



DBCPC: a database for the cultivated plants of Cuba

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RESUMEN

Se desarrolló una base de datos computarizada como ayuda para la compilación de una lista de las plantas cultivadas de Cuba. Dicha lista es un valioso instrumento en el campo de la exploración y colección de recursos genéticos vegetales y una base para la flora de las plantas cultivadas.

La base de datos contiene información nomenclatural, nombres vernáculos, usos y referencias bibliográficas de 747 taxa (411 géneros, 102 familias) con 500 sinónimos y 947 nombres vernáculos. Se describen la estructura y operación del sistema y se dan ejemplos.

SUMMARY

A microcomputer-based database was developed to support the compilation of a checklist of the cultivated plants of Cuba. Such checklists are valuable tools in the field exploration and collection of plant genetic resources and a basis for floras of cultivated plants. The database contains nomenclatural information, folk names, uses and literature references for 747 taxa (411 genera, 102 families) with 500 synonyms and folk names. The structure and operation of the system are described, and examples for the inputs and outputs are given.

INTRODUCTION

For the exploration and collection of plant genetic resources it is helpful to dispose of a compilation of information about the cultivated species, their folk names and uses in the particular area. This enables the collectors in further missions to ask the farmers about specific plants which otherwise would not be found. In addition, it allows to check whether a cultivated plant species detected during an expedition was reported for that area before or not.

Such a compilation of information should have the form of a checklist in order to be easily manageable in the field work. During expeditions as well as by investigations of additional sources (literature, catalogues, notes of other collectors), the contents of such lists can be completed and improved. Checklists are also a good basis for the compilation of floras of cultivated plants.

Several checklists have been published so far (e.g., Hammer and Perrino, 1985, Baik et al., 1986, Hammer et al., 1987).

They contain information on the scientific names, families, synonyms, folk names, plant uses, other remarks, and literature references. They may also include alphabetical indexes of synonyms and folk names.

During several collecting missions in Cuba since 1982 (Esquivel et al., 1986, 1987, 1988a, b, c, d, 1989b, c, d, e, Pérez et al., 1985, 1988) many species of plants have been found in cultivation. Searches in the literature revealed additional reports of cultivated plants. It was expected that the number of taxa would be higher than in the previously published checklists. It was also recognized that there was no actual taxonomic treatment of many plant species concerned, and many synonyms exist in the Cuban botanical and agricultural literature. In addition, some confusion arises from the use of the same folk name for different species.

This led to the idea to develop a computerized system to compile all this information. The former checklists were prepared by a text processor, and the indexes of folk names and of synonyms had to be arranged manually. A file management system offers much more flexibility in the handling of the data (cf. Pankhurst 1988). The application of file and database management systems in systematic botany undergoes a rapid development (see, e.g., Allkin and Bisby, 1984). There are large, very sophisticated, nearly all purpose projects resembling expert systems (e.g., Adey et al., 1984, Heywood et al., 1984, Mascherpa and Pellegrini, 1985) as well as small programs for special purposes, e.g., for herbarium catalogues (cf. Pankhurst, 1984). The task of compiling a checklist of cultivated plants and some related indexes on the basis of a limited number of data fields is comparable with a herbarium catalogue.

In this paper we describe the Database of Cultivated Plants of Cuba (DBCPC), the program system, its inputs, operations and outputs. The checklist of cultivated plants of Cuba, the main product of the system, is published elsewhere (Esquivel et al., 1989a).

General Description and Contents of the Database

The Database of Cultivated Plants of Cuba consists of a set of inter-related data files. Each item of information is stored only once. The different lists (i.e., the checklist itself, the synonym index and the folk names index) are produced from the same set of files.

The information has been extracted from the main Cuban literature sources and completed by own observations during expeditions (see Esquivel et al., 1989a). The nomenclatural information has been thoroughly checked against the standard literature. The iterative process of corrections and additions to the database is supported by the program system: there is a

facility to produce special correction lists which are well suited for proof reading. After the inclusion of new information it is possible to produce the lists on the basis of the most actual data. A number of additional benefits results from the features of file management systems, i.e., a higher degree of standardization of author names and literature citations, and the presentation of the species in different sorting orders, e.g., alphabetically by species name or alphabetically by family and species.

At present the database contains 747 taxa belonging to 733 different species, 411 genera and 102 botanical families. For more detailed information, see Esquivel et al. (1989a). The families with the highest number of species are the Leguminosae (92 taxa), Gramineae (62), Myrtaceae (41), Compositae (34) and Rutaceae (30). 303 taxa are used as medicinal plants, 230 as fruits, 81 as fodder crops, 77 as vegetables and 49 as spices. A total of 500 synonyms and 947 folk names are stored in the database.

The DBCPC is a menu-driven system of data files and programs written in the language of the file management system dBASE II. It runs on an NGB IRS-83 microcomputer (8 bit processor) under the operating system CP/M. Although it can be run with two diskette drives (788 kByte each), the present size of the database cannot be accommodated on one pair of diskettes, and the use of a hard disk is preferred, also for reasons of program execution time.

The program system consists of two main components i.e., the data entry and the data output (Fig. 1). A special retrieval program is not yet implemented, but the existing output part is capable for some simple retrieval functions.

Main Menu

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A -- Enter / Correct / Delete Data
B -- Prepare Lists
Y -- Reorganization of Index Files
Z -- End of Operation

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Enter / Edit Menu

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A -- Main File
B -- File of Synonyms
C -- File of Folk Names
D -- File of Remarks
Z -- Return to Main Menu

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Lists Menu

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A -- Correction List
B -- Checklist for Publication
C -- List of Synonyms
D -- List of Folk Names
Z -- Return to Main Menu

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Fig. 1. General options of the program system.

File Structures

The data are stored in four inter-related dBASE files, i.e., the main file, the file of synonyms, the file of folk names, and the file of remarks. The system assigns a taxon number to any new entry. It serves as a unique identifier within the system and provides the connection between the data related to the same taxon. The main file consists of those information items which appear only once for a taxon (see below). A taxon may have several synonyms, as well as several folk names (a **one-to-many** relation). Therefore, the respective files may have several records for a taxon. The file of remarks provides the possibility to handle remarks of practically unlimited length. The fast access to each of these files in the order required by different application tasks is provided by several dBASE index files.

The main file contains the following data items (cf. Fig. 2):

- taxon number;
- species (genus and species name);
- author(s) of the species;
- literature reference of the species description, including remarks
- infraspecific taxon (e.g., subsp., var. It is considered that one level, preferably the lowest one, would be sufficient for this purpose);
- author(s) of the infraspecific taxon;
- literature reference of the infraspecific taxon description, including remarks;
- plant family;
- use of the plant (codes for categories of use, e.g., vegetable, medicinal, and for plant organs used, e.g., fruits, leaves. The codes are explained in the Checklist (Esquivel et al., 1989a). Short notes in full text are also allowed);
- general literature references (e.g., concerning the cultivation or use of the plant in Cuba).

MAIN FILE: Entering new data

```
Species Number      442
Species              Lycopersicon esculentum
Author of Species   Mill.
Reference/Species   Gard. Dict. ed. 8 (1768) no. 2

Infraspecific Name
Author/Infraspec.
Ref./Infraspec.

Family              Solanaceae
Use                 V. (fr.)
References          $4dgi
```

(Enter full text or one or several of the following codes preceded by '\$')

1...5--	D--Gomez de la Maza	G--Roig 1975
Fl. Cub. 1...5	and Roig 1914	H--Canizares 1982
A,B,C--La Sagra	E--Menendez et al. s.a.	I--Guenkov 1983
1842,1845,1850	F--Roig 1974	J--Catalogo 1987

Fig. 2. File structure and data input screen for main file. The code \$4dgi entered by the operator in the field Reference is automatically converted into Fl. Cub. 4, Gomez de la Maza and Roig 1914, Roig 1975, Guenkov 1983 by the program.

The file of synonyms consists of the following fields (cf. Fig. 3):

- taxon number;
- synonym (genus and species name);
- author(s) of the synonym;

- literature reference of the synonym description, including remarks;
- synonym, infraspecific taxon (e.g., subsp., var.);
- author(s) of the infraspecific taxon;
- literature reference of the infraspecific taxon description, including remarks;
- year of publication of the synonym description (it allows the chronological sorting of the synonyms of a given taxon by year of publication).

The file of folk names contains (cf. Fig. 4):

- taxon number;
- folk name.

The file of remarks consists of the following fields:

- taxon number;
- continuation number of the remarks record for the given taxon;
- remarks field.

Data Entry and Editing

The system contains four data entry and editing routines corresponding to the four files. Each routine allows two different operation modes with a particular file, i.e., one for the registration of new data, the other one for the correction or deletion of existing data.

To include data on new taxa into the systems, the following steps are necessary:

(1) Addition of data of one or several new taxa to the file of synonyms (cf. Fig. 2). The taxon numbers are assigned automatically by the system, and they have to be noted on paper by the operator to ensure the connection with the respective records of the other files. The most common literature sources may be entered as codes (see Fig. 2, lower part) which are converted into full references and put into the desired chronological order by the system.

(2) Addition of the corresponding data to the file of synonyms. The taxon number has to be entered, and the program checks whether or not the corresponding taxon exists in the main file. The species name is displayed for control (otherwise, an error message appears), and the data input form for the file of synonyms (Fig. 3) is shown. After recording a synonym, the operator has the choice either to enter more synonyms for the same taxon or more synonyms for another taxon, or to return to the previous menu.

(3) Addition of data to the file of folk names, in analogy to the addition of synonyms. The corresponding data input screen is shown in Fig. 4.

(4) Entering taxon-related free text into the file of remarks. This file is maintained by a simple line-oriented text editor programmed in dBASE II which allows to append, insert, edit, split and delete lines of text consisting of up to 240 characters each (see Fig. 5).

The data editing is carried out in a similar way. When the file to be edited is chosen and the species number entered, the corresponding record is presented on the screen for modification or deletion. If new synonyms folk names or remarks are to be added for previously recorded taxa, the procedures for data entry described above have to be followed.

FILE OF SYNONYMS: Entering new data

Enter Species Number: 444
Enter Synonym for Macroptilium lathyroides

Synonym Phaseolus lathyroides
Author of Synonym L.
Reference/Synonym Sp. Pl. ed. 2 (1763) 1018

Infraspec. Name
Author Infraspec.
Ref./Infraspec.

Year of Synonym 1763

Continuation:

- 1--Add more synonyms for this species
- 2--Add more synonyms for other species
- 3--Add this synonym, end
- 4--Edit this synonym, end
- 5--Reject this synonym, end

Fig. 3.
File structure and data input
screen for the file of
synonyms.

FILE OF FOLK NAMES: Entering new data

Enter Species Number: 442
Enter Folk Name for Lycopersicon esculentum

Folk Name tomato

Continuation:

- 1--Add more folk names for this species
- 2--Add more folk names for other species
- 3--Add this folk name, end
- 4--Edit this folk name, end
- 5--Reject this folk name, end

Fig. 4.
File structure and data input screen
for the file of folk names.

FILE OF REMARKS: Editing remarks for species 442: Lycopersicon esculentum

1 Current Line (First line)

 Some landraces as "placero" and "cimarron" exist in Cuba, the last considered
 by some authors as *L. pimpinellifolium* Dun., but it is really *L. esculentum*
 Mill. var. *cerasiforme* (Dun.) Alef. As in *Capsicum* variable populations
 result from.

2 Next Line

 introgression.

Operation :E:

 --- Editing ---
 (A)ppend blank line
 (E)dit current line
 (D)elete current line
 (I)nsert blank line before current e(X)it
 Special characters (E): \$/--split line, \$\$--new paragraph.

--- Positioning ---
 (P)receding line (F)irst line
 (N)ext line (L)ast line

Fig. 5. Data editing screen for the file of remarks.

Outputs of the system

According to the main objective of the system, i. e., to prepare the manuscript of a checklist of cultivated plants of Cuba, four kinds of standard output are supported by the system at the time being. The outputs are prepared as textfiles on the disk. Before printing they may be edited and formatted by a text processor. In addition to the checklist and the alphabetical indexes of synonyms and folk names, a correction list may be produced to support the iterative process of correcting and improving the contents of the database. All textfiles may be generated either as complete lists (from A to Z) or as sub-lists for a selected part of the alphabet.

The textfile **Checklist** follows the format and style of the previously published checklists (cf. Fig. 6). The taxa are sorted alphabetically by genus and species, and in some cases by intraspecific taxa. The first line (or several lines) of each entry contains the accepted species name, possibly followed by the name of an infraspecific taxon. Synonyms follow in the order of years of publication. Author(s) and literature references are given for all accepted names and synonyms, including the infraspecific level. The family name is given in parentheses. The second line lists the folk names in alphabetical order. The third line gives the use(s) of the plant. Additional remarks follow. The last line contains the general literature references. In rare cases where for nomenclatural reasons the order of the synonyms has to differ from the chronological order, or some taxa should have a different sequence in the list, this may be done with the text processor.

The **List of Synonyms** is an alphabetically sorted textfile containing one line per synonym (Fig. 7). For each synonym (including the author) it provides a cross reference to the accepted name.

The alphabetical **List of Folk Names** gives the accepted scientific name for each folk name (Fig. 8). If a name is applied for several species, the corresponding species names have to be put into alphabetical order using the text processor.

The textfile **Correction List** has the same general structure as the checklist (Fig. 9). In addition to the latter it contains the internal taxon numbers to support the corrections of the database. The items of information are preceded by explanatory acronyms, e.g., SYN for synonym or FAM for family. In the accepted names as well as in the synonyms, the name, author(s) and literature reference are clearly delimited from each other. In the case of incomplete information, i.e., if the author or literature reference is missing, an exclamation mark appears before the accepted name or a synonym.

All output lists have to be formatted by the text processor before printing. This concerns the line length, the page length, the spacing between lines, headings and pagination, etc. By changing a few lines in the respective programs it is also possible to modify the output formats of the list for other purposes.

An additional utility program of the system allows to create an alphabetically sorted list of all literature references of descriptions of accepted taxa and synonyms both on species and infraspecific levels (Fig. 10). Many large publications containing nomenclatural information suffer from inconsistencies, e.g., different spellings or abbreviations, in author and literature citations. This is the natural result of extracting information from a variety of sources. A great deal of these inconsistencies may be revealed by checking such an alphabetical list of literature citations (cf. Sarasan and Neuner, 1983), and decisions towards a unification can be made. Another useful tool for the standardization of nomenclatural data could be a KWIC (keyword in context) index as shown for geographical information and accession names in a database of genetic resources of barley (Knupffer, 1988).

Macroptilium lathyroides (L.) Urb., Symb. Antill. (1928) 457. --
Phaseolus lathyroides L., Sp. Pl. ed. 2 (1763) 1018. (Legu-
minosae).
Maribari, pico de aura
Soil improvement
Ref.: Roig 1975

Malpighia glabra L., Sp. Pl. (1753) 425. -- Malpighia punici-
folia L., Sp. Pl. ed. 2 (1762) 609. (Malpighiaceae).
Acerola, cerezo, cerezo de Barbados, cerezo de Jamaica
Fr., M. (fr.)
Ref.: Fl. Cub. 3, Gomez de la Maza and Roig 1914, Roig 1974,
Roig 1975

Fig. 6.
Example from the texfile Checklist (List Menu, Option B). The lines
exceeding the margins of this figure were formatted by the text processor
before. The lines CP 5 are control li the text processor.

Petroselinum hortense Hoffm. = Petroselinum crispum
Phalaris zizanioides L. = Vetiveria zizanioides
Phaseolus antillanus Urb. = Vigna antillana
Phaseolus aureus Roxb. = Vigna radiata
Phaseolus calcaratus Roxb. = Vigna umbellata
Phaseolus cylindricus L. = Vigna unguiculata subsp.
cylindrica
Phaseolus helvulus L. = Strophostyles helvula
Phaseolus lathyroides L. = Macroptilium lathyroides
Phaseolus limensis Macf. = Phaseolus lunatus
Phaseolus max L. = Glycine max
Phaseolus radiatus L. = Vigna radiata
Phyllanthus distichus (L.) Müll. Arg. = Phyllanthus
acidus
Phyllocalyx luschnathiana Klotzsch ex O. Berg =
Eugenia luschnathiana

Fig. 7.
Example from the texfile List of Synonyms (List Menu, Option C). The lines
exceeding the margins of this figure were formatted by the text processor
before.

tabaco = Nicotiana tabacum
tagua-tagua = Diospyros digyna
tamarindillo = Aeschynomene americana
tamarindo = Tamarindus indica
tamarindo de Puerto Rico = Inga vera
tampala = Amaranthus lividus convar. oleraceus
tanaceto = Tanacetum vulgare
taraco = Hippeastrum puniceum
tila = Justicia pectoralis
tomate = Lycopersicon esculentum
tomate americano = Pereskia aculeata
tomate arbol = Cyphomandra betaceae
tomillo = Thymus vulgaris
toronja = Citrus paradisi
toronja criolla = Citrus maxima
toronjil = Melissa officinalis
toronjil = Mentha x piperita

Fig. 8.
Example from the texfile List of Folk Names (List Menu, Option D).

.CP 6
 ** 443 **
Macadamia ternifolia ** F. v. M. ** in Trans. Phil. Inst.
 Vict. 2 (1858) 72
 FAM: Proteaceae
 FN.: nuez de Queensland
 USE: N.
 REF: Roig 1975, Canizares 1982

.CP 6
 ** 444 **
Macroptilium lathyroides ** (L.) Urb. ** Symb. Antill. (1928)
 457
 ! SYN: Phaseolus lathyroides ** L. **
 FAM: Leguminosae
 FN.: maribari, pico de aura
 USE: Soil improvement
 REF: Roig 1975

Fig. 9.
 Example from the textile Correction List (List Menu, Option A). Compare with the Checklist, Fig. 6. The lines exceeding the margins of this figure were formatted by the text processor before.

-#-	Author -----	Citation -----

133 N	Koenig	in Ann. Bot. 2 (1806) 571
553 N	Hochst. ex Chiov.	in Ann. Ist. Bot. Roma 8 (1903) 41
166 N	(Cav.) Rich. ex Juss.	in Ann. Mus. 18 (1811) 481
23 S	Correa	Ann. Mus. Hist. Nat. Paris 10 (1807) 157
545 N	Juss.	in Ann. Mus. Nat. Paris 6 (1805) 113
646 N	DC.	in Ann. Mus. Par. 17 (1811) 424
552 N	(L.) Poit.	in Ann. Mus. Par. 19 (1812) 390
550 N	Poit.	in Ann. Mus. Par. 19 (1812) 393
376 N	Corr. Serr.	in Ann. Mus. Par. 6 (1805) 386
237 S	Risso	in Ann. Mus. Paris 20 (1813) 190
242 N	Risso	in Ann. Mus. Paris 20 (1813) 195
243 S	Risso	in Ann. Mus. Paris 20 (1813) 201
437 S	Juss.	in Ann. Mus. Paris 7 (1806) 73
437 N	(Ruiz et Pav.) Juss.	in Ann. Mus. Paris 7 (1806) 73
699 N	(L.) Soland. ex Correa	in Ann. Mus. Paris 9 (1807) 290
679 N	(N. L. Burm.) Alston	in Ann. Roy. Bot. Gard. Peradeniya 11 (1929) 204
350 N	Hance	in Ann. Sc. Nat., Ser. 4, 18 (1862) 229
169 N	(H. B. K.) Triana et Planch.	in Ann. Sc. Nat., Ser. 5, 14 (1872) 303
645 N	(Vell.) Naud.	in Ann. sci. nat. bot., ser. 4, 18 (1862) 181
62 S	Clos	in Ann. Sci. Nat. ser. 4, 8 (1857) 236, nom. illeg.

48 S	Lam.	Encycl. 3 (1792) 574, nom. illeg.
297 N	(K. Schum.) Pilger	in Engl. Bot. Jahrb. 40 (1907) 82
594 N	(O. Berg) Nied.	in Engl. et Prantl, Nat. Pflanzenfam. 3, 7 (1893) 69
600 N	(O. Berg) Nied.	in Engl. et Prantl, Nat. Pflanzenfam. 3, 7 (1893) 69
744 S	Krug et Urban	in Engl. Jahrb. 21, 573
513 N	Gürke	in Engl., Pflanzenw. Ost-Afrika C (1895) 349
60 N	(A. Rich.) Warb.	in Engler et Prantl, Nat. Pflanzenfam. 3, 6a (1893) 44
62 N	(Gardn.) Warb.	in Engler et Prantl, Nat. Pflanzenfam. 3, 6a (1893) 44
199 S	(Pers.) K. Schum.	in Engler et Prantl, Nat. Pflanzenfam. 4, 2 (1895) 159
466 NI	(Briq.) Briq.	in Engler et Prantl, Nat. Pflanzenfam. 4, 3a (1895) 319
451 N	(J. F. Gmel.) Pax	in Engler, Pflanzenr. H. 44 (1910) 71
577 N	Vahl	Enum. 1 (1804) 312

270 N	(L.) Schott et Endl.	Melet. bot. (1832) 18
267 N	(Pal. Beauv.) Schott et Endl.	Meletem. (1832) 33
268 N	(Vent.) Schott et Endl.	Meletem. (1832) 33
145 S	Trin	in Mem. Acad. Sci. Petersb. 6, ser. 3, 2 (1835) 256
487 N	Colla	in Mem. Acad. Sci. Torino 25 (1820) 384
144 S	Fig. et De Not.	in Mem. Acc. Torino ser. 2, 14 (1854) 329
485 N	Colla	in Mem. Accad. Sci. Torino 25 (1820) 394
588 S	Griseb.	in Mem. Am. Acad., N. S. 8 (1862) 517
680 N	(L.) Merr. et Perry	in Mem. Amer. Acad. Arts Sci. 18 (1939) 196

Fig. 10.

Examples from the alphabetical list of literature references for descriptions of taxa. The columns show: (1) the taxon number, (2) N--accepted species name, NI--accepted name, infraspecific category, S--synonym, species level, SI--synonym, infraspecific category, (3) author(s), (4) literature reference. The column taxon name is omitted from this figure for space reasons.

CONCLUSIONS

The DBCPC has proven to be a useful tool in the compilation of the checklist of cultivated plants of Cuba. It allows to have an up-to-date database of all knowledge related to this field at any time. In addition to this primary aim, it allows also to quickly extract information needed for specific purposes, either with the existing or slightly modified programs, or by using the dialogue mode of dBASE II.

For example, the list of cultivated Solanaceae of Cuba (Esquivel and Hammer, 1988a) was prepared by simply altering the sorting order of the taxa (namely, by family and taxon) and generating a list of Solanaceae only. The list of cultivated plants of South East Asian origin (Esquivel and Hammer, 1988b) was derived by producing a sub-database and adding Chinese, Japanese and other folk names as well as specific remarks to this database. In this case, the folk names list is ordered by language and by folk names alphabetically within each language. This could be achieved by alteration of the key expression of the corresponding index file and the subsequent application of the unchanged program components.

A special retrieval part is not yet included into the system, but it is possible to look up for information about a certain taxon, a synonym or a folk name by using the sublist options of the output possibilities.

The system may be adapted to dBASE III using special conversion programs.

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