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COLLECTION OF YAM BEAN (Pachyrhizus (L.) Urban) GERMPLASM IN CENTRAL AND SOUTH AMERICA AND THE CARIBBEAN

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ABSTRACT

Two field collection trips, one in 1985 and another in 1988, were carried out in the Neotropical distribution area of the tuberous legume genus Pachyrrhizus. The localities visited were identified through studies of herbarium material. Some 49 accessions of the species P. erosus, 7 of P. ferrugineus, 1 of P. panamensis, 3 of P. tuberosus and 2 of P. ahipa were collected. Plants representing all the material collected were initially grown under greenhouse conditions in Denmark and have formed the basis of the hybridization programme.

INTRODUCTION

During the last decade the interest in and realization of the obvious advantages of tuberous legume crops have increased considerably. Among these relatively few leguminous taxa the most well known is probably the genus Pachyrrhizus. This genus comprises 5 species of which 3 are known in cultivation (one, P. erosus, in numerous places outside its original distribution area), and 2 species only known in the wild. Although the genus had been the subject of a previous taxonomic revision by Clausen (1945), the taxonomy of the genus remained somewhat diffuse mainly due to the limitation of available herbarium material caused by World War II. However, the narrow species concept held by the author of this first revision, e.g., made obvious by the great number of infraspecific taxa included, also contributed to the considerable complexity of this work. Hence, as the herbarium material available for a new taxonomic revision included material from all relevant European herbaria as well as the material collected during the 40 years elapsed since the work by Clausen (1945) it appeared that the completion of a new revision was justified; see Sorensen (1988).

Based on the information appearing on the labels of the approximately 1500 herbarium specimens studied, lists were prepared of the most promising localities in the Neotropical distribution area of the genus for collection of live material. These lists formed the basis for the two subsequent collection trips carried out in order to provide the material needed for the present biosystematic project.

MATERIALS AND METHODS

Initially, all herbarium specimens identified as representing a single species were divided into specimens known to originate from cultivated material and specimens which could with some justification be considered as representing material of wild origin. This procedure involved a considerable amount of qualified guesswork as only specimens where their cultivated nature was directly indicated on the label could their true nature be ensured with absolute certainty. The greatest difficulty arose when examining material from areas where cultivation was known to have been practiced or was still being practiced, and from areas where at the same time the existence of wild populations was recorded. The distribution and number of the species, arranged according to country of origin, is given in Table 1.

When determining the route to be followed when visiting herbaria or fields, priority was given to collections or plantings less than 40 years old. Although only in a limited number, some herbarium specimens dating up to 100 years old were available for study. This priority was established since colleagues collecting Hordeum spp. in the same region had noticed that major changes in cultivation practices and changes in land use had rendered most localities older than 20-30 years unyielding when looking for specific genera. Care was taken to include localities with populations representing as great a morphological and ecological variation as possible, i.e. differences in outline and pubescence of leaflets, and from humid to semi arid climates, high and low altitudes, etc.

The first field collecting trip, conducted during January 1985, covered the following 9 countries: Mexico, Belize, Guatemala, Costa Rica, Panama, Colombia, Ecuador, Bolivia and Argentina. The second trip partly covered the same region in Central America, i.e. Mexico, Guatemala and Costa Rica, but the areas visited within each country had not been included during the first trip. In addition, 3 countries in the Caribbean were included: Trinidad, Guadeloupe and the Dominican Republic. This last region was of particular interest, as all material growing there originates from old cultivars of South American origin, i.e. P. tuberosus, or Central American origin, i.e. P. erosus.

The material collected included seed and tuberous roots, or both, herbarium material for later reference, and soil samples.

In addition to the germplasm collected in the field, number of institutions generously supplied samples from the material in their possession.

Table 1. Origin and number of herbarium specimens seen, number of accessions collected, and localities recorded (only 8 out of a total of 12 countries included).

Species	Country	Status	No. Herb. Specimen	No. Acc. Collect.	Loc. Rec.
erosus	Mexico	cult.	12(6) *	10	10
erosus	Mexico	wild	127(69)	2	5
ferrugineus	Mexico	wild	27(26)	-	-
erosus	Guatemala	cult.	4(-)	8	10
erosus	Guatemala	wild	38(7)	7	9
ferrugineus	Guatemala	wild	27(6)	1	5
erosus	Costa Rica	cult.	4(3)	2	1
erosus	Costa Rica	wild	13(12)	9	9
ferrugineus	Costa Rica	wild	10(4)	2	3
ferrugineus	Panama	wild	10(3)	4	4
panamensis	Panama	wild	12(5)	1	1
panamensis	Ecuador	wild	7(3)	-	-
tuberosus	Ecuador	cult.	1(1)	2	2
tuberosus	Ecuador	wild	20(15)	-	2
tuberosus	Bolivia	cult.	1(-)	-	-
ahipa	Bolivia	cult.	2(1)	2	2
erosus	Dom. Rep.	wild	20(17)	4	5
erosus	Haiti	cult.	1(-)	-	-
erosus	Haiti	wild	4(-)	-	-
tuberosus	Haiti	cult.	3(2)	1	1

*The figures in parentheses represent the herbarium specimens from the last 40 years.

RESULTS AND DISCUSSION

The field collections carried out so far have resulted in the availability of:

- 27 accessions of different cultivars of P. erosus
- 22 accessions of wild P. erosus
- 7 accessions of P. ferrugineus, (of which an additional 8 localities have been recorded where seeds may be collected at a later stage)
- 1 accession of P. panamensis
- 2 accessions of P. ahipa
- 3 accessions of cultivars of P. tuberous (and 2 localities of wild P. tuberous, but mature seeds were not available yet)

The total germplasm presently included in multiplication under natural climatic conditions as well as in greenhouses is presented in Appendix I. If the distribution of the herbarium material studied is considered as being representative of the size of the natural and cultivated populations of each species within each country, the comparison between the equivalent accessions from each country included in the germplasm collection appears to constitute a fair representation of the population sizes (Table 1). Whether the natural variation can likewise be claimed to be fairly represented in the germplasm collection is difficult to assess. However, if altitude alone is considered an indicator of the naturally occurring variation, it appears that the material present in the germplasm collection, i.e. figures for P. erosus only, is in reasonably good agreement with altitudinal range recorded from the herbarium material (Table 2).

CONCLUSIONS

The authors feel that the approach outlined in this paper can justifiably said to be an efficient method when contemplating germplasm collecting of cultivated plants and their wild relatives. When such an effort seeks to encompass as great a genetic (morphological) variation as possible, there is probably no better alternative reference material available than that present in the various herbaria.

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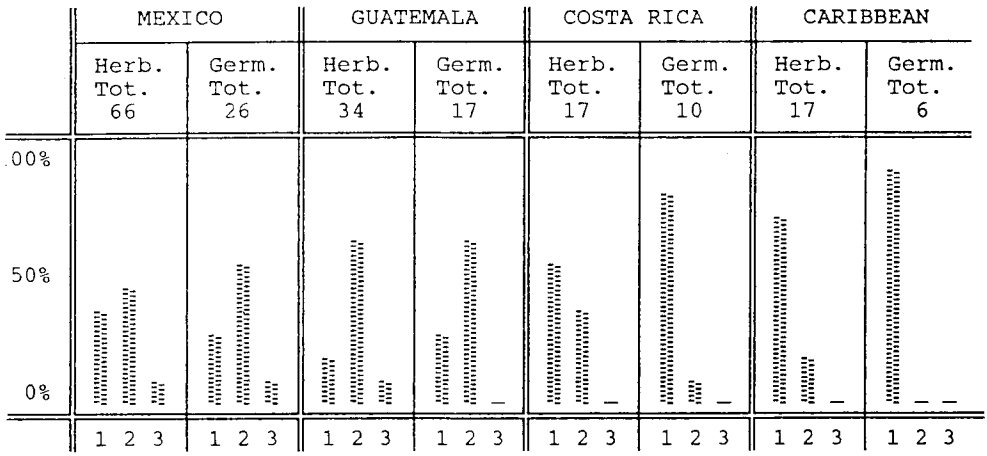
Table 2. The altitudinal range of herbarium material vs. that of germplasm material, P. erosus.



1: 0-500 m a.s.l; 2: 500-1500 m a.s.l.; 3: 1500+ m a.s.l.

Total neotropical herbarium specimen seen: P. erosus, 249; P. ferrugineus, 124; P. panamensis, 19; P. tuberosus, 61 and P. ahipa, 8.

Total accessions in germplasm collection: P. erosus, 85 (63 cult. and 2 wild); P. ferrugineus, 13; P. panamensis, 1; P. tuberosus, 7 and P. ahipa, 4.

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Appendix 1. Accessions and germplasm collections, revised 1st June 1990.

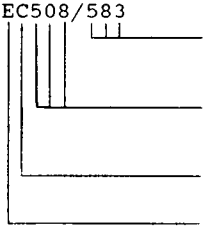
Acc. number	Country of origin	Acc. number	Country of origin
AC072/485	BOLIVIA	AC102/485U,F	BOLIVIA
AC521/386F	BOLIVIA?	AC524/387U,F	BOLIVIA?
EC004/285	MEXICO	EC005/285	MEXICO
EC006/285U,F	MEXICO	EC032/285U	MEXICO
EC033/285U,F	MEXICO	EC040/385U,F	GUATEMALA
EC041/385U,F	GUATEMALA	EC042/385U,F	GUATEMALA
EC043/385	GUATEMALA	EC104/385F	MEXICO
EC106/-	EL SALVADOR	EC109/885	MALAYSIA
EC111/885	INDONESIA	EC114/1285U,F	BRAZIL
EC116/186U	GUATEMALA	EC117/-86F	THAILAND
EC119/986	MARTINICA	EC120/986U,F	GUATEMALA
EC201/1188	MEXICO	EC204/1188U,F	MEXICO
EC205/1188U,F	MEXICO	EC214/1188U,F	GUATEMALA
EC216/1188	GUATEMALA	EC219/1188F	GUATEMALA
EC234/289F	THAILAND	EC236/789F	MEXICO
EC501/482F	MEXICO	EC502/882U,F	MEXICO
EC503/882U,F	MEXICO	EC507/283	MEXICO
EC508/583U	MEXICO	EC509/578F	COSTA RICA
EC510/1278	MEXICO	EC511/181	MEXICO
EC512/385U	MEXICO?	EC516/385U	MEXICO
EC517/385	MEXICO	EC518/385	MEXICO
EC519/385	MEXICO	EC523/684U,F	MEXICO?
EC524/686	CHINA	EC525/686F	CHINA
EC526/388	MEXICO	EC527/-	CUBA
EC528/389	PHILIPPINES	EC529/389	HAWAII
EC531/1189	MEXICO	EC532/1189	U.S.A.
EC533/390	MACAU	EC534/490	MEXICO
EC535/490	MEXICO	EC536/490	MEXICO
EC537/490	MEXICO	EC538/490	MEXICO
EC539/490	MEXICO	EC540/490	MEXICO
EC541/490	MEXICO	EC542/490	MEXICO
EC543/390	EL SALVADOR	EC544/390	MEXICO?
EC545/390	COSTA RICA	EC546/390	MEXICO?
EC547/390	MEXICO?		
EW048/385	COSTA RICA	EW049/385	COSTA RICA
EW050/385	COSTA RICA	EW051/385	COSTA RICA
EW051/385	COSTA RICA	EW053/385U,F	COSTA RICA
EW054/385	COSTA RICA	EW115/1285U	GUATEMALA
EW202/1188	MEXICO	EW203/1188	MEXICO
EW206/1188	GUATEMALA	EW207/1188	GUATEMALA
EW208/1188	GUATEMALA	EW209/1188	GUATEMALA
EW211/1188	GUATEMALA	EW212/1188	GUATEMALA
EW223/1188	COSTA RICA	EW227/1288U,F	DOMIN. REP.

Continued...

Appendix 1 Continued.

Acc. number	Country of origin	Acc. number	Country of origin
EW228/1288U,F	DOMIN. REP.	EW229/1288F	DOMIN. REP.
EW230/1288F	DOMIN. REP.	EW522/385U,F	MAURITIUS
FW044/385	GUATEMALA	FW061/385	PANAMA
FW063/385	PANAMA	FW064/385	PANAMA
FW103/585	PANAFM	FW213/1188	GUATEMALA
FW215/1188	GUATEMALA	FW217/1188	GUATEMALA
FW218/1188	GUATEMALA	FW220/1188	COSTA RICA
FW221/1188	COSTA RICA	FW237/789	MARTINIQUE
FW514/383	CUBA		
PW055/385F	PANAMA		
TC118/186U,F	HAITI	TC122/887	PERU
TC238/590	ECUADOR	TC239/590	ECUADOR
TC525/287U,F	BRAZIL	TC526/287	BRAZIL
TC530/-	BRAZIL		

Accession number code:
e.g. EC508/583



month and year of first registration in the germplasm collection.

accession number; if higher than 499 obtained from an institution.

C=cultivar, W=wild material.

Species: E=erosus, A=ahipa, T=tuberosus, P=panamensis, F=ferrugineus.

U Accessions used in the cross breeding experiments.
F: Accessions involved in field trials.
(All accessions have been multiplied in Tonga, South Pacific.)