CLASSIFICATION OF CULTIVATED PLANTS

W.A. Brandenburg
Department of Plant Taxonomy
Agricultural University
POB 8010, 6700 ED
Wageningen, the Netherlands

Abstract

Agricultural practice demands principles for classification, starting from the basal entity in cultivated plants: the cultivar. In establishing biosystematic relationships between wild, weedy and cultivated plants, the species concept needs re-examination. Combining of botanic classification, based on biosystematic research, and agricultural classification starting from the cultivar, into one unequivocal classification system for cultivated plants, is urgently needed. This is illustrated by the often obscure position of cultivated hybrids.

1. Introduction

According to Lawrence (1951), plant 'classification is the placing of a plant (or groups of plants) in groups or categories according to a particular plan or sequence and in conformity with a nomenclatural system'. This definition implies that the choice of clear starting-points in classification is necessary for the establishment of a uniform nomenclature system.

McKelvey (1982) distinguished general and special classification systems. Botanical classification, reflecting biosystematic relationships, is a general classification system. Special classifications emphasize just a few characters of particular interest. Classification within cultivated plants, based on agronomic characters of cultivars, is such special classification.

Nowadays, a wide range of cultivated plants is grown. Under domestication, some cultivated plants have hardly been changed, whereas others have evolved to such an extent that only biosystematic research may reveal their affinities towards wild or weedy relatives. Plants can be domesticated in many directions due to different usages by man: food plants, fodder plants, green manure, medicinal plants, timber and fibre plants, plants producing various raw materials for industrial purposes and ornamental plants. Most species have been mostly domesticated for a single usage. There are, however, species which have been domesticated in several directions, such as cole crops.

It was therefore argued that specially designed classifications were needed for complex cultivated plants in order to describe their variation properly. (Mansfeld, 1953, 1954; Danert, 1962; Jirasek, 1966; Harlan and De Wet, 1971).

In the following, a strategy is shown to develop a uniform classification system for cultivated plants.

2. Cultivated plants, wild and weedy relatives

Classification of cultivated plants should reflect the degree of relationship between cultivated plants and their wild or weedy relatives

ted plants based on many additional infraspecific ranks. Instead of these it is necessary to design cultivar classifications as open classification systems in which all categories are both described and circumscribed (Brandenburg et al., 1982). To meet practical demands of various plant users, cultivar classification may use characters important in agriculture rather than biosystematic evidence as distinguishing characters, irrespective of descendance or degree of relationship.

Many cultivated plants consist of large numbers of cultivars. For purposes of efficient communication, it is necessary to group these cultivars properly (Baum, 1981) and to characterize them by the group to which they are assigned. The ICNCP, Art. 26, defines the cultivar group as an assemblage of cultivars. Unfortunately, this article is not clearly stating relative systematic positions. Not surprisingly, the cultivar group has not found general acceptance thus far.

Since new cultivars replace old ones every year, and even since new cultivars are selected from old cultivars by defining another mean and variation of characters, cultivar groups are not entities which are defined for ages. Hybridization programs between cultivars may obscure once defined distinctions between cultivar groups. If so, there is no need to maintain these groups anymore, and new cultivar groups based on then important characters have to be defined. Following this procedure, it is clear that classification within cultivated plants will keep in step with future developments in plant breeding. International Registration Authorities may play an important role in cultivar classification, as they, like no others, have a good survey of cultivars in their genus concerned.

There are two possibilities to connect open cultivar classification with the botanical classification;

- through cultivars, directly introduced from nature, thus being coextensive with a taxon at the specific or an infraspecific rank;
- by assigning cultivars to species, or if that is impossible because of complex hybridization, to genera.

4. Hybrids raised in cultivation

The term hybrid causes problems in plant taxonomy. Dansereau (1940) distinguished three types of hybrids. Cultivars, which have to be reconstituted on each occasion, are genetic hybrids. Cultivars of which the parents belong to different taxa are taxonomic hybrids. Cytogenetic hybrids may either be treated as taxonomic hybrids or simply belong to one of the parent taxa if the only result of hybridization has been chromosomal rearrangement after deletion of all or most chromosomes of one of the parents.

There is a clear distinction to be made between (sub)spontaneous hybrids and hybrids raised in cultivation; (sub)spontaneous hybrids are usually the result of introgressive hybridization between populations once isolated, but after environmental changes or mutation exchanging genes.Hybrids raised in cultivation are the result of a determined hybridization program ranging from intergeneric crosses to single, double, top crosses and repeated backcrosses.

Although hybrids of similar rank e.g. interspecific hybrids may differ in genetic background: (sub)spontaneous or raised in cultivation; authors are left the choice whether they follow the Hybrid Appendix of the ICBN (1983) or the ICNCP (1980) Art. 13-18, as is clear from ICBN

Art. 28 Note 2 and Art. H 4.1 Note 1.

In the most recent edition of the ICBN, the Hybrid Appendix has been totally revised, now having provisions for a hierarchical system of nothotaxa. Apart from intergeneric and interspecific hybrids, hybrid populations can be described at the subspecific and varietal level, irrespective of the parental subspecies of botanical varieties belong to one or more species. The new draft of the Hybrid Appendix is certainly an improvement where it concerns (sub)spontaneous hybrids. The variation originated from introgressive hybridization can be more exactly described, the nothotaxon status indicating the hybrid nature of new but distinct populations.

However, hybrids raised in cultivation cannot be classified after the Hybrid Appendix, because:

- hybrids resulting from reciprocal crosses should have the same name (H 4.1.);
- irrespective of breeding methods, hybrid combinations should bear the same name (H 4.1.);
- cultivars of hybrid origin are at the same time to be considered nothotaxa (H 2).

It is generally known that different hybrids may occur in reciprocal hybrid combinations due to the different cytoplasmic backgrounds. As already different crops were bred from reciprocal crosses, it should not be in accordance with common practice to apply the same name for different cultivated plants.

Repeated backcrosses is a common procedure to transfer desirable characters. Many rye characters are so transferred to wheat. According to Art. 4.1 the resulting wheat cultivars have to be named X T r i t i c o s e c a l e , if the rye characters remain recognizable. Such cultivars cause many problems to registration authorities, because under Art. 4.1 there is no clear distinction possible between wheat and triticale, although agricultural practice knows the distinction very well.

Cultivars of hybrid origin may have a nothotaxon designation without further cultivar epithet. Plant populations, which meet the requirements of the cultivar definition, may act so as a hidden cultivar. This is an undisirable situation by confusing classification and nomenclature. Therefore it is preferable to classify and name cultivated hybrids after the rules and provisions of the ICNCP (1980). The rules, laid down in Art. 13-18, are based on former drafts of the Hybrid Appendix with some notable deviations.

- 'Where, however a hybrid seqregate resembles one parent only in nearly all characters, it is given the same name as that parent' (Art. 13);
- 'The formula designating derivatives of an interspecific of intergeneric somatic cross, obtained by a parasexual process such as protoplast fusion, consists of the botanical names of the parents connected with the multiplication sign within parentheses (round brackets) (Art. 14).

The first deviation amplies a discrepancy between both Codes. It is partly the reason of confusion of cases whether wheat cultivars with some rye characters belong to triticale or not. Art. 14 is an attempt

to cover cultivars raised by using various in-vitro breeding techniques, but it is ineffective for the same reasons as is the Hybrid Appendix and accordingly Art. 13-17 of the ICNCP.

Art. 18 reads: 'A collective epithet may also be a word or a phrase of not more than three words in a modern language. For the purpose of this article, an arbitrary sequence of letters, an abbreviation, or a numeral is counted as a word. All derivatives from the combination of the same two or more parental species have the same collective epithet in a modern language except where established custom or special circumstances demand otherwise, as, for example, in orchids'. Although it needs more exact formulation, this article gives the opportunity to classify and name reciprocal cultivated hybrids. Based on cultivars, these hybrids are clearly distinguished from non-cultivated hybrids. Art. 13-17 of the ICNCP must be replaced by a new set of articles starting from Art. 18, thus meeting current practice and future developments of the hybrids raised in cultivation.

The principle of open classification has also to be worked out for these articles. Furthermore, they should make clear the relations between cultivar groups and hybrids in cultivation.

5. Nomenclature of cultivated plants

There is an apparent need for a uniform nomenclature system for cultivated plants. Therefore, it is necessary to classify the cultivated plants, starting from both the species and the cultivar, thus taking into account biosystematic evidence and practical needs demanded by various plant users. Both approaches will often meet at the rank of species but if necessary at the rank of genus. Both Codes should be coordinate. As a consequence the ICBN Art. 28 Note 2 should provide instead of the current formulation a clear statement that with respect to, and especially within cultivated plants, the ICNCP must be followed. In the same way the Hybrid Appendix should obligatory refer to the corresponding but revised articles of the ICNCP. Rules concerning cultivar classification in the ICNCP should be more explicitly formulated. The ICNCP should clearly state where it meets the ICBN. In this way, it is possible to design a total nomenclature system accompanied by unambiguous and flexible classification devices to meet future developments.

References

Baum, B.R., 1981. Taxonomy of the infraspecific variability of cultivated plants. Kulturpflanze 29:209-239.

Brandenburg, W.A., 1983. Taxonomy of cultivated plants with regard to breeding value in accessions. Genetica 15: 325-335.

Brandenburg, W.A., 1984. Biosystematics in hybridization in horticultural plants. In: Plant Biosystematics (ed. W.F. Grant). Academic Press Canada: 617-631.

Brandenburg, W.A., Oost, E.H., and Van de Vooren, J.G., 1982. Taxonomic aspects of the germplasm conservation of cross pollinated cultivated plants. In: Seed regeneration of cross-pollinated species (eds. E. Porceddu and G. Jenkins). Balkema, Rotterdam: 33-41.

Danert, S., 1962. Uber Gliederungsprobleme bei Kulturpflanzen, Kulturpflanze 10: 350-358.

Dansereau, P., 1940. Etudes sur les hybrides de Cistes. Ann. Epiphyt. Phytogenet 6: 7-26.
Fuchs, H.P., 1958. Historische Bemerkungen zum Begriff der Subspezies. Taxon 7: 44-52.
Hanelt, P., 1973. Merkmalsvariabilität bei V i c i a f a b a L. I Künstliche morfologische Systeme bei Kulturpflanzen-Arten. Kulturpflanze 21: 55-60.
Harlan, J.R., and De Wet, J.M.J., 1971. Towards a rational taxonomy of cultivated plants. Taxon 20: 509-517.
Hawkes, J.G., 1980. The taxonomy of cultivated plants and its importance in plant breeding research. In: Perspectives in World Agriculture CAB, Farnham Royal, 49-66.
Hawkes, G.J., 1981. Biosystematic studies of cultivated plants as an aid to breeding research and plant breeding. Kulturpflanze 29: 327-336.
Hogenboom, N.G., 1973. A model for incongruity in intimate partner relationships. Euphytica 22: 219-233.
Hogenboom, N.G., 1975. Incompatibility incongruity: Two different mechanisms for the non-functioning of intimate partner relationships. Proc. R. Soc. London ter B. 188: 361-375.
International Code of Botanical Nomenclature, 1983. (ed. E.G. Voss et al.). Regnum Veg. 97.
International Code of Nomenclature for Cultivated Plants, 1980. (ed. C.D. Brickell) Regnum Veg. 104
Jeffrey, C., 1968. Systematic categories for cultivated plants. Taxon 17: 109-114.
Jirasek, V., 1966. The systematics of cultivated plants and their taxonomic categories. Preslia 38: 267-284.
Lawrence, G.H.M., 1951. Taxonomy of vasculur plants. MacMillan, New York.
MacKey, J., 1981. Comments on the basic principles of crop taxonomy. Kulturpflanze 29:199-207.
Mansfeld, R., 1953. Zur allgemeine Systematik der Kulturpflanzen I. Kulturpflanze 1: 138-155.
Mansfeld, R., 1954. Zur allgemeine Systematik der Kulturpflanzen II. Kulturpflanze 2: 130-142.
McKelvey, B., 1982. Organizational Systematics. Univ. of California Press, Berkeley and Los Angeles.
Meikle, R.D., 1957. What is the subspecies? Taxon 6: 102-105.
Parker, P.F., 1978. The classification of crop plants. In: Essays in plant taxonomy (ed. H.E. Street) Academic Press, London, 97-124.
Wagner Jr., W.H., 1984. A comparison of taxonomic methods in biosystematics. In: Plant Biosystematics (ed. W.F. Grant) Academic Press, Canada, 643-654.