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Role and Content of Species-level Crop Descriptions[1]

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An analysis is provided of certain types of crop description and their uses. It is suggested that users of some forms of crop description could benefit if greater consistency of content could be achieved—particularly in dictionary entries, broadly-based articles and chapters, and forms closely related to these two. Ways of making these improvements without restricting authors' freedoms are discussed.

The description of crop species has a history of over 2,000 yr. Among the ancestors of modern writers—e.g., Burkill (1966) and Purseglove (1968, 1972)—are Theophrastus and Pliny the Elder.

Until recently, descriptions of crops have been textual, with or without illustrations. Lately, however, tabular descriptions have begun to appear which are intended for use in both printed and computer searchable forms. Short descriptions of this type have appeared in inventories (Duke, 1978), and sets of more extensive descriptions have emerged in forms which can be called compendia (Webb et al., 1980; Hackett and Carolane, 1982).

To someone interested in the use of crop information at the species level for land-use planning, as the present writer is, the tabular format is particularly attractive because it provides a consistency of structure which makes for very rapid retrieval of information. Contemplation of the textual and tabular formats as vehicles for conveying information therefore prompted thought about their respective functions and possible relationships in the future. Examples of the questions which arose were: what uses are the textual and tabular forms best suited to; are they potentially complementary or could they become competitive; and if the course of crop description in the future could be guided, in what ways might the textual and tabular forms be encouraged to develop? This paper reports the writer's response to these questions.

CROP DESCRIPTION AS AN ACTIVITY

To come to grips with questions about the future of crop description, it was necessary to analyse it as an activity. The conclusions are summarized in Fig. 1.

Hierarchically, the lowest level of activity is taxonomic and yields labels (Class A descriptions). These emerge as common names and scientific names, which are periodically published as checklists (e.g., Terrell, 1977).

The next level of activity gives the crop an identity. Simple, almost indisputable observations such as growth habit, use, and location are appended to the name and appear as dictionary entries or as short entries in crop inventories. The entries compiled by Uphof (1968) represent examples of these Class B descriptions.

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The third level of activity expands on the second and starts to add interpretations. The factual supplement can include such information as the names of pests, types of propagule used, and methods of cultivation; examples of interpretations commonly included are frost sensitivity and drought tolerance.

The number of crop attributes covered in these Class C descriptions can be several score, but the overall length of the descriptions is always short. In the textual form they occupy on the order of 300–3,000 words, with an average of only 10–20 words being used per attribute. Tabular Class C descriptions are some 10 times shorter in terms of words or characters used, but this brevity is often achieved at the cost of making a textual statement elsewhere to explain the meaning of abbreviations and ratings used in the tabular format. Examples of textual Class C descriptions are those of Purseglove (1968), and tabular examples are those in Part I of Hackett and Carolane (1982). Both forms of these Class C descriptions can be thought of as crop profiles.

The highest level of crop description activity considered was that which attempts to survey and integrate all knowledge of a crop. These Class D crop descriptions appear as reviews or monographs. They summarize the botany of the crop, its responses to external physical and biological factors, and the methods of cultivation, harvesting, storage and marketing. Economic considerations are also commonly cited. The works by Doggett (1970), Grist (1975), and Hartley (1977) represent examples of these Class D descriptions.

USES OF CLASS A–D CROP DESCRIPTIONS AND THE NEED FOR DEVELOPMENT

All the classes of crop description recognized above serve as means of documenting knowledge and as basic reference material. Many examples also serve as educational material. This paper is mostly concerned, however, with the value of these descriptions as direct aids to decision making about land use, and from this standpoint it can be seen that each Class serves a particular level of thinking (Fig. 1).

Sound decision making about the choice of a crop requires analytical thought. For this, dynamic quantitative information at the species *and* cultivar levels is needed, which Class D descriptions can provide. Class C descriptions are too short and qualitative to serve analytical thinking, but because of their wide coverage of attributes in a short space, they are well suited to exploratory thinking (this is the thinking which reviews a large number of possible crops at the species level, eliminates those which are obviously unsuitable, and identifies candidate crops which deserve detailed attention—see Hackett and Rattigan (1981) for further explanation). Dictionary entries and the other types of Class B description can only give short answers to simple questions, and Class A descriptions serve only in the present context as aids to standardizing nomenclature.

Class A and Class D descriptions appear sound in design and capable of serving for many years to come, but Class B and Class C descriptions leave something to be desired. The content of tabular descriptions prepared independently cannot be aggregated because different descriptors are used, and the textual forms are so inconsistent that within a single publication an important attribute may be mentioned under one crop but not under the next, which leaves the enquirer

CLASS	CONCEPTUAL INCREMENT	PRODUCT	FORMAT		TRENDS	USES WHEN CHOOSING A CROP
A	Labels	Names	Checklist entries: 3 attributes, 5 words		Static, qualitative, recognition	Standardizing nomenclature
B	Factual observations	Identities	Dictionary entries 5 - 10 attrib. 10 - 100 words	Inventory entries 5 - 10 attrib. 5 - 10 entries	↓	Quick reference
C	Interpretations	Profiles	Articles, chapters, journal papers 20 - 120 attr. 300 - 3000 words	Compendia entries 20 - 120 attr. 20 - 500 entries	↓	Exploratory thinking
D	Evaluations	Comprehensive descriptions	Reviews, monographs, models		Dynamic, quantitative, appraisal	Analytical thinking

Fig. 1. Crop description as an activity.

wondering whether the desired information was unavailable, too trivial to mention, or had simply been overlooked. Standardization of descriptions of cultivars for conservation and breeding purposes is already being promoted (see, for example, the annual reports of the International Board for Plant Genetic Resources, FAO, Rome), but although the thinking of germplasm conservation organizations will always be relevant to species level thinking, these agencies are giving little attention to the problem of describing species so that species themselves can be compared. Thought was therefore directed to how Class B and Class C descriptions at the species level might be improved.

ROLES OF TEXTUAL AND TABULAR CROP DESCRIPTIONS

Because Class B and Class C descriptions now appear in both textual and tabular forms, it is necessary to consider how people respond to these contrasting formats. (It is assumed that illustrations and figures can accompany both textual and tabular descriptions, and no comment on the use of such illustrative material is given in this paper.) As there has been no formal survey of opinion on the qualities and uses of crop descriptions, it is impossible to present well-founded conclusions, but the following statements are considered to be true.

(1) Textual and tabular descriptions in Classes B and C deal with the same type of observations about crops (e.g., both tend to concentrate on the organ and whole-plant levels and refer rarely to the cellular and subcellular levels).

(2) Most people can comfortably use tables as look-up devices, but many cannot assimilate tables as a whole. Hence, textual descriptions are generally more effective for conveying an overall impression of a crop's characteristics than tabular descriptions.

(3) Tabular descriptions lend themselves well to the construction of retrieval systems. Searching textual descriptions for a crop with a particular set of characteristics can be tedious and frustrating.
(4) The use of text helps the writer to make emphasis when necessary, to indicate degrees of confidence, and to convey informal knowledge gained from long observation. The tabular format can constrain and frustrate a writer, and because the entries have such a factual air, they can lull readers into dropping their critical guard.
(5) An attractive style of writing can aid the absorption of information. It is doubtful whether even the best type of tabular arrangement can have comparable effects on comprehension and memorizing.
(6) The costs of preparing and publishing textual and tabular crop descriptions may differ—e.g., conventional typesetting of tables can be more expensive than typesetting prose in the same space—but no comprehensive comparison can yet be made.

Considered overall, these statements suggest that textual descriptions are likely to be used throughout the foreseeable future. However, increasing attention will be given to tabulations because of the widespread interest in codifying crop information in forms which can be searched on computers.

GOALS FOR THE DEVELOPMENT OF CLASS B AND C DESCRIPTIONS

Whilst it is no intention of this paper to stifle the freedom of authors of crop descriptions, it is recognized that many people around the world are trying urgently to draw on crop descriptions for practical, and often humanitarian, purposes. Authors of crop descriptions therefore have some duty to facilitate use of what they record. The problem is in how to do this while preserving scientific integrity, allowing for different types of interest in crops, and respecting the aesthetic qualities of plants in general which give deep satisfaction to many who study them. Ways of satisfying these apparently contradictory requirements do seem attainable.

For example, a relatively easy improvement to make in Class B and Class C crop descriptions would be to increase the consistency of coverage of crop attributes in sets of textual descriptions presented as a single publication. Authors of such publications could decide on attributes they would always refer to and could indicate absence of knowledge when such was the case. Other attributes could be mentioned according to the availability or significance of the information. This goal could be met without the descriptions becoming repetitious.

The next goal would be the provision of simple manual retrieval systems with sets of textual descriptions. Such retrieval systems occur commonly in books on vegetable growing (e.g., Lorenz and Maynard, 1980) and can be found in works on forest and ornamental trees (e.g., Simpfendorfer, 1975), but they are rare in works on field crops.

A more difficult goal to achieve would be greater constancy in the coverage of crop attributes in descriptions compiled independently, both textual and tabular. This would require agreement on the attributes which are most relevant to Class B and Class C descriptions. Some agreement already exists in that Class C descriptions almost always refer to attributes of truly major importance such as temperature relationships, but how far such agreement can be extended is unknown.

Also desirable is agreement on how to define crop characteristics in a way which suits the types of thinking which Class B and Class C descriptions serve.

Vague statements such as "This crop does best in warm conditions" are common but unsatisfactory. Expressions are required which are better defined but still immediately understandable. The expressions should also be capable of providing an interface with other data bases useful for exploratory thinking about the choice of crops, such as data bases on climate, terrain and soils.

CROP ATTRIBUTES RELEVANT TO CLASS C CROP DESCRIPTIONS

As an aid to attaining the goals identified above, a list is provided in Table 1 of crop attributes considered relevant to Class C crop descriptions. The list has been compiled from comments received during construction of Hackett and Carolane (1982) and from an analysis of 50 broadly-based prose descriptions in the literature, ranging in length from 500–5,000 words.

Because the various classes of crop description can be considered to be composed of strata of knowledge, Table 1 has been structured so that, as far as possible, the crop naming and crop identity attributes (Classes A and B) appear in the first half. The second half adds those interpretative and management attributes which turn a Class B description into a Class C description.

Table 1 is presented primarily as a basis for thought about the contents of crop descriptions, but it can obviously be of immediate use—e.g., to agronomists preparing inventories of traditional crops in developing countries, to archaeologists attempting to integrate scraps of information about ancient crops, and to committees planning to produce sets of crop descriptions.

MODULES FOR CLASS C CROP DESCRIPTIONS

A suggestion is also offered on how consistency between tabular descriptions constructed independently might be achieved without unduly restricting the freedom of compilers. It is that thought be given to the development of descriptive modules which cover groups of attributes.

A module can be most easily thought of as a data sheet, and the 9 groups of attributes listed in Table 1 may be considered as foundations for the design of 9 modules capable of covering all crops.

Use of modules for tabular crop descriptions would simplify the aggregation of information prepared by different workers and yet would leave compilers free to choose the particular modules which suit their circumstances. Indeed, compilers with special interests could design special supplementary modules for use by others when needed.

Acceptance of the module concept would also make it easier to document and use the knowledge of attribute specialists. At present, most crop descriptions are prepared by crop specialists, who have to think across a wide range of attributes. Attribute specialists habitually think across a range of crops, and if they were willing to document their knowledge in modules, crop by crop, these could be used with ease by crop specialists.

This proposal has similarities to the idea of defining minimum crop and environmental data sets for the description of agronomic experiments so that the results obtained by workers in different locations become directly comparable (Angus, 1981), but it differs in that the demands on compilers could be much smaller and priority could always be given to local needs. The proposal assumes

TABLE 1. CROP ATTRIBUTES RELEVANT TO CLASS C CROP DESCRIPTIONS.[a]

GENERAL BOTANY
- Scientific name and authority, including subsp., bot. var., or cv.
- Family
- Synonymous scientific names and authorities
- English common names
- Names in other languages
- Growth habit of shoot system
- Maximum height (including support if provided)
- Spininess
- Availability of dwarf types
- Degree of morphological variation within the sp.
- Rootstock sp. or cv. (if applicable)
- Maximum depth of root system
- Natural life span
- Life span as grown
- Main developmental stages or events
- Chromosome number—basic
- Chromosome number—somatic
- Existence of wild forms of sp.
- No. of spp. in genus
- Ease of interspecific crossing within genus

USES
- Degree of domestication
- Uses as a living plant in situ
- Parts harvested
- Portions of parts used
- Uses of harvested parts
- For parts consumed by humans:
  - nutritional value, toxicity and if noteworthy or helpful—colour, smell, taste, texture
- Toxicity to humans of parts not usually consumed
- Toxicity to animals

GEOGRAPHY AND HISTORY
- Centre(s) of origin
- Centre(s) of diversity
- History of spread
- Locations of production:
  - names of places or regions, elevations, generalizations (e.g., pantropical), seasons of activities (e.g., harvesting), yields (per planting, per yr, potential)
- Conditions experienced by crop:
  - daylength, humidity, rainfall, salinity, seasonal contrasts, solar radiation, temperature—day, temperature—night, waterlogging

ENVIRONMENTAL RELATIONSHIPS—BIOLOGICAL
- Allelopathy
- Mycorrhizal associations
- Nitrogen fixation
- Pests and diseases
- Pollinating agents
- Weeds

ENVIRONMENTAL RELATIONSHIPS—PHYSICAL
- Light:
  - photoperiodicity, shade requirement, shade tolerance, type of photosynthesis

TABLE 1. CONTINUED.

- Soil and land suitability:
  - depth, drainage, nutrient status, pH, slope, texture
- Temperature:
  - cold requirement, cold sensitivity, heat tolerance, temperatures for growth and development
- Water:
  - drought requirement, drought tolerance, humidity requirement, salinity response, tolerance of inundation, tolerance of waterlogging, water use
- Wind:
  - tolerance

HUSBANDRY

- Farming systems
- Harvesting:
  - methods, machinery, maturation spread, problems
- Irrigation (timing)
- Need for:
  - fertilizer additions (majors, minors), flowering stimulus, frost as a management aid, management skills, physical support, supporting services, wind protection
- Pest control
- Plant spacing
- Planting machinery
- Propagation methods, problems
- Propagule viability
- Ratooning capability
- Risk of becoming a weed
- Tillage requirements
- Transplanting requirement
- Working life of a planting

STORAGE

- Bruising resistance
- Drying or curing requirement
- Humidity relationships
- Temperature relationships
- Lifetimes under specified conditions
- Pest problems

MARKETING

- Consumption rates
- Cultural aversions/predilections
- Price:weight ratio
- Processed products
- Production quantities
- Trade

MISCELLANEOUS

- Centres of research
- Experts
- Literature
- Location of germplasm collections
- Major research problems (e.g., characteristics which restrict location or use)
- Propagule sources

[a] See text and Fig. 1 for number of words per attribute and overall length of Class C descriptions.

that an agency would be willing to record completed modules as they are published, produce an annual directory, and perhaps publish comprehensive descriptions of individual crops as this becomes possible. Organizations presently involved in the preparation of abstracts could perhaps aid an activity of this kind—e.g., the Commonwealth Agricultural Bureaux.

As for the actual wording to be used in the modules, the compendia by Webb et al. (1980) and Hackett and Carolane (1982) and the descriptor sets compiled by the International Board for Plant Genetic Resources provide starting points.

CONCLUSION

The simplicity of the contents of this paper might suggest that crop description as a scientific activity is backward. There seems, for example, to be little difference from an enquirer's point of view between calling for a comprehensive bibliographic search by satellite link and calling for a crop search. Yet the former can be done and the latter cannot. The work of Duke (1978) goes some way towards providing this type of crop search facility but it is not yet comprehensive in terms of Table 1.

The reason for this contrast between bibliographic retrieval and crop retrieval highlights one of the central problems of crop description, which is that it is unavoidably concerned with questions of degree. Bibliographers who feed on-line retrieval systems are largely working with presence-or-absence questions, and if they themselves had to describe the degree to which qualities are exhibited in their material—e.g., originality, conciseness, utility—they might be little further forward than those who describe crops.

Existing problems in using crop descriptions at the species level for practical purposes should therefore not be ascribed to unwillingness to use modern technology but to inherent difficulties in describing plants. Plant taxonomists have reached a position where general principles are widely followed, but within this framework variations are permitted and expected. This paper attempts to stimulate movement towards a consensus on the description of the utility, ecology, and husbandry of crops at the Class B and C levels in the hope of improving the appreciation and use of crop resources.

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