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Cultonomy of *Aster* L.

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SUMMARY

Recent increase in commercial breeding in the genus *Aster* of cultivars particularly suitable for the cut-flower industry calls for a reassessment of the systematics of cultivated asters. A system of three cultivar-groups is proposed here to encompass most of the diversity of cultivars based on typical user criteria: the Dumosus Group, the Universum Group and the Novi-belgii Group. The applicability of numerical character analysis for cultonomic classification is outlined. The flexibility of open ('cultonomic') classifications for culta is demonstrated. It is shown that this system of cultivar-groups serves stability much better in the application of names to *Aster* cultivars than the continued use of Latin binomials. The use of the culton concept and its consequences for classifying *Aster* cultivars is outlined.

Key-words: Aster, cluster analysis, cultivar-group, culton, cultonomy, taxonomy.

INTRODUCTION

Species and cultivars of the genus *Aster* L. have long been in cultivation, especially as garden plants. A relatively small number of all cultivated species has been used in breeding programmes, e.g. *A. alpinus* L., *A. amellus* L., *A. cordifolius* L., *A. dumosus* L., *A. laevis* L., *A. lanceolatus* Willd., *A. lateriflorus* (L.) Britton, *A. novae-angliae* L., *A. novi-belgii* L. and *A. tradescantii* L. Interspecific hybridization has led to an array of cultivars suitable for the garden, for the cut-flower industry, or for both. Many of these cultivars were given epithets in conjunction with a Latin binomial. Several of these binomials, however, are wrongly applied or belong to species that are taxonomically confused, resulting in much instability in the application of such names. Organizations in the Dutch flower trade requested the Vaste Keurings Commissie (VKC, Aalsmeer, The Netherlands) to present a solution to the confusion that had arisen in the application of Latin binomials to *Aster* cultivars.

The urge to use species binomials for grouping cultivars is often flawed because many cultivars have no full genetic link with a particular species. The degree to which their genomes actually differ from a species genome is irrelevant. What is relevant is that the cultivars deviate from the main body of a species, either as the result of continuing selection and artificial maintenance of these characters or by combining characters of more than one species in a cultivar through artificial hybridization or genetic engineering. The introduction of individuals of species from the natural environment into the

realm of human society and the subsequent modification of these deliberately selected gene pools to the satisfaction of Man (domestication) obviously leads to a new kind of diversity. Hetterscheid & Brandenburg (1995) have argued that this particular diversity needs its own mechanisms of classification and its own categories to work with. They therefore introduced the concept of 'culton' as a general term for systematic categories of cultivated plants as opposed to 'taxon' in use for systematic groups of organisms which make up the biodiversity of natural populations. The practical advantages of the culton concept and its consequences will be shown to solve a number of classificatory and nomenclatural problems in cultivated *Aster*.

MATERIALS AND METHODS

A total of 87 cultivars of garden and cut-flower asters was grown at the Research Station for Nursery Stock (Boskoop, Netherlands) and the Research Station for Floriculture and Glasshouse Vegetables (Aalsmeer, Netherlands). All cultivars were described, photographed and herbarium specimens were vouchered and deposited in WAG. The morphological descriptions were entered in the VKC Register database. Of 50 cut-flower cultivars a total of 48 characters were scored and used in numerical cluster analyses. These characters included plant height, root system, indumentum, leaf shape, length, width, shape and position of the inflorescence and characters of the capitula (involucral bracts, bracteoles, disc florets, ray florets, etc.). Using these data, cluster analyses were performed using SPSS-PC 4.0 (Norusis 1990). Analyses were run with all characters, and with subsets of characters, choosing those which showed consistent and repeatable differences, and including the characters given in the *UPOV Guideline*. Figure 1 shows an example of the resulting dendrograms. Growers of asters were asked which characters they use to group cultivars with on an informal basis. These characters (diameter of the capitula, shape of leaves, height of plant and degree of doubling in the capitula) were finally used to circumscribe the cultivar-groups. Standard cultivars and standard specimens were designated (the latter deposited in WAG). All information is stored in the VKC cultivar database.

RESULTS

Binomials applied to cultivars

Taxonomic screening of the species names used for the cultivars studies gave the following results.

Aster dumosus L.

This name is widely used in garden asters to differentiate a group of low-growing, cushion-forming cultivars. Their morphology deviates considerably from proper *A. dumosus* L., the latter, for example, being 40–100 cm tall and the former only 20–40 cm. Other differences and the known history of breeding of cultivars of this group indicate that the use of the binomial *A. dumosus* is misleading and does not refer to the actual nature of the cultivars assigned to it. An alternative cultivar classification is proposed here (see below under Dumosus Group) retaining the well-known epithet as part of the new cultivar-group name.

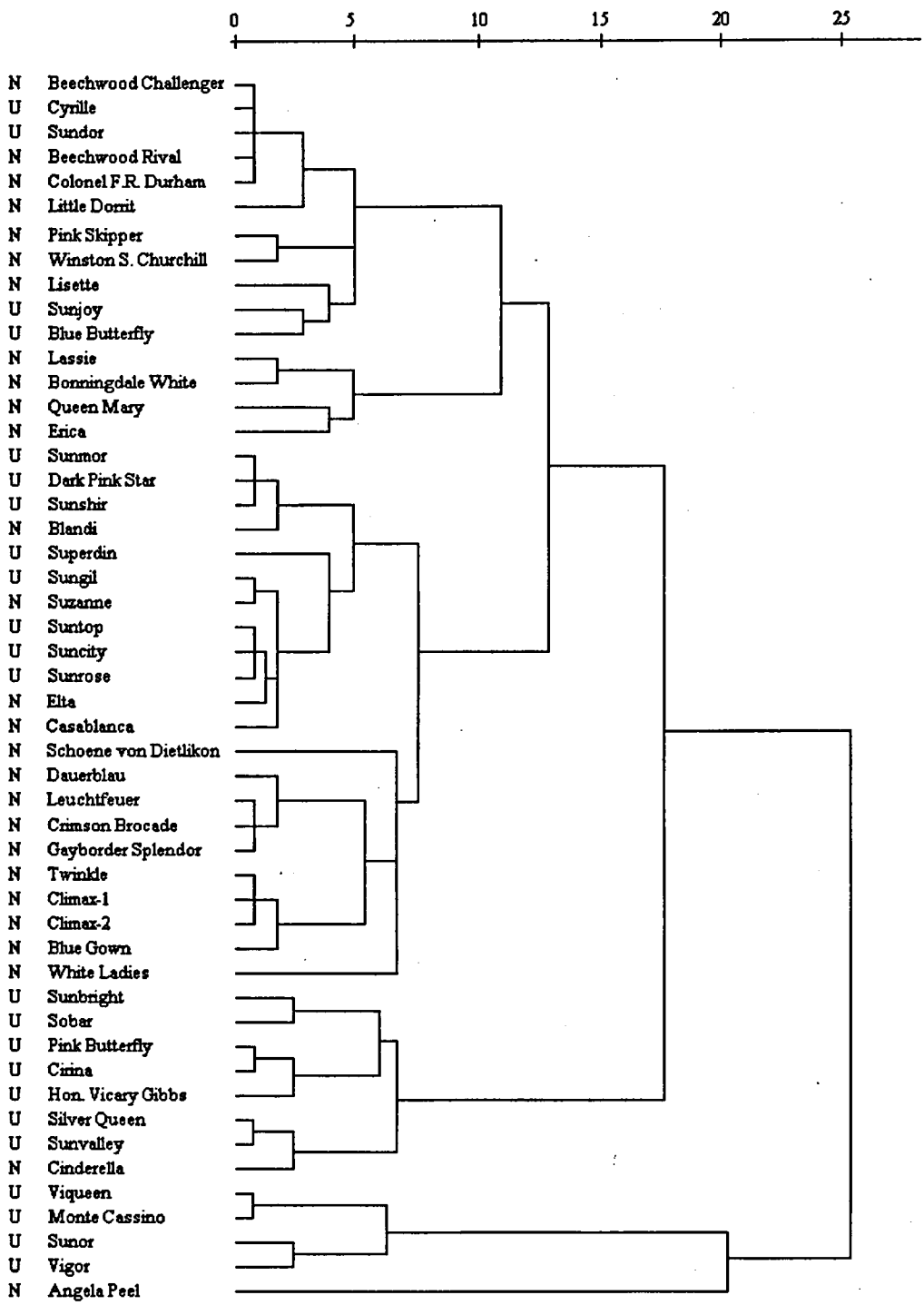

Fig. 1. Dendrogram of 50 *Aster* cut-flower cultivars with designations of the cultivar-groups they belong to. N: Novi-belgii Group, U: Universum Group.

Aster ericoides L.

This binomial is usually applied to a diversity of low-growing garden cultivars with a heather-like appearance, e.g. 'Schneetanne' and 'Ringdove'. In the cut-flower industry, however, this name has long been associated with the commercially very successful cultivar 'Monte Cassino'. This success has prompted breeders of cut flowers to imitate this cultivar by crossing other species in order to preserve the good characteristics of it and eliminate bad ones. A number of cultivars have arisen from these efforts to imitate *A.* 'Monte Cassino'. Breeders have also attempted to strengthen the similarity to 'Monte Cassino' of their new cultivars by assigning them all to *A. ericoides*. The relation of 'Monte Cassino' with *A. ericoides*, however, is in doubt. Recently it has been suggested that 'Monte Cassino' belongs to *A. pringlei* (A. Gray) Britt. (syn: *A. pilosus* var. *pringlei* A. Gray). The morphology of 'Monte Cassino' certainly is closer to *A. pilosus* but a long debate over this issue is not very productive since we are dealing with quite extensive hybrid swarms in cultivated asters.

The interspecific nature of many of the new cultivars imitating 'Monte Cassino' renders the urge to use a Latin species name obsolete. The use of the name *A. ericoides* for 'Monte Cassino' and similar cultivars is thus misleading but taxonomists and horticulturists have not been able to present a proper alternative and instead battle over the question of the application of several species names. It is therefore proposed here to use the cultivar-group category as a sensible classificatory alternative (see below under Universum Group).

Aster novi-belgii L.

This is the most widely used binomial in commercial aster breeding. The many cultivars assigned to it (more than 500) show a variety of characters illustrating their derivation from more than simply *A. novi-belgii*. Bergmans (1924) created a separate species, *A. hybridus* Bergm., to accommodate these cultivars, and he stated that other species have been used in the creation of the cultivars, notably *A. lanceolatus*, *A. laevis* and *A. tradescantii*. The application of the epithet '*novi-belgii*' at the species level to group the cultivars with is therefore not justified and we propose to retain the epithet for use in a new cultivar-group name (*A. Novi-belgii Group, see below*). As with the retention of the epithet *dumosus*, we have chosen for stability of names and accepted custom. An alternative solution would have been to use Bergman's epithet *hybridus* but this word is not allowed as part of a cultivar-group name under the present ICNCP (Trehane *et al.* 1995).

The cultivar-groups

The data gathered from taxonomic enquiry and discussions with users have been used to propose a new classification of the cultivars of *Aster* with a major economic importance. The latter argument should serve to gain as much support as possible for the classification and simultaneously stabilize the latter's usage as soon as possible. The following characters proved to be relevant for a classification proposal:

- plant height;
- leaf shape and indumentum; and
- diameter of capitula.

With these main characters the following three cultivar-groups are proposed and officially established following the rules of the ICNCP (Trehane *et al.* 1995).

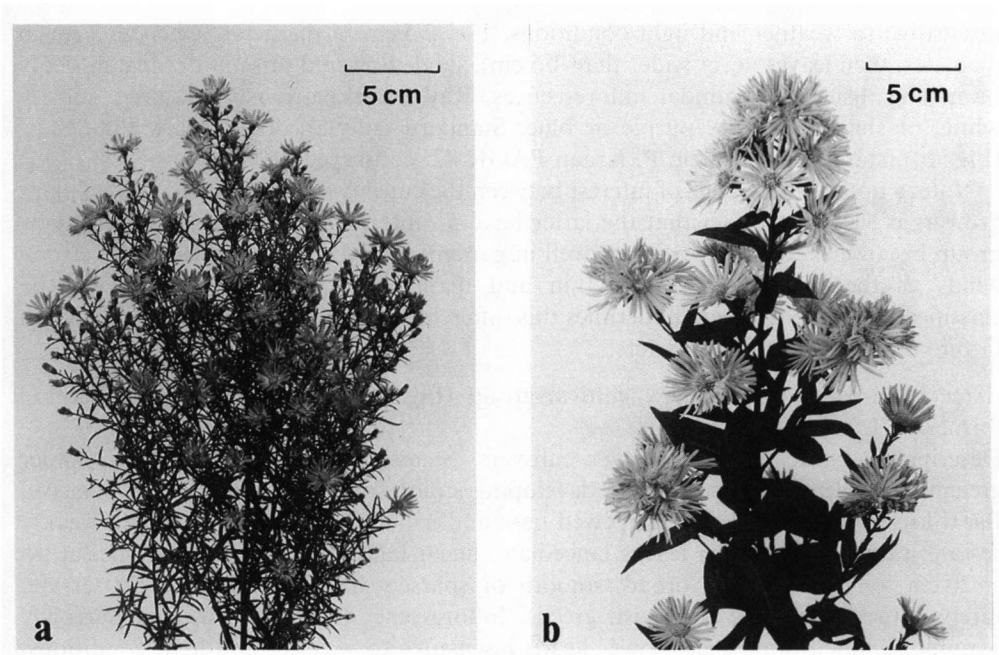

Fig. 2. (a) *Aster* (Universum group) 'Dark Pink Star'; (b) *Aster* (Novi-belgii group) 'Blue Titanic'.

Aster Dumosus Group, new cultivar-group (syn: *A.* Dumosus-Hybrids; *A.* × *dumosus* Hort. non L.)

Description: Plants with stolons, forming dense groups of 20–50 cm high. Basal leaves usually with a stalk-like narrowed base, blade triangular-cordate, margin weakly serrate, stem leaves lanceolate, sessile, *c.* 2–3 cm wide, margin entire or weakly serrate. Inflorescence compact, highly branched, umbellate. Flower heads 2·5 cm in diameter or more. Autumn flowering. Standard cultivar: *Aster* 'Apollo' (standard specimen: Hetterscheid 95-009, conserved at WAG).

Note: this assemblage originated mainly from crosses between *A. dumosus* L. (and derived cultivars) and *A. novi-belgii* L. (and derived cultivars). The non-Linnean application of the name *A. dumosus* in circles of growers and breeders of these cultivars has long been recognized and a few attempts at expressing this are known, notably Trehane (1989) who applied the name as '*Aster* × *dumosus* Hort. non Linnaeus 1753' and Schacht & Fessler (1985) who use the term 'A. Dumosus-Hybriden'. This latter solution has no place under the new ICNCP (Trehane *et al.* 1995), where the word *hybrid* is not allowed to be part of a cultivar-group name. Therefore this group has now been given a name that accords with the ICNCP. In order to maintain maximum reference to relevant literature and stabilize the long-known use of the epithet '*dumosus*' in horticulture, we have chosen to retain the epithet *Dumosus* for the cultivar-group.

Aster Universum Group, new cultivar-group (Fig. 2a)

Description: cut-flower cultivars. Plants producing runners or not. Stems more than 80 cm long (under greenhouse conditions), smooth or sparsely hairy. Stem leaves linear or linear-lanceolate, sessile, smooth on both surfaces, up to *c.* 20 cm long and *c.* 2 cm wide (usually *c.* 1 cm wide), margin entire or with scattered, small teeth. Flower heads

insensitive to weather and light conditions, 1–*c.* 2·5 cm in diameter (when *c.* 3 cm in diameter, then leaves never wider than 1·5 cm), single flowered or semi-double, in richly branching, usually pyramidal inflorescences. Ray florets variously coloured, mostly white, or shades of pink, purple or blue. Standard cultivar: *Aster* 'Dark Pink Star' (Fig. 2a) (standard specimen: P. Kraan PAGK 42, conserved at WAG).

Note: a notable difference of interest between the cut-flower growers and garden plant growers is seen in the fact that the latter have no interest in the cultivars of this new group because they do not perform well in gardens. They are easily affected by strong winds as their stems are rather thin and many seem sensitive to mildew. The classification presented here underlines this difference by qualifying the new Universum Group as typical cut-flower asters.

Aster Novi-belgii Group, new cultivar-group (Fig. 2b) (syn.: *A. hybridus* Bergm.; formerly: *A. novi-belgii* cultivars)

Description: garden and cut-flower cultivars. Stems more than 80 cm high (under greenhouse cultivation), sometimes developing stolons and then usually very invasive. Basal leaves with a stalk-like narrowed base and usually elliptic blade, margin weakly serrate, rarely entire. Stem leaves lanceolate, linear-lanceolate or linear, sessile, up to *c.* 20 cm long and 4·5 cm broad, smooth or sparsely hairy, margin weakly serrate, rarely entire, green (never greyish green). Inflorescence pyramidal, usually narrowly pyramidal, much branched. Flower heads insensitive to weather and light conditions, *c.* 2·5–6 cm in diameter (when between 2·5 and 3 cm, then leaves always broader than 2 cm), single flowered, semi-double or double. Ray florets in various colours, notably white or shades of blue, pink or purple. Standard cultivar: *Aster* 'Dauerblau' (standard specimen: W. Addink WA 20, conserved at WAG).

Cluster analyses

Cluster analyses were performed in order to evaluate the relation between the proposed classification based on user criteria and the outcome of cluster techniques, using several sets of characters. One of the resulting dendrograms is shown in Fig. 1. The codes for the two cultivar-groups recognized for cut-flower asters (N: Novi-belgii Group, U: Universum Group) are added, showing how the members of these groups based on only a few user criteria are distributed over the many clusters in the dendrogram based on a multivariate analysis of morphological traits.

DISCUSSION

A prominent example of the problems in the adherence to the taxon concept for classifying cultigenic diversity is seen in *Aster*. We have chosen here the cultivar-group classification approach and use all advantages of open classifications to eliminate the useless debate about taxon names and focus on the need of the actual users. We feel that the recent developments in the systematics of cultivated plants (Hetterscheid & Brandenburg 1995) and the entirely new ICNCP (Trehane *et al.* 1995) provide a stable and logical system of classifying cultivated plants in general and a nomenclature suitable to translate such classifications. The emphasis in this context is heavily on the establishment of cultivar-groups to use as classifying categories for cultivars instead of adhering to the species category (and its ICBN nomenclature) for this purpose. The use

of the taxon concept and its Linnean classification system are unsuitable to classify cultigenic diversity. Attempts to build hierarchic categorical systems according to Linnean philosophy have failed (e.g. Jeffrey 1986), and are rarely used because of their cumbersome nomenclature (see e.g. Helm 1957) and inflation of ranks (Jirásek 1961, 1964).

The philosophy of cultivar-group classification (Brandenburg 1986a, 1986b; Brandenburg & Schneider 1988; Hetterscheid & Brandenburg 1995) provides a useful alternative for all aspects of a problem such as outlined above. Users of the cultivars are provided with a collective epithet to use in print and to communicate what type of cultivar is indicated. The destabilizing effect of an uncertain assignment of cultivars to a botanical species is avoided.

A conspicuous advantage of cultivar-group classifications is the absence of obligatory hierarchy (Hetterscheid & Brandenburg 1995). It is usually sufficient to present a single-level classification to satisfy the needs of the users. For the establishment of such a classification a minimum of characters suffices. This gives the opportunity of using convenient user criteria as grouping devices. Such criteria are typically few in number, and unsuitable to build extensive hierarchies within which defining characters are needed for every level of the hierarchy. Another advantage of using few and easily observable characters is the ease with which the classification can be adapted to new breeding developments. Breeding may be entirely focused on one or a few characters, and does not need to be burdened with classifications needing large numbers of characters (such as required in numerical analyses). New cultivars should be easily classified in the proposed cultivar-groups (Oost & Toxopeus 1986).

A few cultivars of *A. cordifolius* exist and some of these suggest that hybridization with another species has taken place. However, the merits of *A. cordifolius* cultivars are very limited and currently no efforts are made to improve them. Therefore, no cultivar-group is proposed here for these cultivars. The use of the epithet *cordifolius* for certain cultivars needs screening. This illustrates the most typical aspect of open classifications. There is no demand to exhaustively classify all culta of one level into culta of a higher (or lower) level (Hetterscheid & Brandenburg 1995). If this were the case with *Aster* cultivars a taxonomist proposing cultivar-groups would be forced to group *all* existing cultivars into cultivar-groups. This would automatically force the establishment of cultivar-groups for which there is no demand by the users, which is in direct contravention with the 'special purpose' goal of classifying cultivars in general. This lack of demand should be respected and the mechanisms of building typical taxonomic classifications in the Linnean tradition ignore this. It is here that the mechanism of open classification solves the problem.

The different goals of breeders and growers of garden asters and cut-flower asters has prompted the idea of presenting two alternative classifications of the large flowered cultivars formerly assigned to *A. novi-belgii* and here reclassified in the *A.* Novi-belgii Group. In circles of perennial plant growers no relevant criteria exist to divide this assemblage. However, for the cut-flower industry a distinction is made between narrow-leaved and broad-leaved cultivars. The former, especially when grown under glass, are more elegant in a vase whereas the latter are more robust. Growers of cut flowers have acknowledged this difference and therefore an alternative classification could have been proposed for the cut-flower market. This procedure would be in line with the acceptability of two or more coexisting classifications for roughly the same set of cultivars as discussed by Hetterscheid & Brandenburg (1995). The reason for this

procedure would be the existence of different classificatory needs of different user groups. The two proposed classifications would not be considered conflicting because they do not try to explain or describe one pattern of diversity (as in taxonomic classifications trying to describe natural biodiversity), but they address two different goals in creating a certain diversity of cultivars. However, growers have declined this alternative because too many of them cultivate asters for both markets and the idea of having to assign one cultivar to two cultivar-groups within the same firm was judged to be too confusing. A more strict division between growers of exclusively garden asters or cut-flower asters would have allowed the existence of both classifications.

The results from the cluster analyses were revealing. Every set of characters differing from those used in the final classification based on user criteria led to classification proposals that were unacceptable to the users when confronted with them. Apparently the continuous attention given to only a few characters for breeding purposes renders other characters as grouping criteria unsatisfactory. This important notice should be a warning for taxonomists of cultivated plants that proposed cultivar-group classifications should not be implemented without an attempt at prior screening by the user group. There is no need for classifications that are not taken up by the users. The task of the taxonomist therefore seems to be to evaluate which characters will yield a classification with as much public support as possible. The role of cluster analyses may be to produce crude groups that may be fine-tuned later. Cluster analyses may also reveal relevant distribution patterns of non-selected characters that may support cultivar-groups or may even point out alternatives. In any case it is clear that the directive to use 'as many characters as possible' (as practiced in classifications of taxa) may be obsolete cultonomy.

In conclusion, we feel that the presented cultonomic classification of *Aster* cultivars accurately divorces their nomenclature from destabilizing and confusing discussions of the proper application of Latin species names. In general the use of cultivar-groups as classification device for cultivars satisfies the needs existing in society for a stable, unambiguous and consumer-directed taxonomy. The urge to use the species category or the Linnean taxonomic system in general to classify artificial diversity is deemed to lead to confusing situations and is therefore disclaimed here.

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