

The Future of the Taxonomy of Cultivated Plants

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Abstract

In agriculture and horticulture, at least 80% of taxonomic problems are related to the cultivar. In particular, questions such as (a) “Am I really dealing with a new cultivar?” (b) “To which species does a cultivar belong?” (c) “How can I recognize a cultivar phenotypically, especially if it is a hybrid?” and (d) “Does the cultivar-group system always work?” continually impact on the work of those dealing with the classification and naming of cultivated plant material. Further questions dealing with the very nature of cultivars and whether wild forms or other categories named under the provisions of the *International Code of Botanical Nomenclature* (ICBN) should be eligible for cultivar status form an ongoing debate, as do a range of other issues such as the nomenclatural treatment of mixtures as cultivars in the agricultural industry. Statutory registration systems are based on DUS (Distinction, Uniformity, and Stability). The denominations provided through these systems have historically been made with minimal reference to the *International Code of Nomenclature for Cultivated Plants* (ICNCP). Stability in naming is the first priority for those trading in, and legislating for, cultivars in the market place. Clearly there is a need to provide an international forum for discussion and resolution of these and other related problems so that the interests of plant breeders, collection managers, plant traders, taxonomists, and legislators may be discussed and resolved in a decisive way through a platform that carries international recognition. These and other issues are discussed from the perspective of European legislation, UPOV recommendations, and statutory registration in vegetables, fruit, and ornamentals, with examples to demonstrate the problems and to promote a discussion on the future of taxonomic work in the field of cultivated plants.

INTRODUCTION

In the 25 odd years that I have worked as a statutory registration authority, I developed a kind of love-hate relationship with taxonomy. It is the love part that brings me to these symposia for the fourth time.

At the first symposium in Wageningen (1985) a lot of exciting new developments were presented. In Seattle (1994) it seemed to me that not much progress was made. In Edinburgh (1998) on the contrary the fire was re-lit, but since then not much was heard from the initiatives launched there. So now we find ourselves in Toronto and for me this is the congress where the outcome will decide if I will ever visit a next symposium.

Progress in our field is slow, while in the 17 years since the Wageningen meeting the world has changed around us rapidly. Within these years UPOV (the international organization on plant breeders' rights) renewed its convention so that now in principle cultivars from the whole plant kingdom may be protected with Plant Breeders' Rights. The GATT/WTO agreement forced many countries to recognize intellectual property rights including Plant Breeders' Rights. The membership of UPOV is growing rapidly. These two things combined give a far greater importance to statutory registration than 17 years ago.

In the *International Code of Nomenclature for Cultivated Plants* (ICNCP) now, the presence of legal obligations is mentioned as reason to diverge from the rules, where

in reality more and more these legal obligations are the rule and the ICNCP is becoming the exception. The statutory registration system is based on DUS (Distinction, Uniformity and Stability). The requirements are embedded in legal systems which are difficult to alter. In cases of disputes, no generally accepted international authority on the taxonomy of cultivated plants exists, therefore many problems remain unsolved or are solved in an inconsistent way.

More and more, taxonomy and cultonomy seem to be in conflict. Can we keep the two together, or has the time come to part as good friends and each go our own separate ways?

The technical possibilities in breeding are enormously expanded. Marker techniques speeded up the breeding process, DNA techniques make (through genetic modification), crosses possible that were undreamed of 17 years ago. This has led to a large increase of the introduction of new cultivars. The consequences of all this for the correct denomination of these cultivars has been largely ignored. In agriculture and horticulture at least 80% of all taxonomic problems are related to the level of cultivar. The input of taxonomists in these discussions is seldom sought or actively offered.

The economic development of the agricultural sector developed in the direction of an industry where quality, consumer protection, safety and stability are important factors. Many companies are now ISO certified and the logistic procedures are well developed. The lack of freedom on the level of the denomination of the cultivars, an important marketing device, is difficult to maintain. The tendency taxonomists have to impose a name change on taxonomic grounds, is no longer acceptable. Added to this fear is the increasing interest in the phylogenetic approach. This system, largely based on relations between plants on the DNA level, may well lead to new insights that could lead to the change of many genus and species names.

A development in the last 17 years with a huge impact on our work is the Internet. Answers to questions may now be found in seconds, where 17 years ago a trip to the library would have been necessary. It is hard to imagine how we could cope today without the support of well-established taxonomic databases such as GRIN and PlantScope[®]. At the same time, the possibilities of these tools are not yet fully implemented in our thinking.

IS THE INTEREST IN CULTONOMY EQUALLY DIVIDED?

An arboretum or botanical garden has a different interest in the ICNCP than a lettuce or gerbera breeder. Are all user-groups equally served? I have the feeling that still too much cultonomy is seen through the eyes of people with their roots in classical taxonomy focusing on ornamentals and trees where the border between wild and cultivated is not always clear. One could ask if the rules that are developed with these sectors in mind also apply to e.g., vegetables and agriculture, where cultivars are really man made, even to the point that the cultivar ceases to exist when man decides on economical grounds that maintaining (producing) the cultivar is no longer profitable. Especially in the field of F₁ hybrids, this is the case.

The stability of names is the first priority for the trade in cultivars and legislators. Unfortunately we saw some prime examples of what can happen if, on taxonomic grounds, the names of species that are economically important are changed. When it was decided to change the name *Chrysanthemum* into *Dendranthema*, this caused tremendous problems for the trade in The Netherlands, where in the whole chain from breeder, grower, auction, wholesale and retail sales the name had to be changed and customers convinced of the necessity to do so. Many fingers were pointed to foreheads, when the sanity of taxonomy was discussed. When then, by those same taxonomists it was decided to change everything back again and the same costs had to be made to change the names again, the little credibility taxonomy had, was lost completely. Something comparable almost happened when it was discovered that the taxonomically correct name for *Eustoma* was, in fact, *Lisianthus*. After some fruitless attempts to change the whole industry's labeling, the taxonomists decided to conserve *Eustoma* over *Lisianthus*.

TO WHICH SPECIES DOES MY CULTIVAR BELONG?

A simple question that may confront us with sometimes unexpected answers. An applicant will clearly state the species of his cultivar in the application phase e.g., Winter cabbage. We all know what he means but the system forces us to choose between White cabbage or Savoy cabbage. Cultonomists will advise that the cultivar belongs to *Brassica oleracea* (Winter Cabbage Group), a clearly defined cultivar-group. UPOV does not mind because both White and Savoy cabbage are included in the same guidelines. The legislator forces us however to consider either *Brassica oleracea* convar. *capitata* var. *sabauda* or *Brassica oleracea* convar. *capitata* var. *alba*, giving the impression that anything belonging to neither taxon automatically falls outside the scope of the legislation.

Legal systems, as can be seen in the Winter cabbage example, sometimes stick to old-fashioned or even outdated nomenclature models. In discussions on this subject, in the end it always comes down to the point that no internationally accepted taxonomic authorities exist that can be consulted. The consultation of individual taxonomists always leads to conflicting opinions. So in fact, we stay where we are, knowing that what we do is wrong.

Another example where even court cases are devoted to principle taxonomic problems, is the proper classification of seed propagated shallots. Until recently, only vegetative propagated shallots existed. The culture of this crop takes place on small, specialized holdings. The material was covered as *Allium ascalonicum* L. When seed propagated shallots were introduced this caused a great disturbance of the market; any farmer with a sowing machine can produce these shallots, resulting in a pressure on the prices and rebellion among the original growers. The problem was presented to the (in this case) European legislators, arguing that these seed propagated shallots in fact are not *Allium ascalonicum* but belong to *Allium cepa* L. It got more complicated when it was discovered that the grown varieties/cultivars of vegetative propagated shallots probably do not belong to *Allium ascalonicum* in the first place and a new solution was suggested to place everything under *Allium cepa* but first to split *Allium cepa* into *Allium cepa* var. *cepa* (onions and seed shallots) and *Allium cepa* var. *aggregatum* (shallots). In my view, it is a better solution to introduce cultivar-groups in *Allium*. This would create *Allium* (Shallot Group), *Allium* (Onion Group) and possibly *Allium* (Seed Shallot Group). However, this could not be accepted due to the lack of an internationally accepted authority to promote this solution, and due to the continuing difficulties in introducing those, by definition, unstable cultivar-groups as a basis for legislation.

Many of the varieties/cultivars of known crops such as tomato, pepper etc. now on the market are in fact interspecific crosses between the cultivated form (e.g. *Lycopersicon esculentum* Mill.) and a wild form to be able to cross in disease resistances or other characteristics. The rule is applied that as it looks like a tomato, it grows like a tomato and it tastes like a tomato, it probably is a tomato and therefore is covered by *Lycopersicon esculentum*. The introduction of the crop group model or cultivar-group model would be a much better solution but, as explained earlier, there is great reluctance to replace the present legislative principles by more cultonomic principles. In the meantime we keep our fingers crossed that no clever lawyer will discover this and use it in infringement cases.

DO THE PRINCIPLES FROM THE ICBN OR THE ICNCP APPLY?

In perennials it is sometimes not easy to establish if we are dealing with the “wild form” of a species or with a cultivar. As new cultivars are created, the description of the wild form remains unchanged. There is a lack of a clear definition of the “wild form” that is amended in time as more and more new cultivars are created. This lack of consistency creates many problems in the correct identification of material that is being marketed. Finding a plant with just the Linnaean genus and species name, it is impossible to say if you are dealing with the wild form of with a cultivar that represents the species.

This year we spent our family holidays in Sweden where I found a prime example of this problem. We visited the university town of Uppsala where Linnaeus started his

work on the classification of the plant kingdom. He was, in mid-1700, the successor of father and son Rudbeck, who paved the way for him. Linnaeus created a garden where he brought plant material together to be used in his classification model. This garden is still there. The original lists of plants included in this garden still exist and was used in 1980 to restore the garden to look exactly like it appeared in 1748. Walking around this garden that contains some 2000 plants systematically planted according to his just-developed Sexual System was quite impressive. Contrary to our plans, and to the dismay of my daughters, we spent almost a day in this garden that could be considered as the basis for our work here today. Looking at the plants, the sometimes-original handwritten labels and the layout was very interesting. On the labels were the names according to the binomial system, data on the origin and in all cases the Swedish common name. All the plants were labeled with the original name, so this is as good as you can get. However, one thing was very disturbing; the vast majority of the annuals and a good part of the perennials were not wild forms but cultivars representing the species. This fact however was not mentioned on the labels thus creating the idea that they were the same plants Linnaeus had described in 1748. Even here at the birthplace of taxonomy, the absence of a clear splitting between the *International Code of Botanical Nomenclature* (ICBN) and the ICNCP was on display, adding to the confusion in the field of proper nomenclature. A clear dividing line between the *Botanical Code* for the “wild” forms and the “man made” cultivars could solve many problems.

Precisely here we see a strange contradiction; as the ICNCP in fact is still an appendix to the ICBN, the major rules of the ICBN apply at least on the genus and species level, also to man made cultivars. This means that the botanical correct denomination of the material on genus and species level may change in time, due to changed views on taxonomic principles. For man-made cultivars that still are linked to the genus and species name due to legislation and marketing requirements the stability in denomination is of much greater importance than for the “wild” forms.

AM I REALLY DEALING WITH A CULTIVAR?

When asked to describe a “cultivar” of *Liquidambar* we are forced to study our definitions of a cultivar very thoroughly. Also in this case the definition given by the ICNCP differs from that of UPOV and sometimes the national legislator. The term cultivar is applied to different concepts; a cultivar of lettuce, legally, is treated in the different legal systems in the same way as a cultivar of *Liquidambar*. The stability of these cultivars (lettuce being a self-pollinating seed propagating seed-crop whereas *Liquidambar* is a clonal, vegetatively propagated cultivar) and the way further cultivars may be developed from the existing ones differ largely.

THE IDENTIFICATION AND DESCRIPTION OF NEW CULTIVARS

Which characteristics may and can be used - are these discreet or continuous? The classical botanical approach simply does not allow to describe the vast stream of man-made cultivars, let alone fill hundreds of boxes with specimens. Other ways were found, and generally the UPOV guidelines are used. Those guidelines are still often based on knowledge from the western hemisphere. With a growing number of countries joining UPOV from other parts of the world, the existing guidelines sometimes prove inadequate to describe the variation found in these new Member States. Different types of characteristics have to be taken into account to accommodate the research in different countries. Discrete characteristics, where the expressions exclude each other are very valuable, as it may be expected that these are easy to apply under different circumstances. Continuous characteristics pose more problems as there are no clear borders between the different expressions and not seldomly the value of the expression is scored differently in different climates. Little is known of the relation between genotype and the phenotypic characters we may see in the field, so a clear gene-based description of the expressions is not possible. I feel that at the moment not enough exchange takes place between taxonomists, who in the meantime have much experience with the modern DNA based

techniques, and the registration authorities, statutory and non-statutory alike. We could benefit from each others' knowledge.

Before a cultivar can be recognized, it has to be checked to ensure that the material really did not exist elsewhere at the time of application. Growing international traffic and contacts make for many "new" cultivars that originate from the wild in far away places, but which may be being cultivated successfully in glasshouses elsewhere. For registration authorities, this means that one way or the other, the world collection has to be taken into account when deciding on the novelty of a new candidate cultivar. The management of data on all cultivars in trade is rapidly becoming a vast task, where again taxonomists and registration authorities should join forces.

CULTIVAR DENOMINATIONS

With the increased membership of UPOV and the enlargement of protection to the whole plant kingdom, the importance of the UPOV denomination rules is growing rapidly. UPOV recognizes this and is in the process of updating their present Denomination Guidelines. The feeling is that the present rules developed by the European CPVO office that now apply to Plant Breeders' Rights and National Listing in Europe together with the pending legislation on varietal denominations in the USA will be leading the discussion. ICNCP will have to struggle to play its role in these discussions. A recognized international organization to participate in these discussions is clearly missed.

DEVELOPMENTS IN LEGISLATION WHERE CULTONOMISTS COULD HAVE PLAYED A VALUABLE ROLE

Varietal Associations

In agriculture, a variety/cultivar may only be marketed if tests have shown that the Value for Cultural Use (VCU) is at least as good as the existing varieties/cultivars. In oilseed rape (*Brassica napus* L.) recently, a development occurred where the existing legislation had no solutions, so a new approach had to be developed. In oilseed rape the product to be harvested is the seed from which oil is derived. New material was developed where in fact two parents were sown in the field. Through cross pollination, F₁ hybrid seed was produced that gave more oil than the usual varieties. Each of the lines sown in the field did not answer to the VCU requirements (one of the lines being male sterile, did not produce seed at all). Therefore it was not possible to treat the two parts as cultivars and describe the whole as a mixture. After long technical (but not very taxonomic) discussions it was decided to invent the notion of a "varietal association" with a set of separate requirements. I am sure that in this discussion the help of a cultonomist could have been useful.

Conservation Varieties/Biological Varieties

Is the cultivar concept applicable to these phenomena? One of the main topics in the legislative process within the European Union at the moment is to give safeguards against genetic erosion and to enable/promote the development of ecological production. Also in these cases the existing rules and regulations make it difficult to fit in "conservation varieties"; varieties with a low level of uniformity and subject to genetic drift. Biological seed and biological varieties will also have to be defined in order to answer the needs of the ecological farmer. In fact the question is on the table as to whether the definition of a cultivar allows these different subjects to be treated as cultivars. In this discussion, where plant genetic resource and ecological organizations participate, cultonomic input could be valuable.

Mixtures of Ornamentals and Grasses

In agricultural practice, mixtures are treated as cultivars - does the ICNCP provide for this? During the Edinburgh symposium, attention was focused on the practice in ornamentals to market both mixtures and series. No firm decision was provided, but there

again, who is to give that? In the suggestions to further develop the ICNCP, some attention is given to these aspects. Also here, no recognized forum has the decisive power to act upon these questions. The lack of this usually means that the practice goes its own way, thus widening the gap with the ICNCP. We should join forces and come up with a cultonomic sound solution that is acceptable for the seed industry.

CONCLUSION

Facing these problems and looking at the future of the taxonomy of cultivated plants, the conclusion can be drawn that if we do nothing there will be no future. The work on cultivated plants will be divided between the classical taxonomist and phylogenists at the one side and the forces of economy, represented by the legal systems of the statutory registration authorities on the other side. Cultonomists will be left struggling in between, desperately trying to bring these two worlds together.

If on the other hand, we now act decisively, we are in a unique position to create a bridge between the two worlds. In order to do so we need to create an internationally accepted organization that is recognized as the authority to decide on questions around the taxonomy of cultivated plants.

The border between classical taxonomy and the taxonomy of cultivated plants has to be re-defined. Stability in naming is a first priority. Even if the name of the wild form that was the basis for many cultivars has to be changed according to taxonomic principles, the separate question, if this means that automatically the names of all cultivars also have to be changed, has to be answered separately. Modern communication makes it possible to store and make available relations between wild material and cultivated material if these do not carry the same name.

Together with the authorities that govern the rules for naming in Plant Breeder's Rights we have to find solutions for the problems we are facing.