannot be applied for the following reasons:

- A type does not necessarily have to be a representative element.
- A type of any living plant material cannot exist.

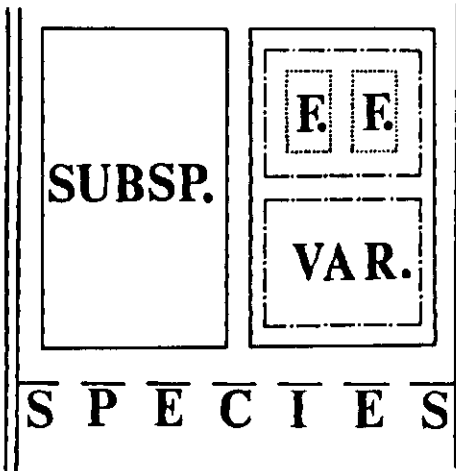


Fig. 1. Closed classification under the ICBN. Hierarchical order of ranks.

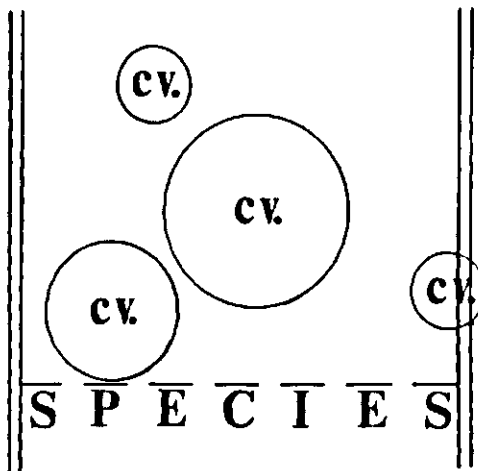


Fig. 2. Open classification of cultivars, independent of botanical classification.

Instead of a type, we strongly recommend using a living and conserved standard, both consisting of a representative sample of the cultivar. The mean and variation of characters within a cultivar are fixed by these standards. A living standard is important, because of its independence of locality and time. Being sampled once, a conserved standard is determined by the then prevalent environmental factors. Therefore, it is less useful than the living standard. However, it is valuable for a longer term, in case the living standard is absent or lost. By using both standards, a reliable connection between the cultivar and its name can be made.

TAXONOMY AND GERMPLASM OF CROSS-POLLINATED PLANTS

The aim of Genetic Resources Centres (GRCs) is to conserve as wide as possible a range of genetic diversity, with potential agricultural value. At present, among all the accessions of GRCs, cultivars, including land races, are the most frequent items (Ayad et al., 1980).

There are two main reasons for conserving germplasm by means of cultivars. Firstly, cultivars representing certain combinations of characters are entities that have already proved their usefulness in agriculture. So, asking for cultivars, plant breeders will find the desired genes in a more or

less balanced genetic background, formed under the process of domestication and breeding. Secondly, a cultivar is indicated by a name. This name forms an entry in all documentation about the cultivar. In the case of old cultivars, one can trace back original descriptions or illustrations and even make use of oral tradition. The documentation on cultivars acquired in this way can be used for definitive identification of an accession. Likewise, if additional knowledge about origin, special characters and (historical) use etc. is obtained, this can be of great importance to plant breeders and crop evolutionists.

In cross-pollinated plants, there are obvious advantages in conserving especially old cultivars, provided that they can be obtained in sufficiently large quantities of seeds. Because these cultivars are sufficiently heterogeneous, thus securing conservation of genetic diversity, the number of accessions can be restricted. Consequently, more time per accession becomes available to complete the documentation of each accession.

PROCEDURES TO CHECK THE IDENTIFICATION OF ACCESSIONS

In GRCs, documentation on accessions is standardised by means of descriptors, e.g. place of collection, morphological features, agricultural value (Seidewitz, 1973, 1979). Botanical names as well as cultivar names are also considered to be descriptors, because they supply intrinsic information about the plant material concerned.

There is, however, one essential condition for the usefulness of names as descriptors, namely the check whether names are correct. Botanical names, regulated by the ICBN, can be checked by comparing with the protologue. If an accession has been found to be correctly named, a symbol can be added behind the name, as is done in the seed indexes of botanic gardens.

Cultivar names, regulated by the ICNCP, cannot be verified by studying protologues. However, the check whether cultivar names have been correctly applied is made possible by living and conserved standards, descriptions and memory.

A living standard has to be sampled from the original

plant material. With regard to old cultivars, a sample has to be taken from the accession at the time of introduction. With regard to modern cultivars, a living standard has to be sampled preferably from the original plant material, grown at the winner's nursery. This is already done in several cases by registration authorities.

The same holds for conserved standards. They should consist of herbarium specimens, colour photographs, colour slides and preparations.

By description, the oldest, validly published description is meant, irrespective of the acceptance of the cultivar by a registration authority.

The memory of experts is sometimes the only way to identify an accession as a named cultivar.

The variation of cross-pollinated plants necessitates living and conserved standards, containing enough variation to circumscribe a certain cultivar and to distinguish it from other similar cultivars. In comparison with living standards, the rate and nature of drift and contamination can be determined after regeneration. Both phenomena may cause the shift of frequencies of characters in such a way, that an accession no longer resembles the original cultivar. In the long run accessions can only be compared with conserved standards, because living standards have a restricted size and lifetime. Consequently, determination of drift and contamination will then be impeded.

Apart from comparing with standards, accessions can be checked on original descriptions. In some cases, however, descriptions, especially of old cultivars, cannot be used because they are either non-existent or incomplete. Then it will be necessary to base identification on the expert's experience. It is obvious that this is less desirable since it is the most subjective identification.

The results of these four procedures can be used as descriptor states. Incorporation can be done by adding a four digit code to the descriptor 'cultivar name' (Figure 3). A positive check on each of these procedures will give the corresponding digit; a negative check the digit '0'.

During each regeneration of an accession every precaution should be taken to preserve its integrity. A sample of the regenerated accession has to be checked again with the four procedures on characters with descriptive value. If, for instance, the accession no longer corresponds to the living standard, the code 0-2-3-4 has to be added to the cultivar name, as can be seen from Figure 4. Changes in the four digit code must be added as soon as possible to the descriptor 'cultivar name'.

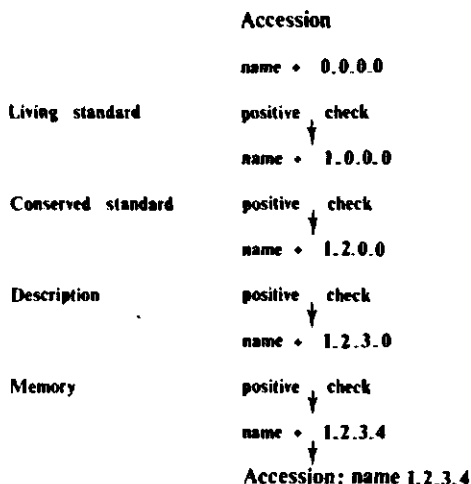


Fig. 3. Procedures to check the identification of accessions.

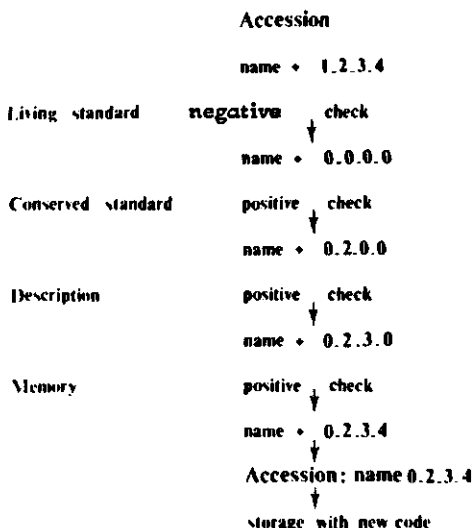


Fig. 4. Procedures to check regenerated accessions. In this example the accession will be recoded.

DISCUSSION

According to Hyland (1970), the controlled use of wild or cultivated plant germplasm is largely dependent on accurate description and taxonomic identification. Taxonomically well-identified accessions will obviously provide us with important data. Exchange of accessions will be facilitated by good, standardised documentation (Seidewitz, 1973, 1979; Erskine and Williams, 1980). As duplicates can be avoided, and regeneration especially of cross-pollinated plants is very laborious, a restricted number of well-documented accessions will be favourable, avoiding the necessity of pooling more or less similar accessions into 'race reservoirs'. A 'race reservoir'

will end up as an amorphous mass without the opportunity to maintain interesting, special properties of single accessions (Marshall and Brown, 1975; Burton, 1979). In the case, however, of several poorly documented similar accessions, based only on memory (code O-O-O-4), pooling them will be justified.

The proposed method will provide every user of GRC accessions with information about the present status of the name. A well connected name will supply entries in all documentation of the accession concerned, and will facilitate international communication.

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DISCUSSION

Henny Roelefsen (*Netherlands*) I would like to know more about the four digit code you mentioned. Is it meant for computer administration?

W.A. Brandenburg (*Netherlands*) Yes, it is possible to incorporate it in a computerised system but I am not a computer specialist. To have such a code adds the descriptor cultivar name so you have the name of the accession, and the present status of the name will be given in the code. For instance, for a good cultivar which is clearly documented, you can have the code 1-2-3-4, there is a living standard, there is a conserved standard, there is a good description and there are enough people who know the accession or the cultivar. Then you have a complete code. However, if after three or four regenerations the living standard is lost because you cannot regenerate the seeds of these living standards, then you have to say the present status of your cultivar name is 0-2-3-4. This will prevent names going on and on in cases where the material is not the same as the original. That is the meaning of this code.

Henny Roelofsen So there is no reference to the documentation material in it, the code only establishes whether or not it exists?

W.A. Brandenburg Yes, it is an administrative code.