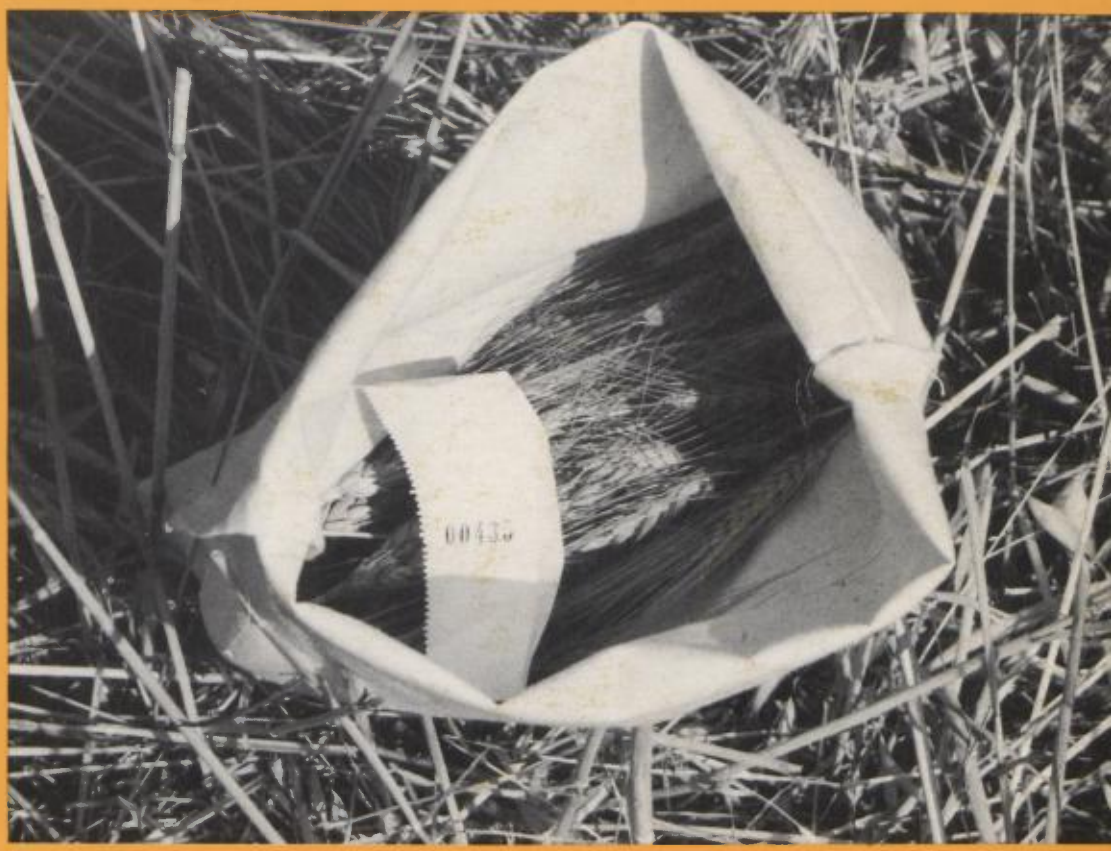
PLANT GENETIC RESOURCES - Newsletter
RESSOURCES GÉNÉTIQUES VÉGÉTALES - Bulletin
RECURSOS GENETICOS VEGETALES - Noticiario

57

INTERNATIONAL BOARD FOR PLANT GENETIC RESOURCES
CONSEIL INTERNATIONAL DES RESSOURCES PHYTOGÉNÉTIQUES
CONSEJO INTERNACIONAL DE RECURSOS FITOGENETICOS



FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ORGANISATION DES NATIONS UNIES POUR L'ALIMENTATION ET L'AGRICULTURE
ORGANIZACION DE LAS NACIONES UNIDAS PARA LA AGRICULTURA Y LA ALIMENTACION

The Plant Genetic Resources Newsletter is published under the joint auspices of the Plant Production and Protection Division of FAO, and the International Board for Plant Genetic Resources. Contributions in English, French and Spanish are considered, and if accepted, will be published in the original language, with a summary in the other two.

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Cover photo: Wheat collected during a mission in Greece

AGP:PGR/57
March 1984

PLANT GENETIC RESOURCES NEWSLETTER

C O N T E N T S

WHEAT GENETIC RESOURSES PROGRAMMES IN CHINA

Yue Dahua[1/]

China is considered a secondary centre of diversity of bread wheat (Triticum aestivum). Wheat has been cultivated in China for more than 4,000 years under various complex ecological conditions; as a result, a great number of wheat cultivars and landraces have evolved. According to a meeting on crop germplasm resources in 1958, about 23,000 accessions had been collected. Some are early maturing with good grain-filling characteristics; others possess a high number of spikelets per spike. There are also local cultivars which are tolerant to low temperatures, dry or rainy weather, or are resistant to acidity or alkalinity of soils (Table 1).

In the early 1950s collections of primitive wheat cultivars grown in China for thousands of years were made for the initiation of wheat improvements programmes. The first series of improved wheat cultivars distributed to production units were selected from these collections. During a period of 10-20 years, many new cultivars based on these as progenitors were bred.

In the past few decades, more than 11,000 foreign wheat cultivars were introduced from 80 countries. Some semidwarf to short-stature varieties from Australia, Chile, Italy, Mexico, USA and USSR possessing rust resistant characteristics were found suitable for use as breeding parents, and a few excellent introductions were recommended directly to the productions units without further selection.

China is extremely rich in crop genetic resources. However, the germplasm research institution was established rather recently and research work has been comparatively weak.

In 1958 a germplasm research section was set up in the Institute of Crop Breeding and Cultivation of the Chinese Academy of Agricultural Sciences (CAAS) in Beijing. Then similar sections were set up on some provincial academies. The activities undertaken by these research sections include collecting, documentation, multiplication, evaluation, maintenance and distribution of seeds. Unfortunately during the 10 years of the "cultural revolution" germplasm organizations were dismissed and a considerable number of collections lost.

Since then, more attention has been given to the sciences. The Institute of Crop Germplasm Resources (ICGR) was established in Beijing in 1978. It is responsible for organizing a national network of crop germplasm research in addition to carrying on its own studies. There are eight research sections in the ICGR, ie Introduction; Rice; Wheat, Barley and Oat; Maize and Legumes; Sorghum and Millet; Physiology, Biochemistry and Genetics; Disease and Pest Resistance; and Genebanks.

In 1979 CAAS held the third national meeting on crop germplasm resources and it was urged that research should be more efficiently done. The documents enhanced

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[1/]Chinese Academy of Agricultural Sciences (CAAS), Beijing, China

germplasm research work and a national system of crop germplasm work was then established. The tasks of this coordinated germplasm work are exploration and collection, systematics and documentation, evaluation and investigation, multiplication and rejuvenation, conservation and utilization (Table 1).

Following the third national meeting, various provincial academies conducted extensive programmes to collect local cultivars and wild relatives of crops.

During 1979-1980, a joint expedition of CAAS and Yun-nan Provincial Academy was

Table 1. Distinguishing characters of some representative cultivars

Character	Name of cultivars	Origin (province)
Early maturity with good grain filling	1) Sanyuehuang	Heibei
	2) Siyuehuang	Shanxi
	3) Houshaotian (spring)	Jiangsu
	4) Jiangdongmen (spring)	Jiangsu
High number of spikelets per spike	5) Hechuan Guangtou (spring)	Sichuang
	6) Chengdu Guangtou (spring)	Sichuang
	7) Mazha Mai	Shanxi
	8) Youzi Mai (spring)	Henan
Tolerant to low winter temperatures (winter hardiness)	9) "1885"	Hebei
	10) Yanan Laomai	Shanxi
	11) Changji Xiaohong Dongmai	Xinjiang
Drought resistant	12) "1817"	Shanxi
	13) Kashi Baipi	Xinjiang
	14) Hongqi Mai	Gansu
Wet resistant	15) Lanxizao Mai (spring)	Zhejiang
	16) Shaoxing Laolaibai (spring)	Zhejiang
	17) Chongyang Hong Mai	Hubei
Tolerant to soil acidity	18) Nanchang Tiaoshenzi (spring)	Jiangxi
	19) Jinxian Paozi Mai (spring)	Jiangxi
Tolerant to soil alkalinity	20) Cangxian Hongmang Mai	Hebei
	21) Yan-Cheng Yashezi	Hebei

made to the western regions of Yun-nan Province, including 18 counties and six districts, to collect landraces and diploid or tetraploid wheat species. Collections included 86 local bread wheats consisting of 65 botanical varieties, 30 T. aestivum subsp. yunnanence King with 15 varieties and nine accessions of other species (T. turgidum, T. compactum and T. durum). Some of them have never been known before inside or outside China. Among the local varieties collected, some display resistance to drought or tolerance to rainy weather. There is a durum wheat variety named 'Sanlicum' with a 1000-kernal weight over 80 g.

In June-September 1981, an expedition team of CAAS visited the southern part of Tibet (the Yaluzangbu Valley and the Ximalaya Mountains) to collect landraces of various crops and wild species. A total of 1,131 accessions of wheat landraces were collected comprising 885 T. aestivum with 70 varieties, 187 semi-wild wheats (T. aestivum ssp. tibeticum Shao) with 23 varieties and 59 other wheat species (T. compactum, T. turgidum, T. polonicum) with 22 varieties. Among the 70 varieties of T. aestivum, 22 have never been found before.

During a joint expedition of ICGR and Xinjiang Autonomous Region Academy to the northern and eastern regions of Xinjiang in 1982, additional collections of wheat landraces and wild relatives were obtained. They comprise six species of Triticum with 46 varieties and 10 genera of wheat relatives such as Psathyrostachys Nevski, Hordeum L., Elymus L., Leymus Hoehst, Roegneria C. Koch, Elytrigia Desv. Eremopyrum Jaub. et Spoch, Secale L., Agropyron Gaert. and Aegilops L. (Table 2).

In the 1950s in conjunction with wheat collection and documentation some studies on systematics and ecotypes were conducted. Over 5,000 local varieties of wheat were studied at Nanjing Agricultural College under the guidance of Professor Jing Shanbao, and a paper entitled "Wheat forms and their distribution in China" was published in 1957. It noted that the wheat cultivars in China belonged to six species: T. aestivum, T. turgidum, T. compactum, T. durum and T. polonicum. The bread wheat was extremely rich in forms, including 80 botanical varieties, 21 of which were newly found. In addition, T. aestivum subsp. yunnanence King was grown only in China.

"Wheat Cultivars in China" edited by Professors Jing Shanbao and Liu Dingan was published in 1962. A total of 623 wheat cultivars comprising 93 botanical varieties from 26 provinces were compiled in this book. The origin, systematics, morphological and agronomic characters, area of adaptation and utilization of various varieties listed were described in detail with photographs.

Recently another book "Chinese Wheat Cultivars and Their Genealogies" (edited by Professor Jing) was published in May 1983. In this publication the modern Chinese wheat varieties and their pedigree were analyzed and the experiences on the utilization of germplasm from China or other countries and the choice of parents and combinations were described in detail. Some aspects of wheat breeding methodology were also described. These publications have helped to develop on-going wheat genetic resources projects in China.

At the same time wheat collections in China are being evaluated for various agronomic characters, disease resistance and tolerance to certain environmental stresses (Table 3).

To conclude, the research on crop genetic resources in China is now facing a new development stage. In order to catch up with the international level much effort has to be made.

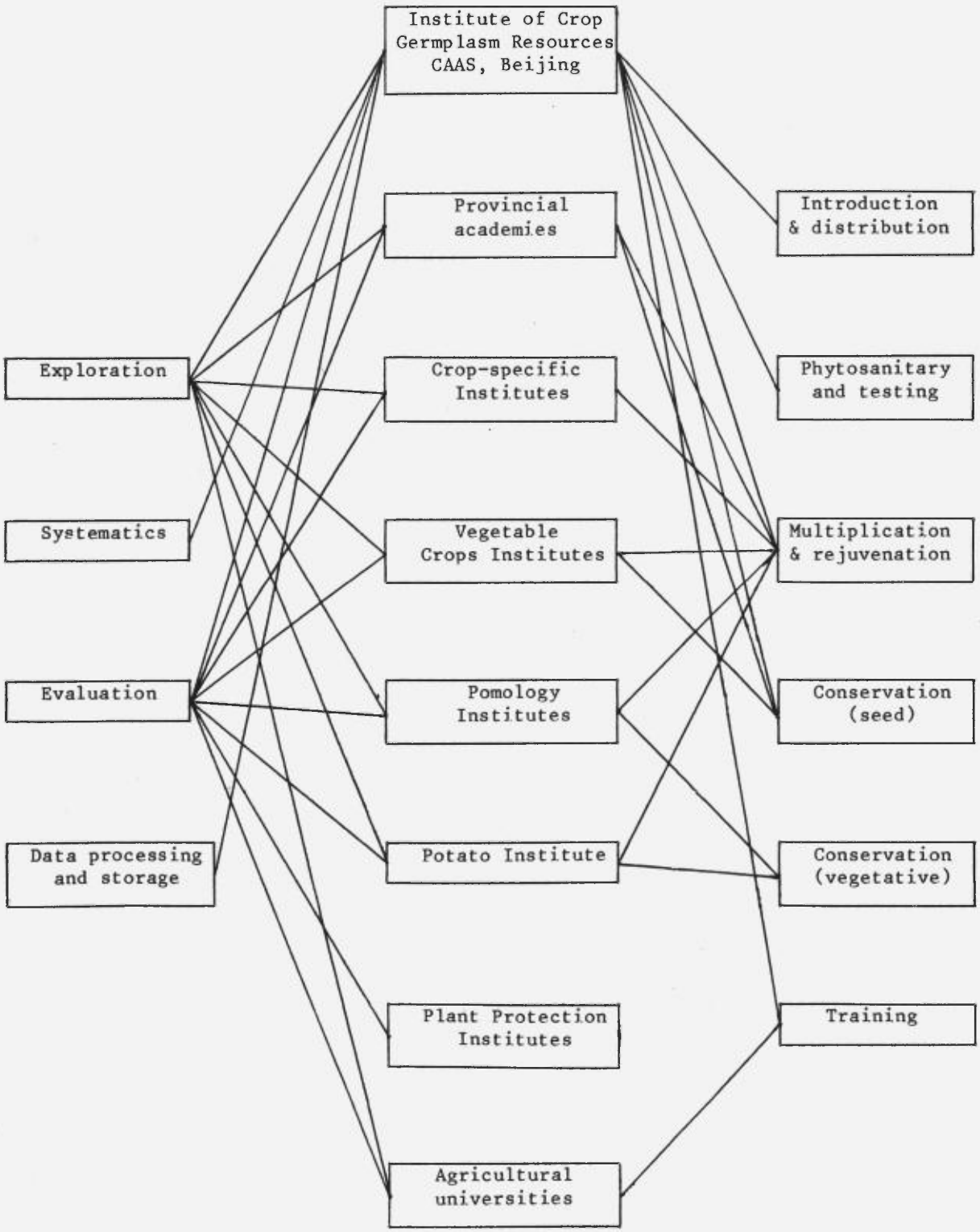
Table 2. Triticum samples collected in China (1979-82)

Species	Number of samples collected					
	1979/80 (Yunnan)		1981 (Tibet)		1982 (Xin jiang)	
	Samples	Varieties	Samples	Varieties	Samples	varieties
T. aestivum ssp. yunnanense King	30	15	-	-	-	-
T. aestivum ssp. tibeticum Shao	-	-	187	23	-	-
T. aestivum	86	65	885	70	101	33
T. durum	1	4	-	-	9	2
T. turgidum	3	2	13	4	10	2
T. turanicum	-	-	-	-	3	1
T. compactum	5	13	30	11	8	5
T. polanicum	-	-	15	6	4	3
T. petropavlovskyi Vdacz. et Migusch	-	-	1	1	-	-

Table 3. Germplasm evaluation studies in 1979-1983

Number of varieties	Recipient institute	Year of study	Reason for research
8,931 local varieties 7,000 introductions	Institute of Plant Protection of CAAS and provincial academies	1979-1983	Screening for resistance to Puccinia graminas f. sp. tritici, P. recondita and P. striiformis
18,238 local varieties and introductions	Institute of Plant Protection of Shanghai Academy of Agricultural Sciences	1979-1983	Screening for resistance to scab (Fusarium spp.)
433 introductions	Institute of Crop Germplasm Resources, CAAS	1980-1981	Screening for winter hardiness
826 introductions	Institute of Crop Germplasm Resources, CAAS	1982	Search for high protein and lysine content
15,931 local varieties and introductions	Institute of Crop Germplasm Resources, CAAS and provincial academies	1979-1983	Test for major agronomic characters

Fig. 1. The organization system of plant genetic resources and the cooperation scheme in China



RESUME

La Chine est considérée comme un centre de diversité secondaire de Triticum aestivum, qui est cultivé dans ce pays depuis plusieurs milliers d'années, dans des conditions écologiques variables et complexes. Un bref historique des activités phytogénétiques concernant le blé est donné, à commencer par les collections de cultivars de blé primitif faites durant les années 50. Nombre de ces cultivars avaient un rendement accru et possédaient autres caractéristiques intéressantes. Il n'existe pas de documentation sur les variétés botaniques de T. aestivum récoltées ultérieurement. Les spécimens de blé récoltés en Chine sont évalués aujourd'hui pour divers caractères agronomiques, pour la résistance aux maladies et pour la tolérance à certaines agressions du milieu.

RESUMEN

China se considera un centro secundario de diversidad de Triticum aestivum, que se ha cultivado a lo largo de varios milenios en condiciones ecológicas complejas y muy variadas. Se describen brevemente las actividades en materia de recursos genéticos relacionados con el trigo, comenzando con las recolecciones de cultivares primitivos de trigo efectuadas en los años 50. En muchos de esos cultivares se halló un mayor potencial de rendimiento y otras características útiles. Más tarde se han recogido variedades botánicas de T. aestivum no descritas anteriormente. Actualmente se están evaluando las colecciones de trigo de China para determinar diversas características agronómicas, la resistencia a las enfermedades y la tolerancia a determinados factores ambientales.

IBPGR Appointments

Mr. Jan Konopka took up his appointment as Information Officer for the IBPGR in February 1984. He graduated from the Technical University (Electronic Faculty) in Warsaw, Poland in 1974 as an Electronics Engineer with an M.Sc. From 1974-1977 Mr. Konopka was employed in the MERA Computer Factory in Warsaw as a designer of operating systems for minicomputers. Since 1977 he has been employed at the Plant Breeding and Acclimatization Institute, Radzikow as Systems Analyst.

Dr. KarLing Tao joined the IBPGR in January 1984 as officer responsible for seed conservation. Dr. Tao previously worked for USDA Beltsville, Md., USA on seed physiology and seed testing. He was born in China but is currently a citizen of the USA; he was educated in Hong Kong, Alabama and Wisconsin, receiving his Ph.D. degree in Horticulture and Botany from the University of Wisconsin, Madison, USA in 1971. Prior to working for USDA, he was employed at Cornell University conducting research in seed germination, dormancy and vigour.

STRATEGIES AND METHODS FOR COLLECTING THEOBROMA

John B. Allen[1/]

(1) Introduction

This paper is an attempt to present, informally, some ideas on cocoa germplasm collecting, based on the experience of the London Cocoa Trade Amazon Project (LCTAP). The objectives of this project are to collect, evaluate and distribute wild cocoa germplasm from the Amazon region of Ecuador in collaboration with Instituto Nacional de Investigacions Agropecuarias (INIAP). A detailed account of the first three years of LCTAP is contained in Allen and Lass (1983).

It is not suggested that the experience of LCTAP will be directly applicable to all future cocoa germplasm collecting programmes. Specifically, recommendations made here will refer to collecting from wild cocoa populations and not to collecting from Criollo and other cultivated populations. However, it seems useful to present a description of some alternative collecting strategies, with a discussion of the circumstances in which they might be appropriate.

Collecting strategy

In general terms, the objective of any germplasm collecting programme is to increase the range of genetic variation available for use by breeders. Various attempts have been made to translate this objective into a practical collecting strategy, of which the most convincing is that of Marshall and Brown (1975). They considered the aim of plant exploration to be the collection of at least one copy of each allele occurring in the target population with a frequency greater than .05. Rare alleles (defined as those with frequencies less than .05) were considered to be generally uninteresting to breeders, and in any event collecting from wild populations would be an inefficient means of collecting these rare genes. Marshall and Brown then calculated the minimum number of plants to collect from a population, defining this minimum as the number of plants needed to obtain, with a probability of .95, all the alleles at a particular locus which occur with frequencies greater than .05. This minimum number varies according to the assumptions that are made about gene frequency distributions, but in general lies in the range of 25-50 plants. It is normally more efficient to sample a larger number of populations at this intensity than to collect larger samples within populations. A larger sample may be appropriate, however, in populations which are highly polymorphic for observable marker loci or highly variable for quantitative characters.

This approach appears to offer an objective basis for planning a collecting programme. However, for a species such as cocoa which is continuously distributed over a wide area, the demarcation of a population presents difficulties. Conventionally, wild cocoa populations are defined by reference to broad geographical regions (for example, the "Upper Amazon"), to particular river valleys (for example, Pound's Nanay clones) or to loosely-defined combinations of pod and seed characteristics (for example, Theobroma cacao subsp. sphaerocarpum, as described by Cuatrecasas 1964). However, Marshall and Brown's approach implies a more strictly defined population, in which the same set of common alleles occurs throughout, as a result of continuous gene flow and a reasonably homogeneous environment.

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Since the alleles of agronomic importance cannot in general be identified at the time of collection, a population can only be demarcated on the basis of indirect evidence. For cocoa, this evidence comes at present from three sources: first, descriptions of the genotypes using a list of standard descriptors; second, information on the physical environment (basically altitude, climate and soils); and third, information on the breeding biology of the species, and in particular, pollen transfer, compatibility, and seed dispersal.

Genotype descriptions

Although a standard descriptor list for cocoa has been published (Engels, Bartley and Enriquez 1980; IBPGR, 1981), very few cocoa genotypes have been described using these descriptors: the published descriptions are those for the Turrialba gene bank (Engels, 1981) and the LCTAP collections (Allen and Lass, 1983; however, the latter uses a different, though compatible, set of descriptor states). A project to describe the genotypes in the Trinidad gene bank has recently started (R.J. Kennedy, personal communication).

The full descriptor list suggested by Engels *et al.* (1980) requires about 115 items of data to be recorded for each genotype, which probably involves too much work to be applied to complete genebanks. Use of a limited number of descriptors should help to demarcate genetically distinct populations both among genotypes already held in gene banks and, possibly, while collecting. Although further work needs to be done to determine which descriptors are appropriate for these purposes, it is essential that collectors should record and publish descriptions of collected genotypes using standard descriptors.

Environmental variables

It is also important that collectors should record and publish information on the physical environment of the areas in which they have collected. From experience with other plant species, it should be assumed that areas differing markedly in altitude will have genetically distinct populations of wild cocoa even if the genetic differences are not immediately obvious. No general statement can be made about the importance of other environmental variables, but they must be recorded in case new information subsequently becomes available.

Breeding biology

Information on the breeding biology of cocoa is at present of only minor importance in demarcating populations. In general terms, it should be remembered that although many wild cocoa genotypes are self-incompatible, the short distances over which pollen and seeds are dispersed suggest some degree of in-breeding and hence of local genetic differentiation of wild cocoa populations. This differentiation might occur over distances as little as a few hundred metres. On the other hand, trees occurring in groups up to 10-20 m apart may be the result of vegetative reproduction or be seedlings with a common female parent, and hence genetically identical or at least similar.

If all the information referred to above were available to the collector before setting out to collect, it would be possible to demarcate in advance a series of populations. The collecting programme would then be organized to collect from an appropriate number of trees in each population. In practice, the most important information, that is, the genotype descriptions, will probably be available only after an area has been visited, and the collecting programme will have to be planned on the basis of incomplete and ambiguous descriptions of population characteristics published by earlier collectors and travellers. In these circumstances, it will be important to make full use of published information on the physical environment of the region of interest. The planning stage of a collecting programme should include the acquisition of topographical maps, as well as soil, vegetation, geological and geomorphological maps, and published climatic data. Aerial photographs and satellite images have been suggested as sources of information but these are unlikely to yield useful information without sophisticated interpretation techniques.

There may be cases where genotypes collected earlier from a particular locality have already proved of value in breeding. Such a locality would be an obvious priority for further collecting. Nonetheless, it will still be useful to attempt to demarcate the population, because similar genotypes may occur in localities other than that originally visited.

Systematic collecting

Taking all this information into account, it may be possible to divide the target region into areas where there is a reasonable likelihood of collecting from a genetically distinct population. In some regions, this approach alone will identify more than enough populations to occupy fully the collector's time; in other regions, lack of information or a homogeneous environment over a large area might lead to the adoption of a systematic collecting strategy. For example, in planning the LCTAP collecting programme in the Amazon region of Ecuador, the target region was divided into squares, half a degree of latitude by half a degree of longitude (about 55 km x 55 km). Collecting trips were then planned in order that every square could be visited at least once. The systematic approach has the advantage of generating more complete information about genetic variation throughout the target region and it encourages the collector to visit the less accessible localities, but it must not be assumed that it is appropriate in all regions or when collecting budgets permit coverage of only a few localities in the target region.

Biased or random collecting?

Having decided to collect in a particular locality (see also Section 3 below), it is also necessary to decide whether to select trees for collecting on the basis of visible characters (sometimes referred to as "biased" collecting), or whether to collect from a random sample of the local wild cocoa population. Leaving aside theoretical considerations (discussed in Marshall and Brown, 1975), it seems clear that for cocoa at least, there are no characters of agronomic importance which can be assessed at the time of collection. For example, although many collections of cocoa were originally selected for apparent resistance to witches' broom disease (Crinipellis perniciosa), few have shown resistance in cultivation; the apparent degree of infection in a particular wild tree is strongly influenced by the conditions in which it is growing, and absence of symptoms is not good evidence of resistance. On the other hand, rejection of a tree because it is infected with a particular disease ignores the potential value of the genotype for other characters. In general, therefore, collecting at a particular locality should be on a random (non-biased) basis, trees for collection being a random sample of the whole population. In practice, it will rarely be possible to apply a rigorous randomization procedure in the choice of trees, but this will not matter as long as trees are not selected on the basis of visible characters.

Seed or budwood?

Given that trees are not selected for collection on the basis of individual characteristics, there is no theoretical reason to favour the collection of vegetative material, except in places where wild cocoa may have been pollinated by cultivated cocoa growing nearby; otherwise, seed may even provide a more extensive sampling of the local wild gene pool. Since seed is also easier to handle and propagate from, it should be collected in preference to budwood whenever possible (see Section 3).

Organization of the collecting programme

Once the overall collecting strategy has been determined, it will be necessary to take practical decisions related to the organization of the collecting programme. A collecting programme may be organized as a single expedition lasting up to perhaps three months, or it may consist of a series of shorter expeditions over a period of several years. A single expedition will normally be based at an established cocoa research station with nursery facilities and permanent staff; careful arrangements must be made for returning material from the collector to the nursery at intervals during the expedition (see Section 3). Single expeditions are appropriate for collecting from

identified populations, but in practice they are expensive, and because participating staff have other responsibilities, the resulting collections are frequently not documented.

When planning a collecting programme for a region in which the wild cocoa populations have not been adequately identified, it may be more efficient to organize a collecting programme as a series of shorter expeditions made by specially appointed staff over a period of several years. This approach will facilitate the acquisition of information on the target region, as outlined in the previous section, followed by a detailed exploration, with full documentation of the collected material. The same staff will also have responsibility for propagation of the collected material, and for sending material to quarantine, as the first stage in distribution to breeders. Shorter expeditions also simplify the return of material from the collector to the nursery, leading to a higher rate of survival of collections.

When a collecting programme is planned to continue for several years, it may be possible to set up a base for the project within the target region. This base will normally be on an existing agricultural research station, requiring only the construction of basic nursery facilities for cocoa and some land for planting out the collections. The site for the base will be selected to facilitate travel within the target region; local air charter services should be available. It is also important that the base has good access by road or air, including international flight connections for despatch of material to quarantine.

Taking into account the time which should be spent on planning and documentation for a collecting programme, as well as the cost of propagating and establishing the collections, it is likely that a full-scale collecting programme will be cheaper per established collection than a single expedition. Unfortunately, data on expedition costs are not generally published; it may be noted that the full cost, including staff costs, of the first three years of LCTAP, involving the acquisition, establishment and documentation of about 250 collections, was of the order of US$120,000, or about US$500 per collection.

(2) Collecting methods

A team of two people, plus a local guide or boatman where necessary, will be sufficient for collecting germplasm in most circumstances. Although shortage of time will occasionally limit the amount of material which can be collected by two people, this minor disadvantage is greatly outweighed by the ease with which a small group can travel in remote areas, and by the reduction in costs.

The area to be visited during a particular expedition will be identified in general terms during the planning stage of the collecting programme as outlined in Section 1. The final planning of the expedition will depend on detailed local information. Where this information is difficult to obtain, a preliminary reconnaissance of the area may be justified. A typical expedition will then involve travelling to the selected area by road or by chartered light aircraft, followed by a detailed exploration of the surrounding area by road, by canoe, on horseback or on foot. Alternatively, an expedition will involve exploring along a road or river. In all cases, the final detailed exploration will be done on foot, spending anything from half an hour to eight hours walking away from the village road or river.

A four-wheel drive vehicle is necessary for collecting in areas with access by road. Where long journeys in mountainous terrain are necessary, the vehicle chosen should be as powerful and comfortable as possible. It is important to be able to lock the vehicle to prevent the theft of equipment, so that a pick-up truck is not really suitable.

Many remote areas are accessible only by using chartered light aircraft. When planning on the use of such aircraft, it is important to enquire what load can be carried as the smaller aircraft (which are much cheaper to hire) may be limited to a total load, for passengers and equipment, of as little as 250 kg, when using short runways. In oilfield areas, oil companies may provide free helicopter transport for one

or two people, which may provide access to particularly remote areas; otherwise, helicopters are generally too expensive to charter.

For exploration along rivers, large dugout canoes with outboard motors are usually easy to hire, and it is not necessary for an expedition to provide its own boat. However, in remote areas, boat owners do not keep stocks of fuel, and it is necessary to fly-in with one's own supply. This may necessitate a larger aircraft, or, where transport of petrol on passenger flights is illegal, an extra flight.

Locating wild cocoa

Wild cocoa trees for collection can be found by asking local people, by employing a local guide, or by searching for them directly. With experience, the last approach may be more efficient; wild cocoa trees in pastures or along river banks can be picked out from at least 500 m distance with the aid of binoculars, while in forests the multiple-stemmed habit of wild cocoa is quite distinctive. Discussions with local people may provide information on the origin of apparently wild cocoa, although information provided casually is often unreliable. Local names and uses for cocoa and other Theobroma species should be carefully recorded. A full taxonomic account of the genus Theobroma is provided by Cuatrecasa (1964).

(3) Selection of trees for collection

As discussed in Section 2, it is preferable to collect material from a random sample of the trees encountered in a given area. In areas where wild cocoa is scarce, it may be feasible to collect material from all trees located. The maximum number of trees which can be collected in one day varies from between 8 and 15, depending on the time spent travelling and the kind of material collected (budwood taking longer to collect than pods). If it seems likely that more than this number of trees will be located in the course of a particular day's exploration, then material should be collected from only a proportion of the trees encountered; for example, by stopping every 20 minutes along a river.

Collecting

Collecting and propagation techniques have been reviewed by Soria (1974). Once it has been decided to collect material from a particular tree, the tree should be carefully inspected for ripe pods. If suitable pods are present, one or two pods should be collected. Pods up to 6 m above ground can usually be collected using a long stick (found nearby, rather than carried as expedition equipment) with a noose of string attached to the end. Pods higher up must be collected by climbing. If pods are absent, budwood should be collected, usually by cutting down one or two trunks of chupons (assuming a typical multi-trunked tree). Ideally, around 20 budsticks with 4 or more buds each would be collected; the budsticks would be 8-15 mm in diameter and 15-20 cm long, with the wood more than half-ripened and the buds clearly visible but not burst. In practice, wild trees, particularly those growing in dense shade, will often yield only poor quality budwood, the branches being too old or too thin and the buds underdeveloped or damaged. Failures when propagating with such material are unavoidable.

The policy of collecting pods in preference to budwood is discussed in Section 2.

Packing of collected material

When it is possible to collect healthy, undamaged pods, the simplest procedure is to maintain these unopened until they can be returned to the nursery. Unopened pods in good condition can be stored for at least three weeks with no special precautions except to keep the pods in a container which allows moisture to evaporate freely. A cardboard box or a sack will be satisfactory; pods kept in plastic bags will rot rapidly. Individual pods can be identified by wrapping a length of masking tape around the pod and writing the collection number on the tape with a waterproof marker pen.

With pods in poor condition, or when it is necessary to save space and weight, the seeds can be removed from the pods. The testas should be peeled off by hand and the

seeds packed in damp (20-30 per cent moisture) charcoal in sealed plastic bags. Seeds stored by this method should remain in good condition for two weeks; the seeds will germinate and the bags should be handled carefully to avoid breaking off the emerging roots.

Budwood should be stored wrapped in newspaper after sealing the ends of the budsticks (to prevent drying out) by dipping the ends into molten wax. Paraffin wax (melting point 49°C) is satisfactory. The packets of budwood in newspaper are then placed in boxes with tightly fitting lids. When using newspaper which has been stored in a humid atmosphere, it is not necessary to dampen the newspaper further, but if it is dry or the packets appear to be drying out in transit a little water should be sprinkled over the newspaper. Excess moisture will lead to rapid rotting of the budsticks.

Budwood, and seeds packed in charcoal, can be conveniently stored and transported in insulated plastic containers ("cool boxes", as sold for domestic use). These protect the material against abrupt changes in temperature and are convenient to handle while travelling.

During long expeditions, storage of collected material and the regular return of material to the nursery present problems which have rarely been completely overcome and some losses of material are inevitable. If expeditions are limited to a maximum of 2-3 weeks, these problems will largely disappear (the length of expeditions is discussed in section 2).

Data recording

Collections should be identified by a number with a distinctive prefix. Lockwood and Gyamfi (1979) list most of the prefixes used by previous collectors. Some basic information on the location, immediate environment and obvious characteristics of the tree should be recorded at the time of collection. This information is specified in the standard descriptor lists for cocoa (Engels *et al*. 1980; IBPGR, 1981). These data can most easily be recorded on a form, prepared to suit the needs of a particular collecting programme. A second form can be used for pod and seed characters, which might not be recorded until the pods have been returned to the nursery. At the same time, the pods should be photographed and tracings made of the pod shell (longitudinal and transverse sections). All data forms, pod drawings and photographs should be duplicated and both sets deposited with appropriate institutions.

Propagation

Standard nursery facilities will be needed, together with a supply of seedlings as stocks for budding. The seedlings will need to be 6-12 months old at the date of the collecting expedition; it is useful to have stocks of different ages to match budwood of varying diameters.

Any budding technique can be used successfully and the choice of technique will depend on local practice and the experience of nursery staff. Budsticks from wild trees are often rather thin; with such material the "modified side-graft" technique (Soderholm and Shaw, 1965) is useful. Normally, 12-20 buddings (one per stock plant) will be made for each collection but this number should be increased if time permits and the quantity of budwood is sufficient. Losses of up to 95 per cent must be expected when budding with wild budwood; these losses seem to depend more on the condition of the budwood at the time of collection than on the length of storage.

Seeds will be sown directly into soil-filled plastic bags. If space permits, all collected seed can be sown, but otherwise it is reasonable to sow 15-20 seeds of each collection. This point is still open to debate; some breeders wish to retain all seedlings of a collection but this results in an excessive number of similar genotypes in the genebank. LCTAP practice has been to retain 10 seedlings of each seed collection, and up to 5 duplicates of each collection made as budwood. Both seedlings and budded plants will be maintained in the nursery for 9-15 months before planting out. Given the value of each plant, it may be preferable to use larger plastic bags than usual to encourage faster growth.

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RESUME

Des méthodes de récolte de spécimens de populations sauvages de Theobroma cacao sont décrites par l'auteur qui, dans le cadre du "London Cocoa Trade Amazon Project" (LCTAP), prospecte activement la région amazonienne de l'Equateur. Il évoque diverses questions: méthodes d'échantillonnage, organisation de la mission, localisation des cacaoyers sauvages et choix des arbres.

RESUMEN

El autor, que está participando activamente en recolecciones en la región amazonica del Ecuador en el marco del "London Cocoa Trade Amazon Project (LCTAP), describe los métodos propuestos para la recolección de poblaciones silvestres de Theobroma cacao. Entre los aspectos examinados de la recolección figuran los diversos métodos para la obtención de muestras, la organización de la misión, la localización de cacao silvestre y la selección de los árboles.

CIAT TROPICAL FORAGE COLLECTION : A STATUS REPORT

R. Schultze-Kraft and G. Alvarez[1/]

One of the major world collections of tropical forage germplasm is held by the Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia. Its origin dates to 1971 when the former CIAT Beef Production Program received a series of forage legume introductions including commercial cultivars from Australian collections for species evaluation in the lowland tropics of Colombia. Already at that time, a certain emphasis of the Program's research activities was on selection of germplasm adapted to acid, infertile soil conditions, particularly within the legume genus Stylosanthes.

By 1973, in view of serious disease problems, particularly within the genus Stylosanthes, it was recognized that the genetic base of the legume collection needed to be broadened considerably. Thus, taking into consideration that tropical America is the major centre of diversity of most of the tropical legume genera, a series of exploratory trips to collect native legume germplasm were undertaken between 1973 and 1976 in Bolivia, Brazil, Colombia and Venezuela. Consequently, the CIAT collection of tropical forage germplasm increased from 70 accessions at the end of 1972 to 1,350 accessions at the end of 1976. The 1974/75 collection activities were financed by the IBPGR.

In 1976 the objectives of the CIAT Beef Production Program (which was later re-named Tropical Pastures Program) were re-defined as the development of germplasm-based technology for increasing cattle production in the acid, infertile soil areas of the under-utilized savannah regions of tropical America. Within the subsequent reorganization of the Program and in recognition of the need to explore the range of natural variability of yet under-exploited, potentially valuable grass and legume species, a Plant Introduction Section was created. Assisted by the CIAT Genetic Resources Unit, this Section assumed responsibility for the collection, introduction, maintenance and characterization of forage germplasm.

Intensive collection activities started in 1977. Up to now a total of 15 systematic collecting expeditions has been carried out in tropical America (Brazil, Colombia, Panama, Peru and Venezuela). Furthermore, two trips have been undertaken in Southeast Asia (Malaysia and Thailand), one of them financed by the IBPGR. Germplasm introduction activities, in terms of exchange of material with other institutions, were also intensified. As a consequence, the CIAT collection of tropical forage germplasm increased from 1,350 accessions (December, 1976) to 11,100 accessions in October 1983 (Table 1). More than 90 per cent of this collection accounts for legumes and 70 per cent of these are the result of collecting expeditions rather than germplasm exchange with other institutions. Since the collecting trips are principally conducted in regions with acid, infertile soils, the CIAT collection is a unique and valuable genetic resource with a high degree of specialization in germplasm adapted to those marginal soil conditions.

All collecting trips outside Colombia are carried out as joint ventures in collaboration with the respective national institutions. The international character of the CIAT collection is reflected by the information given in Table 1 in which the total collection is divided into "Own Collections", "Collaborative Collections" and "Material

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from Other Sources" which account for 23, 42 and 35 per cent, respectively. At the request of the collaborating national institutions, a duplicate of the collected material is either left in the country of origin or is made available after seed multiplication.

Only eight per cent of the total collection consists of grass germplasm (Table 1). This low proportion reflects the fact that the regions so far explored lack grasses that can presently be considered potentially promising. Since most of the tropical grass genera with potential as forage plants have their major centre of diversity in Africa, the introduction of grass germplasm to date has had to depend heavily on donations from other institutions. This includes the genera Andropogon, Brachiaria and Panicum which are at present of major interest to CIAT's Tropical Pastures Program; thus, 94 per cent of the CIAT grass germplasm is introduced from other sources, i.e. mainly from collections held in Africa and Australia

The main objective of the collection and introduction activities is to provide the CIAT Tropical Pastures Program as well as collaborating national institutions, mainly in tropical America, with germplasm for cultivar development; thus the collection is an active working collection with a continuous flow of material into the Program's germplasm screening and evaluation scheme. Research emphasis is currently on the legume genera Centrosema, Desmodium, Stylosanthes and Zornia and the grasses Andropogon gayanus, Brachiaria spp., and Panicum maximum. In many national institutions CIAT germplasm is in advanced stages of evaluation; some accessions have been released as officially recommended, commercial cultivars (such as Andropogon gayanus CIAT 621 in Brazil, Colombia, Panama, Peru and Venezuela and Stylosanthes capitata CIAT 10280 in Colombia).

CIAT's Tropical Pastures Program is very interested in intensifying germplasm exchange with other institutions. A computerized catalogue of the collection is available. Due to the lack of appropriate taxonomic revisions for some of the South American legumes genera in this catalogue, with respect to their taxonomic classification, a series of accessions have so far only been tentatively identified; there is evidence that some materials in the collection belong to new, as yet undescribed species.

The seed of the working collection is held in short to mid-term storage at a temperature of 8 $\pm$ 1°C and RH of 65-75 per cent. Long-term storage of the collection is envisaged and it is planned that a duplicate will be deposited in a collaborating genebank within the IBPGR network. In order to obtain seed material of uniform age for that purpose, in early 1983 a seed rejuvenation process was initiated within some of the major legume genera such as Desmodium, Macroptilium, Stylosanthes and Vigna.

Future plans include legume collecting in collaboration with the respective national institutions, in those areas of Latin America which so far have either not been sampled sufficiently, or not at all, such as Central America, southern Venzuela, the Guyanas, Ecuador, the Amazon regions of Peru, Bolivia, northern Paraguay and Central/West Brazil. With regard to germplasm from tropical Africa, expeditions to collect principally grass material in several African countries are planned, in collaboration with the International Livestock Center for Africa (ILCA). Further collecting of native legume germplasm in Southeast Asia is also planned. Depending on research results of the Tropical Pastures Program and its collaborators, the need may arise to carry out collecting trips to specific regions in order to broaden the genetic base of particular species which, on the basis of previous exploratory samplings, have proved particularly promising.

According to CIAT's collecting experience, in the case of wild forage germplasm there is also increasing evidence of genetic erosion due to increasing expansion and development of agriculture throughout the tropics; thus, worldwide- and IBPGR-coordinated actions, with the objective of collecting germplasm for conservation purposes, seem to be desirable. If within any eventual global strategy such actions materialize, the CIAT collection activities which up to the present time have aimed principally at cultivar development, should consequently expand towards germplasm conservation.

Table 1. Inventory of the CIAT collection of tropical forage germplasm as of 31 October, 1983

Genus	Own collections	Collaborative collections	Other sources	Total
	----------number of accessions----------			
Legumes				
Aeschynomene	149	341	61	551
Calopogonium	84	129	27	240
Cassia	55	113	36	204
Centrosema	275	434	349	1058
Desmodium	381	760	305	1446
Galactia	90	174	124	388
Macrotilium/Vigna	212	225	388	825
Rhynchosia	53	104	80	237
Stylosanthes	576	1223	812	2611
Zornia	204	459	153	816
Miscellaneous*	428	721	703	1852
Total legumes	2507	4683	3038	10228
Grasses				
Andropogon	6	14	48	68
Brachiaria	4	0	193	197
Panicum	0	0	387	387
Miscellaneous**	15	8	169	192
Total grasses	25	22	797	844
Total collection	2532	4705	3835	11072

*Clitoria, Crotalaria, Desmanthus, Eriosema, Glycine, Indigofera, Leucaena, Pueraria, Tephrosia, Teramnus and other genera.

** Axonopus, Cenchrus, Chloris, Cynodon, Digitaria, Echinochloa, Eragrostis, Hemarthria, Melinis, Paspalum, Pennisetum, Setaria, etc.

RESUME

Le "Centro Internacional de Agricultura Tropical" (CIAT) de Calí, Colombie, détient une importante collection de souches génétiques de plantes fourragères tropicales. L'évaluation de la collection a porté principalement sur le matériel génétique (spécialement Stylosanthes) adapté aux sols pauvres et acides. Comme l'Amérique tropicale est un centre de diversité de nombreux genres de légumineuses tropicales, des missions de prospection ont été organisées dans cette région et aussi dans le sud-est asiatique. En 1983, la collection du CIAT comptait 11,000 exemplaires. Il existe un catalogue établi par ordinateur.

RESUMEN

En el Centro Internacional de Agricultura Tropical (CIAT) de Calí, Colombia, se conserva una importante colección de germoplasma de plantas forrajeras tropicales. En la evaluación de la colección se ha hecho hincapié en el germoplasma adaptado a suelos ácidos, estériles (especialmente de Stylosanthes). Puesto que la América tropical es una región con numerosos géneros de leguminosas tropicales que muestran una gran diversidad, se han organizado allí misiones de recolección y la misura se ha hecho en el Asia sudoriental. La colección del CIAT contaba en 1983 con 11,000 accesos. Existe un catálogo computerizado.

ERRATA

In the article "A procedure for packing long-term storage seed" which appeared in Newsletter No. 54, on page 30, right-hand column, line 6, "300 mm" should have read "30 mm".

The following corrections should be made in the 1983 IBPGR publication Genetic Resources of Capsicum. (The IBPGR thanks Dr. Barbara Pickersgill, University of Reading, UK for kindly noting them.)

p. 4, Table 3 — Distribution of domesticated C. chinense, given as "From Bolivia (southern) to Brazil (southern)...", should read "Brazil (northern)". As the map (Fig. 2) shows, C. chinense is much more widespread in South America than Table 3 implies and is characteristically northern rather than southern in distribution.

p. 5 — C. 'tovari' is no longer a nomen nudum, but C. tovarii Eshbaugh, Smith & Nickrent (published in Brittonia 35: 55-60). This should also be changed in Appendix III. Tabasco is not the only domesticated form of C. frutescens; Chile chocolate is another, and there are various others which are widely used in Central America.

p. 19 — In the diagnostic descriptions, the types mentioned should serve as examples of the species described, not just the chromosome race. Chromosome data and the examples cited should therefore have been given in two separate sentences.

p. 41 — Fruit colour in immature stage is erroneously shown with identical states to fruit colour in mature stage. Immature fruits are variants on cream, pale green, dark green, etc. and are never red or brown.

AVAILABILITY AND USE OF WILD CICER GERMPLASM

L.J.G. van der Maesen and R.P.S. Pundir[1/]

Despite an increased general interest in wild chickpea (Cicer spp.) their genetic resources remain very limited. Of more than 13,000 accessions of cultivated chickpea (December 1983) in the world germplasm collection at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) only 54 accessions are wild species. There are two reasons for this: the difficulties of seed increase (most species are not adapted to lowland breeding locations), and the political inaccessibility of most countries or areas of origin of the wild species. In addition, the requirements of researchers keep seed stocks at a low level.

Apart from botanical explorers, it has been mainly the scientists from ICRISAT; the International Center for Agricultural Research in the Dry Areas (ICARDA) and its predecessor, Arid Land Agricultural Development (ALAD); the Faculty of Agriculture at Rehovot, Israel; and the Aegean Regional Agricultural Research Institute (ARARI), Turkey, who have collected seed of wild Cicer spp. Wild annual species and a number of perennial species (Table 1) were collected by ICRISAT in 1975 on two trips to Turkey and Afghanistan where only a limited number of samples of most of them could be secured. Apart from political barriers in some countries, physical inaccessibility is to some extent a disadvantage, as many Cicer spp. grow in mountainous areas.

Seed increase is difficult due to the poor adaptation of the wild Cicer spp. to places such as the sites of ICARDA in Syria, ICRISAT in India and at Rehovot in Israel. Two annual species, C. echinospermum and C. yamashitae, were lost at ICRISAT because of poor growth, a warm winter season, excessive pest damage, or poor soil. These samples were again obtained from another research station to build up seed stocks at ICRISAT. Remedial measures, such as day-length extension, cooled glasshouse facilities, protective netting against birds and rabbits, choice of soil and irrigation facilities, have improved the situation markedly during the last few seasons.

Perennial species are much more difficult to grow. Even when some (e.g. C. pungens, C. anatolicum) flowered, seed set failed despite hand self-pollination. At Ankara, Turkey, C. montbretii flowered well but set no seed, being native in the Aegean region and ill-adapted to the Anatolian plateau.

The heavy seed demand by breeders, cytologists, physiologists and microbiologists requires that the samples supplied be small in quantity in order to share the available supply.

Several wild species of Cicer have been found to possess disease resistance and other characters which have value in crop improvement (Table 2). C. reticulatum Ladiz. [= C. arietinum L. subsp. reticulatum (Ladiz.) Moreno & Cuberol] was previously found to have some degree of blight [Ascochyta rabiei (Pass.) Labr.] resistance, when tested at ICRISAT in a plant propagator. It failed to maintain that resistance in Syria. Unfortunately, this is the only species crossable with chickpea by conventional techniques. The products of crosses made at ICRISAT in Hyderabad to incorporate resistance have been screened against Asochyta blight in northern India at Hissar, where

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epidemics were severe between 1980 and 1982. The progenies were all susceptible to blight in 1980-81.

The claim of transfer of resistance earlier made (ICRISAT, 1979) and listed as one of the successes in interspecific hybridization (Plucknett et al., 1983) has to be reconsidered. Because so few accessions of wild species are available (only a portion of 54 samples), it is possible that more sources of resistance may be available in collections from other locations. Other useful characters of wild species are plant habit and morphology, drought resistance, adaptation to stress environments such as cold and infertile habitats (despite the poor survival in crop environments), more seeds per pod, and high protein content. However, the first priority is to determine methods of successfully growing the wild species and to study their barriers to crossability with cultivated chickpea.

Conventional crossing techniques have so far defied success in most cases, despite many pollinations, or hybrid seed did not germinate in spite of careful treatment (Ladizinsky, 1979; Pundir and van der Maesen, 1983).

The urgency for collection of wild chickpeas is much greater than its cultivated species. Most of the important chickpea-growing countries have been well covered (e.g. India, Iran, Afghanistan and Turkey), but not many wild species have been collected from remote or sensitive areas and these often have botanic interest. Scientists of the countries concerned have an excellent opportunity to search those areas (e.g. Arora et al., 1982), in addition to others in the past, such as medical doctors (Aitchison, 1881), and in more recent times, van der Maesen (1972). Civil authorities in countries listed in Table 3 may count experienced amateur botanists among them who may be interested in collecting. Samples of seed, accompanied by herbarium specimens, are needed to facilitate and document identification, not only of Cicer spp., but also of wild relatives of other food crops. The International Agricultural Research Centres provide funds for collection of their mandate-crop germplasm but these funds are limited.

Results from collecting missions for wild species are fewer than those for cultivated species because of their rare and inaccessible occurrence. Shattering in Leguminosae necessitates careful timing of collection. Table 3 lists areas and times suitable to collect wild Cicer spp. At lower altitudes plants ripen earlier than high in the mountains. Detailed locations can be found in a monograph by van der Maesen (1972); more recent information can be furnished by the authors.

Despite initial failures to multiply seeds of wild Cicer spp. and to cross them with cultivated chickpea, attempts to transfer useful genes are continuing. These efforts must be backed by further collecting to increase the wild genetic resources of chickpea. Assistance from national scientists is urged to enlarge the genetic base for chickpea improvement.

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Table 1. Wild Cicer species collection at ICRISAT*

Species	No. of accessions	Origin
ANNUAL SPECIES		
C. reticulatum	4	Turkey
C. echinospermum	4	Turkey
C. bijugum	5	Turkey
C. pinnatifidum	6	Turkey
C. judaicum	4	Lebanon, Israel
C. cuneatum	1	Ethiopia
C. yamashitae	3	Afghanistan
C. chorassanicum	3	Afghanistan
PERENNIAL SPECIES		
C. montbretii	2	Turkey
C. anatolicum	3	Turkey
C. pungens	9	Afghanistan
C. rechingeri	1	Afghanistan
C. microphyllum	8	India
C. floribundum	1	Turkey
	54	

* Not all available for distribution

Table 2. Characters in wild Cicer species useful for chickpea improvement

Species	Particulars	Reference
C. judaicum	Resistant to Fusarium wilt	International Chickpea Newsletter 7:14 (1982)
	Resistant to Grey mold	International Chickpea Newsletter 4: 16-17(1981)
	Resistant to Ascochyta blight	-do-
C. reticulatum	Promising against Aschochyta blight	ICRISAT Annual Report 1978-79, p. 133.
	Acceptable seed size (10 g/100 seeds)	
C. pinnatifidum	Resistant to Aschochyta blight	International Chickpea Newsletter 4: 16-17 (1981)
C. montbretii	-do-, 3-7 seeds per pod	-do-
C. bijugum	Acceptable seed size (9 g/100 seeds)	-
C. cuneatum	Good vigour & ca 3 seeds per pod	-
C. microphyllum	Cold tolerance	-

Table 3. Areas and suitable time for wild Cicer collection (a = annual, p = perennial)

Country	Area	Material	Months
Afghanistan	Sarobi	C. yamashitae a	May
	Central	C. chorassanicum a	May-Jun
	Central	Perennial spp. p	Jul-Aug
		C. multijugum p	Aug-Sep
		C. rechingeri p	Jul-Aug
Ethiopia	Eritrea, Tigre	C. cuneatum a	Nov
Greece	Mt. Kyllene	C. graecum p	Jul-Aug
	Crete	C. incisum p	Jul
India	Ladakh, Zaskar	C. microphyllum p	Aug-Sep
	Lahaul, Spiti	C. nuristanicum p	Aug-Sep

Table 3. (continued)

Country	Area	Material	Months
Iran	Elburz Mts.	C. chorassanicum a	May-Jun
	Kopet Dagh	C. tragacanthoides	Jul-Aug
	Zagros Mts.	Perennial spp. p	Jul-Sep
	Kerman prov.	C. kermanense p	Jun-Jul
	Shiraz	C. subaphyllum p	May-Jun
Iraq	Jabal Sinjar	C. pinnatifidum a	
	Sulaimanya, Rowanduz	C. oxyodon p	(Jun)Jul
Lebanon	Mt. Hermon, Mt. Lebanon	C. incisum p	Jul-Aug
Morocco	Atlas Mts.	C. atlanticum p	Aug-Sep
Pakistan	Chitral, Hunza, Gilgit	C. nuristanicum p	Jul-Aug
Soviet Union	Caucasus	C. balcaricum p	Aug-Sep
		C. incisum p	Jun?
	Tadzhik SSR	C. acanthophyllum p	Aug-Sep
		C. baldshuanicum p	Aug
		C. fedtschenkoi p	Aug
		C. garanicum p	Jul-Aug
		C. incanum p	?
		C. macracanthum p	Jul-Aug
		C. korshinskyi p	Aug-Sep
	Turkmen SSR	C.mogoltavicum p	Jul
		C. paucijugum p	Jul
		C. pungens p	Jul-Aug
		C. songaricum p	Jul-Aug
		C. spiroceras p	Jul-Aug
		C. tragacanthoides p	Jun
	Uzbek SSR	C. grande p	Jul
		C. macracanthum p	Jul-Aug
		C. songaricum p	Jul-Aug
	Kirghiz SSR	C. fedtschenkoi p	Aug
		C. songaricum p	Jul-Aug
	Kazakh SSR	C. flexuosum p	Jul-Aug
		C. songaricum p	May-Jun
Syria	NW Syria	C. bijugum a	May-Jun
	SW Syria	C. pinnatifidum a	Mar-Apr
Turkey	SE lowland provinces	C. bijugum a	Jun(Jul)
		C. echinospermum a	Jun(Jul)
	Taurus Mts	C. isauricum p	Jul-Aug
	Aegean provinces	C. montbretii p	Jun
	Central Anatolia	C. anatolicum p	Jul-Aug
		C. incisum p	Aug-Sep
		C. pinnatifidum a	Jun-Jul
	SE mountain provinces	C. anatolicum p	Jul-Aug
		C. oxyodon? p	Jul-Aug

RESUME

Le nombre des souches génétiques d'espèces sauvages de Cicer spp. reste très limité. Les riches collections mondiales de Cicer, y compris celle de l'ICRISAT, ne comptent que peu d'espèces sauvages. Cela s'explique par la difficulté de multiplier les semences et par le fait que beaucoup des centres d'origine sont inaccessibles aux missions de prospection. L'aide de spécialistes nationaux est nécessaire pour élargir la base génétique en vue de l'amélioration du pois chiche.

RESUMEN

Los recursos genéticos disponibles de Cicer spp. silvestre siguen siendo muy limitados. De los numerosos accesos de Cicer en las colecciones mundiales, incluida la del ICRISAT, sólo un pequeño número son especies silvestres. Ello se debe a la dificultad de aumentar el número de semillas y a la inaccesibilidad de muchas de las zonas de origen para las misiones de recolección. Se requiere la ayuda de científicos nacionales para aumentar la base genética para la mejora de Cicer.

ERRATUM

En juin 1983 le CIRP a publié rapport "Les Ressources Génétiques du Genre Abelmoschus Med. (Gombo)" avec deux grosses erreurs:

-Pages 6 et 7: les illustrations 4, 6 et 8 sont dessus dessous. La position correcte des fruits est érigée dans l'illustration 4, retombante dans l'illustration 6 et horizontale dans l'illustration 8.

-Dans l'illustration 12 (page 17), le trait reliant le type A. sp. à A. manihot et non pas A. esculentus. La position correcte est montrée ci-dessous.

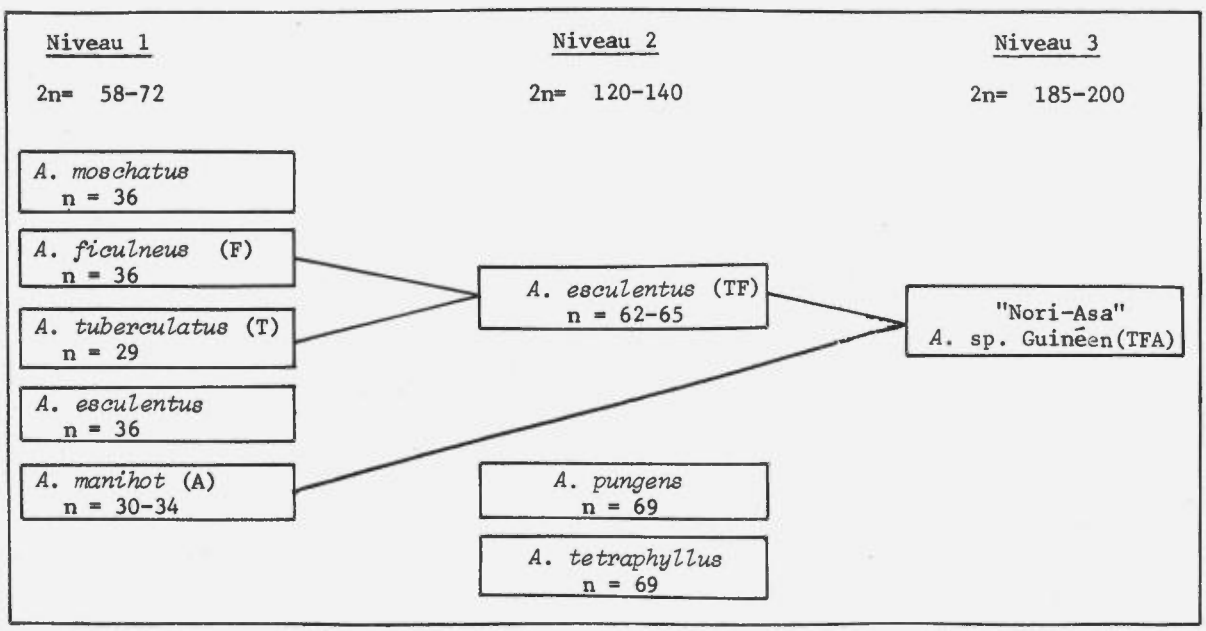

Figure 12. Relations cytogénétiques dans le genre *Abelmoschus* (compartiments et relations proposés)

SHOOT-TIP VANILLA CULTURE FOR STORAGE AND EXCHANGE

Robert L. Jarret[1/] and Roberto Fernandez Z.[2/]

A collection of vanilla (Vanilla planifolia Andrews), a clonally propagated species of economic importance native to southeastern Mexico, Guatemala, throughout Central America and the Antilles (Purseglove, 1972), has been assembled and is being maintained at the Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE), Costa Rica. This germplasm collection, having received 32 introductions over a number of years, has since been reduced in size due to periodic loss of individual introductions from diseases and pests, inclement weather and other natural catastrophes.

In view of the importance of preserving existing genetic variation and considering the great expense of collecting and maintaining vegetatively propagated plant germplasm (Withers, 1980), it seems logical that every effort must be made to protect it from accidental loss subsequent to its establishment in a repository. The results reported here demonstrate that whole plants may be recovered from axillary bud shoot-tips taken from a range of vanilla genotypes when cultured on a chemically defined medium, and suggest that this technique may be adaptable for medium-range germplasm storage of vanilla. Additionally, this technique should facilitate international exchange of vanilla germplasm.

Actively growing plant material consisting of the terminal 5 nodes from each entry to be cultured was gathered from the germplasm collection of CATIE and GTZ (Agency for Technical Cooperation, Federal Republic of Germany) in Turrialba, Costa Rica. Leaves were removed and individual nodes isolated and surface disinfected by immersion in a 10 per cent solution of commercial laundry bleach (diluted to contain 0.5 per cent sodium hypochlorite) and Tween 20 (2 drops/100 ml) for 10 minutes. Shoot-tips (0.5 mm - 1.5 mm) were isolated from the axillary buds with the aid of a dissecting microscope, immersed for 5 minutes in a second bleach solution (diluted to contain 0.1 per cent sodium hypochlorite), rinsed two times in sterile water and transferred to the culture media.

Shoot-tip cultures were initiated on 10 ml of a basal medium containing Murashige and Skoog (MS) salts (1962), i-inositol (100 mg/l), glycine (2.0 mg/l), nicotinic acid (0.5 mg/l), pyridoxine.HCl (0.5 mg/l), thiamine.HCl (0.1 mg/l), sucrose (30,000 mg/l), and Bacto agar (7,000 mg/l), supplemented with either various concentrations of N^6-benzylaminopurine (BAP) or only a single BAP concentration (0.5 mg/l) in 25 mm x 95 mm screw-cap culture vials. Media pH was adjusted fo 5.7 prior to autoclave sterilization for 15 minutes at 121°C. All cultures were maintained at 28° ± 1°C constant with 8 klux illumination on a 16 hour (light) photoperiod. After developing plantlets had attained a height of approximately 3 cm (8-16 weeks after implantation), they were transferred to 40 mm x 85 mm screw-cap jars each containing 20 ml of either the identical medium or basal medium only.

No problems with culture contamination were encountered using the previously described sterilization procedure with field-grown plant material.

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Initial studies were conducted utilizing primary explants taken from 3 randomly selected vanilla genotypes (PIs 8716, 8788 and 8789). Cultures of axillary bud shoot-tips from these three PIs were readily established on basal medium containing 0.5 mg/l BAP.

At this concentration, BAP stimulated explant greening with minimal callus formation at its cut end. Lower (0,0.125, 0.25 mg/l) or higher (1.0, 2.0, 5.0 mg/l) concentrations of BAP resulted in reduced explant viability or excessive callus formation and retarded plantlet development, respectively.

In the 2 months following culture initiation, shoot development occurred and most plantlets attained a length of several cm (Fig. 1). Variation was evident among tested genotypes in the rate of shoot elongation. Transfer of shoots 8-10 weeks after culture initiation to screw-cap jars containing either basal medium, or basal medium again supplemented with 0.5 mg/l BAP, stimulated plantlet growth. The continued growth of PIs 8716 and 8788 was noticeably more rapid when these were recultured to basal medium without hormones.

The addition of BAP at 0.5 mg/l in the reculture medium visibly retarded plantlet development of PI 8716 as compared to shoots of this genotype recultured to basal medium only. Transfer to fresh medium or perhaps to a larger culture vessel also appeared to stimulate the development of adventitious aerial roots. Occasionally these aerial roots lifted the growing plant off the media surface. In addition, for all 3 tested PIs axillary branching resulted in the development of 2-8 shoots per culture vessel (Fig. 2).

In a subsequent study, shoot-tip cultures were initiated from 18 genotypes (10 cultures/genotype) from the CATIE/GTZ vanilla collection on basal medium supplemented with 0.5 mg/l BAP (Table 1). For all genotypes, explant survival exceeded 70 per cent; however, there were great differences between genotypes in the rate of shoot development subsequent to culture initiation, possibly evidence of a sub-optimal hormonal concentration.

As shoots elongated to 2.5 - 3.0 cm (8-16 weeks after culture initiation), they were transferred to screw-cap jars containing basal medium only (Fig. 3). Only a single PI (13299) failed to develop normally after reculture to basal medium, but instead callused and differentiated many small (less than 1 mm) leaf-like appendages over its surface.

Shoot-tip cultures of PIs 8716, 8788 and 8789 have been maintained on basal medium in screw-cap jars for more than 10 months. At this time, there is no visible evidence of culture deterioration; however, space for additional growth is becoming limited. An examination of the effects of various chemicals or environmental factors capable of reducing the growth rate (Withers, 1980) seems advisable.

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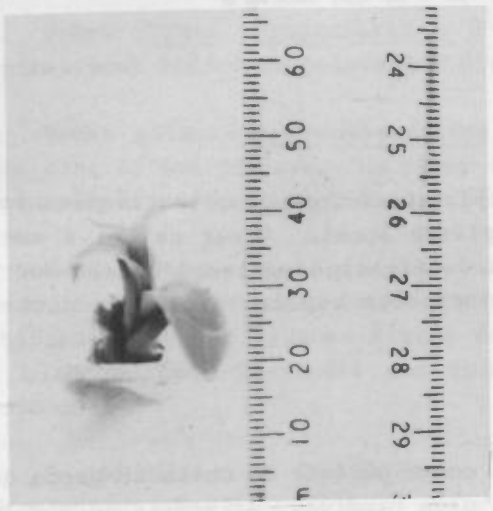

Fig. 1. Developing plantlet of PI8716 on MS medium supplemented with 0.5 mg/l BAP 8 weeks after culture initiation

Table 1. Vanilla accessions in the CATIE/GTZ germplasm collection from which shoot-tip cultures have been successfully initiated on basal medium containing 0.5 mg/l BAP

CATIE accession no.	Country of origin	Date of entry
3938	Costa Rica	1959
8709	Guatemala	1978
8713	Guatemala	1978
8714	Guatemala	1978
8715	Guatemala	1978
8716	Guatemala	1978
8788	Guatemala	1978
8789	Guatemala	1978
8790	Guatemala	1978
8991	Guatemala	1978
8992	Costa Rica	1978
9385	Mexico	1978
12201	Honduras	1980
12499	Panama	1981
13095	Costa Rica	1981
13298	Guatemala	1981
13299	Costa Rica	1982

Fig. 2. Axillary branching in PI 8788

Fig. 3. Actively growing shoot-tip cultures of 17 vanilla PIs from the CATIE vanilla collection 8 weeks after transfer to hormone-free medium

RESUME

Des extrémités de bourgeons axillaires ont été cultivées et des plantes entières ont été régénérées à partir d'une série de génotypes de vanillier, par culture dans un milieu chimiquement défini. Cette technique peut être adaptée pour la conservation à moyen terme de matériel génétique de vanillier et peut faciliter les échanges internationaux de souches génétiques de vanillier.

RESUMEN

En un medio de composición química conocida, se cultivaron ápices de yemas axilares y se regeneraron plantas enteras de diversos genotipos de vainilla. Esta técnica puede ser adaptable para el almacenamiento de germoplasma de vainilla a plazo medio y puede contribuir a facilitar el intercambio internacional de germoplasma de esta planta.

MISSION DE COLLECTE DE VIGNA AU NIGER

I.M. Magah[1/]

La sécheresse persistante, la diffusion de variétés introduites ou sélectionnées sont un facteur certain d'érosion génétique dans le germoplasme local. C'est ce qui a amené l'INRAN (Institut National de Recherches Agronomiques du Niger) à mettre l'accent sur la collecte et l'évaluation des écotypes locaux des principales espèces cultivées dont le niébé. (Vigna unguiculata).

Prospection

Les mois de novembre et décembre ont été choisis comme période de collecte parce que correspondant à la fin de la récolte des variétés les plus tardives, à la mise en grenier et aussi à l'ouverture des marchés officiels où un flux important de niébé y est enregistré.

La collecte a été faite en collaboration avec les agents des services agricoles et s'est déroulée de 1978 à 1980. Au total 115 villages répartis dans les six Départements à vocation agricole, Niamey, Diffa, Zinder, Tahoua, Maradi et Dosso, ont été visités et 390 échantillons ont été prélevés. Ceux-çi ont été enregistrés en fonction de l'année d'introduction: Prospection 1978 = TN1-78, prospection 1979 = TN 1-80 et prospection 1980 = TN1-81.

Nous nous sommes rendus aussi bien sûr les champs paysans que sur les points d'achat officiel (marchés coopératifs); nous avons visité quelques greniers traditionnels, posé des questions aux paysans sur le mode du culture utilisée, les méthodes de conservation, les différents mets préparés, etc.

Le prélèvement a été effectué aussi bien sur gousses que sur graines, au champ comme dans le grenier et au marché. Dans certains villages à cause de la mauvaise récolte la taille des échantillons a été relativement faible surtout lorsque la variété est peu cultivée. Seules les formes cultivées nous ont intéressés. Les formes sauvages existent en particulier dans le centre Sud du pays. La variabilité est différente d'une zone à une autre; ainsi à l'Est et à l'Ouest elle est moindre qu'au centre et d'une manière générale le Sud relativement plus arrosé présente plus d'écotypes que le Nord.

Bien entendu plusieurs des échantillons collectés peuvent représenter un seul et même écotype surtout qu'à la suite des années de sécheresse (1970-1973) beaucoup de transferts ont été faits d'une zone à une autre quelquefois à partir de pays voisin. De l'opinion même des paysans, ces introductions n'ont concerné que les cultivars précoces au dépens des leurs plus tardifs; ce qui a abouti à une érosion génétique certaine en particulier dans la frange Nord du pays à pluviométrie plus faible et plus capricieuse. Il est cependant difficile d'en apprécier le degré en particulier au niveau national à cause justement de la circulation des variétés et de la polyculture variétale largement pratiquée par les paysans.

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Nomenclature des ecotypes locaux

Le paysan Nigérien, en particulier dans la zone centrale distingue trois types de niébé.

Wake: (Vigna unguiculata) : C'est le niébé destiné à l'alimentation humaine. Les graines sont ridées de coloration diversifiée, mais le blanc et le brun y dominent.

Waken guizo: (Vigna dekindtiana) sauvage, utilisé comme fourrage, se rencontre surtout dans le Sud du pays. La fleur est violette, les gousses verdâtres, déhiscentes, les graines très petites ponctuées quelquefois de noir.

Kwama: Sous-espèce généralement spontanée se rencontrant dans les champs de niébé. C'est probablement une forme introgressive des deux précédentes. Les gousses sont déhiscentes et les graines lisses de couleur généralement marron ou noire, rarement rouge et blanche, sont destinées aux animaux. Certains écotypes sont toutefois cultivés et consommés.

La dénomination des écotypes locaux est très variable d'une région à une autre. Cependant un même écotype peut avoir plusieurs dénominations et plusieurs écotypes la même dénomination; ce qui du reste ne facilite pas toujours l'enregistrement des échantillons.

Les critères d'appréciation et de différentiation des cultivars par les paysans peuvent se résumer comme suit: couleur de grain, productivité, cycle, volubilité, forme des gousses, taille des grains, origine: village d'introduction/individu ayant introduit.

Evaluation

Les premières observations faites au champ sur 146 échantillons ont permis de se faire une idée de la diversité existante chez les écotypes locaux, tant du point de vue des caractéristiques morphologiques et physiologiques.

Les feuilles: D'un vert clair ou d'un vert foncé, les feuilles généralement semi-globuleuses, quelquefois globuleuses, jamais effilées, ont des dimensions oscillant entre 8 et 12 cm pour la longueur et 6 à 9 cm pour la largeur. La plupart des écotypes ont cependant des feuilles à dimensions moyennes à larges.

Le degré de persistance des feuilles à maturité varie selon les cultivars.

La tige: La pigmentation pourpre de la tige varie de l'absence totale (dans 30% des cas étudiés) à une coloration assez prononcé (40%) ou uniquement localisée au niveau des noeuds. Ceux-ci sont au nombre de 8 à 12 sur la tige principale, 4 semaines après le semis. Le nombre de ramifications sur la tige principale, 6 semaines après le semis, quant à lui, peut atteindre de 7 à 12, rarement 14.

Le port: Les écotypes étudiés sont de port rampant, à croissance indéfinie avec quelquefois une tendance à grimper. La volubilité est très variable et est surtout prononcée chez les tardifs et photosensibles.

Les fleurs: L'inflorescence racémée est située au-dessus ou entre les différentes couches du feuillage. Le pédoncule de longueur variable peut porter 2 à 5 fleurs dont la coloration va du blanc (dans 30% des cas) au violet (20%) mais ce sont surtout les formes intermédiares qui sont dominantes.

Le cycle à 50% floraison s'échelonne entre 40 et 90 jours quelquefois plus pour les variétés photosensibles. Pour un semis de fin juin à Tarna sur les 146 échantillons étudiés, 35% ont eu leur floraison entre 40 et 60 jours, 41% entre 60 et 80 jours et 24% au delà de 80 jours après le semis.

Les gousses: Sur pédoncule floral on peut avoir 2 à 4 gousses dont les dimensions selon les cultivars varient de 11 à 18 cm pour la longueur et de 7 à 10 mm pour la largeur.

Elles sont le plus souvent pendantes ou dressées, de forme recourbée quelquefois rectiligne rarement spiralée ou enroulée. Au stade immature elles ont une couleur verte avec ou sans bout pourpre, ou violette ou rouge; et à maturité prennent une teinture jaune-paille avec quelquefois une moucheture, ou rouge, ou violacée, ou brune.

Chaque gousse peut avoir de 10 à 15 alvéoles pouvant loger des graines.

Les graines: Les graines présentent une grande variabilité du point de vue taille, forme, couleur, nature et épaisseur du tégument, coloration et type d'oeil. La plupart des écotypes locaux ont des graines de taille moyenne à grosse, de 9 à 11 mm long, réiniforme ou globuleuse, moyennement épaisse à plate. Les graines ridées sont destinées à l'alimentation humaine et les lisses au bétail. Toutefois certaines graines lisses sont largement consomées par les populations.

Les graines sont généralement de couleur blanche uniforme, brune claire ou brune foncée, gris-cendrée, violette, marron, verte, blanche avec une moucheture noire ou brune, blanche avec des stries noires ou brunes, noire uniforme ou rouge uniforme. Les graines ridées sont d'un fond généralement blanc et les lisses marrons ou noires. Quant à l'aire pigmentée se trouvant autour du hile, le noir et le brun dominent mais le violet et le rouge se rencontrent également.

Les types d'oeil courants sont le type petit oeil et le type Kabba, toutefois les types Holstein, les types Watson et les types autocolorés existent également.

Conclusion

Le germoplasme ainsi constitué sert de matériel de base pour le programme de sélection orientée essentiellement sur la recherche de variétés à rendement stable et réputée aussi bien en culture pure qu'en association avec le mil, à bonne adaptation aux différentes zones écologiques et à gout acceptable.

Le nombre d'échantillons (390) collectés et la variabilité génétique observée, en particulier pour le cycle, les caractéristiques des gousses et de graines, la présence de plusieurs formes cultivées, de formes sauvages et de formes introgressives dans le germoplasme local font penser que le Sud de la partie centrale du Niger est inclus dans le centre d'origine défini par Saunders (1959, 1960) puis par Faris (1963).

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SUMMARY

The Institut National de Recherches Agronomiques du Niger (INRAN) has emphasized the collection and evaluation of cowpea (Vigna unguiculata) due to loss of local cultivars and to drought and the introduction of improved cultivars. From 1978 to 1980 a total of 390 samples was collected at 115 sites. Preliminary evaluation of the collection shows a large variability in leaves, stems, flower colour, pods and seeds in addition to yield and maturity time.

RESUMEN

El Instituto Nacional de Investigaciones Agronómicas del Níger (INRAN) ha concedido gran importancia a la recolección y evaluación del caupí (Vigna uguiculata), debido a la pérdida de cultivares locales a la sequía y a la introducción de cultivares mejorados. Entre 1978 y 1980 se recogió un total de 390 muestras en 115 lugares. La evaluación preliminar de la colección pone de manifiesto una elevada variabilidad en las hojas, los tallos, el color de las flores, las vainas y las semillas y además, en el rendimiento y la fecha de maduración.

GOSSYPIUM SURVEY: COLLECTING IN PERU (III)

G.Ano[1/] and J. Schwendiman[2/]

Since 1980, a multi-phase collecting mission for sub-spontaneous cotton has been supported by the IBPGR in association with the Institut de Recherches du Coton et Textiles Exotiques (IRCT), France. These two reports deal with collecting in Peru (October 1981) and Mexico (February-March 1982) and are followed by comments by the authors on the survival of sub-spontaneous cotton. Previous reports in this series appeared in Newsletter No. 54.

The entire coastal area of Peru is desert-like except for the valleys of rivers. Pumping permits the cultivation of irrigated crops, particularly rice, sugarcane and cotton. To the east the foothills of the Andes rise rapidly to high altitudes where temperatures are too low for cotton cultivation. The eastern slope descends abruptly to the hot and humid Amazonian basin where natural conditions would seem well suited to cotton; but cultivation is precluded by an almost total absence of roads. The geographical configuration, therefore, considerably limits the ecological areas favourable for cotton culture and consequently also the regions for sub-spontaneous cotton plants.

No spontaneous Gossypium hirsutum species, except that which was introduced and grown on an industrial scale, was observed. In Colombia the southernmost sample of G. hirsutum race "Marie-Galante" (A.S. 00413) found by the authors originated from south of Cali. It seems therefore reasonable to conclude that on the Pacific Coast, the south of Colombia represents the maximum extension of this species.

Samples of G. barbadense collected in home gardens along the coast do not display remarkable phenotypical variability; it is less prevalent than in samples originating from French Guiana, for example. No authocyanin pigmentation is found on leaves or stems and seeds are always free and naked. An outstanding characteristic is the chocolate-brown fibre which is locally called "pardo" cotton. A cotton called "aspero" shows much less intense coloration and might be a hybrid resulting from the cross between white and pardo fibre. The pardo fibre seems to exist only in Peru; it is considered to be similar to the fibre of samples found in archaelogical excavations in Huaco Prieta and Ica.

In the Iquitos region (upper Amazonian Basin) a large quantity of cotton plants was found despite limited access. Large variability (red-green plants, khaki fibre, kidney seeds, etc.) was also found. Stephens notes that the Andean Cordillera represents an almost impassable natural barrier for a species like cotton. He bases this theory on comparative morphological observations of current G. barbadense cottons between an Ecuadorian type (broad, often pubescent leaf, small rounded capsule, free seeds, small bracts with fine teeth, short staminal column, etc.) and an Amazonian type (having inverse characteristics).

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Such a clear distinction was not found during the present mission but the theory may well serve to explain the area (or areas) of origin or domestication of G. barbardense cotton.

Several researchers have previously noted the presence of "wild" cotton in the region of Tumbes which is very similar to G. barbadense var. darwinii found in the Galapagos Islands. In 1966 Stephens and Phillips visited the Peruvian site. A few kilometres south of the town of Aguas Verdes scattered plants were found; they spread over no more than 1 km along the trail and apparently did not penetrate the bush vegetation. Boll and seed characteristics (small and hard with a brownish and sparse fibre) were similar to that found in Ecuador and bear no resemblance to cultivars growing in adjacent fields which have big bolls and white fibre. A future mission by the authors to Ecuador may determine if these plants still survive.

Stephens and Phillips continued their search 20 km south of Tumbes but with no result; they concluded that it was not possible to locate a population of "wild" cotton plants comparable to the population found in the region of Playas in Ecuador. Since then, thanks to new trails in the hills, the authors precisely located two new areas of limited size, one about 10 km south of Matapalo (called La Guarita del Corral) the other 10 km west of Cabo Inga (Fig. 1). The latter area is of interest because, firstly it is situated in a region practically devoid of human population, and secondly it is 70 km to the south-southeast of Zarumilla and Aguas Verdes. Other sites may exist and this may not be the southern limit for "wild" G. barbadense cotton. A future search will be made on the Ecuadorian slope.

What do these "wild" forms represent in the evolution or domestication of G. barbadense cotton? Stephens and Moseley (1973) analyzed the remains of cotton plants (capsules, seeds and fibres) found in archaelogical sites near Ancon (50 km north of Lima). These possessed characteristics which seem intermediary between the so-called "wild" forms and the cultivars presently grown; thus it may follow that a domestication process took place that resulted in the Ecuadorian type cotton. This cotton formerly grew along the valleys of the Chamaya and Maranon rivers and later on they probably spread to the Amazonian basin and adapted to ecological conditions there. Unfortunately, in the Upper Maranon the cotton plants growing at the present time do not show an intermediary aspect (or transitional aspect) between Ecuadorian and Amazonian types. Moreover, many anthropological data indicate that the Amazonian basin is probably the centre from which South American cultivated cotton is derived.

It may be reasonably assumed therefore, that cotton east of the Andes was domesticated independently of that of the Pacific coast. Stephens recommends that collecting be done in the Upper Maranon and neighbouring rivers to provide information about the origin of the Ecuadorian types. A possible wild ancestor of the Amazonian type is a plant with very small bolls and seeds which originated in Bolivia between the eastern slopes of the Andes and the Mamore River.

COLLECTING IN MEXICO (IV)

A collecting mission for Gossypium spp. took place in Mexico during February-March 1982. There was adequate time to collect seed-cotton, especially in the regions south and east of Mexico City; however, due to the dry season, most plants were without leaves and flowers, making it difficult to identify precisely the species. In areas where thousands of plants subsist, samples were chosen which displayed differences in some morphological characters. Half of the seed-cotton was deposited at the Iguala station to be included in the Mexican germplasm collection.

The following samples were collected: [AS 00601 to AS 00675 (75 samples, 2 lost at replanting)]: G. hirsutum race palmeri (8), G. hirsutum race morrillii (2), G. hirsutum race punctatum (39), G. hirsutum race yucatanense (13), G. hirsutum race latifolium (3), G. hirsutum race richmondi (6) and G. barbadense var. brasiliense (2).

Although it is difficult to compare with results obtained from previous prospecting missions in Mexico (especially during 1945-50 by Richmond and Manning; Stephens, Manning and Ware), it is nevertheless obvious that cotton plants growing in home gardens or along roadsides are only relics of populations which were formerly more abundant. This represents a decrease in cotton-growing at the family level resulting from less fibre utilization. Most plants were not harvested in spite of complete boll opening. In remote areas, e.g. around Salina Cruz, people grow cotton and weave cloth.

Plant populations were found to be extremely variable. Cotton grows abundantly in some places (near Acapulco, around Salina Cruz and Tizimin, along the Campeche Gulf between Champoton and Ciudad del Carmen). On the other hand, the Chiapas Central depression which was intensively surveyed at the beginning of this century now appears devoid of spontaneous cottons.

The different races of G. hirsutum correspond to separate geographic areas which overlap only partially, if at all. Small morphological inter-racial differences make it difficult to assign specimens to particular races. This was especially true for morrillii, palmeri, richmondi and even latifolium races; however, since their place of origin is known, identification was made easier.

G. hirsutum race yucatense grew without any natural interruption from the Rio Lagartos area to the neighbourhood of Sisal (about 200 km). Primitive cotton is a natural element of the vegetation and thousands of plants grow along the new coastal road which connects Dzilam de Bravo to Sisal. They survive even in new coconut plantations where there has likely been extensive alteration of soil and vegetation. Stephens (1973) noted that primitive cottons are generally represented by small and distinct populations but the northern coast of Yucatan appears to be an exception, perhaps the only one. Certain related forms (sparsely distributed) grow in the Dominican Republic, St. Kitts, Antigua, Guadeloupe and Venezuela (Ano and Schwendiman, 1982), and also in the Tamaulipas State of Mexico, on Socorro Island and near Todos Santos.

Phenotypically, plants from northern Yucatan show unusual variation. Some plants were in the vegetative stage without flowers and bolls while others were in complete fructification; this may be due to a differential photoperiod. Also displaying variability were the canopies of plants, petal colour and size, petal spot, pollen colour, and size and shape of the bracts with numerous teeth of variable length. The bolls were small and rounded but sometimes of pyramidal shape. The fibre was short (10 to 15 mm) and light or dark brown in colour.

Hutchinson (1951) wrote that "(race) yucatanense fits naturally into the sequence as a specialized derivative of (race) punctatum, adapted to an exacting ecological situation". It is true that "yucatanense is obviously related to the variable commensal punctatum of Yucatan", but contrary to Hutchinson, the authors believe that it is a primitive type from which punctatum is derived. It should be emphasized that the punctatum types with brownish fibre have been found near the yucatanense area only.

Well-known sites having wild diploid species such as G. aridum, G. trilobum and G. gossypioïdes were also visited. At the Iguala station seeds of G. laxum and G.

lobatum were obtained. Seven new locations, not previously described, contained a wild species which appeared, after growing in the glasshouse, to belong to G. aridum. Five of these new sites are located in the Salina Cruz area (Gulf of Tehuantepec) and this considerably extends the previously known area of dispersion of G. aridum.

Attention must be drawn to some points concerning wild species:

- the extension of a species as shown on a map often does not accurately represent its extension in the country, as the sites are generally scattered over a large area;
- the density of plant population at each site is highly variable, from no more than twenty plants to several hundred.
- due to the mountainous configuration of Mexico, there are large areas which lack roads or trails. Their future development will surely permit the discovery of other wild species locations or even new species.

PRESENT SURVIVAL OF SUB-SPONTANEOUS COTTON

From observations made by the authors in the West Indies and in certain Latin American countries (Ano and Schwendiman, 1980, 1981 and 1982), it is quite surprising to find today archaic types of cultivated cottons. Why do such plants still survive?

Cultivation on a family scale (as opposed to industrial growing), has diminished in importance although many specimens survive in home gardens or as escapes along roadsides. These plants were once more abundant when native people traditionally grew perennial cotton which was regenerated either by seed or by allowing new plantlets to grow spontaneously. This may explain in certain cases the fact that types considered to be primitive are still present today. Nevertheless, plants found in a certain site may not actually correspond to their "area of origin" as in the course of the numerous conversations with local people it became clear that seed exchanges frequently occurred.

While industrial utilization of the fibre is important, other criteria may be used. In addition to such qualities as length, fineness and strength, the natural brown, khaki or reddish coloration may be used to obtain patterns in weaving. Another criterion is the facility with which lint can be removed from the seed by hand, which may partly explain the wide dispersal of the G. barbadense var. brasiliense.

The fibre is also used for making hammocks, fishing nets, wicks for oil lamps and, where no weaving tradition exists, pillows and mattresses. Cotton is also used for other purposes; seeds are used as an emergency food in India and by the Bahia Indians of Brazil. The leaves and roots have been used for medicinal reasons.

These examples of the multiple uses of cotton by native people explain, at least partly, their current wide dispersal and also their survival. If only utilized for fibre it is possible that many sub-spontaneous types would have already disappeared in favour of more modern cultivars. Cotton is still a traditional element of home gardens, even if no longer used; it may also be grown simply as an ornamental.

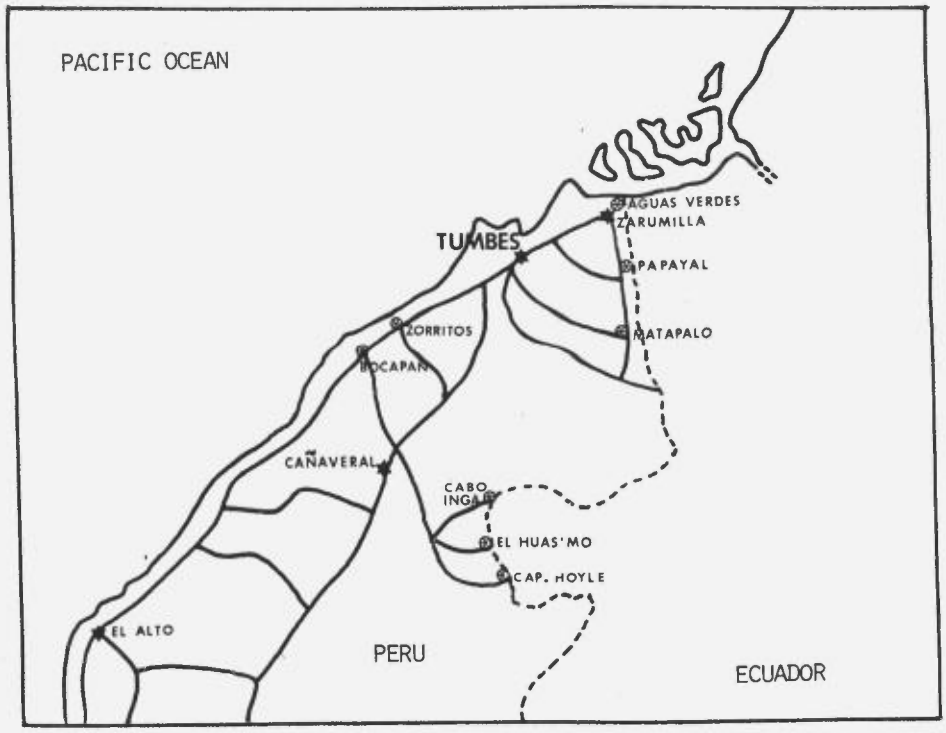

Fig. 1. Location of "wild" Gossypium barbadense plants in Peru

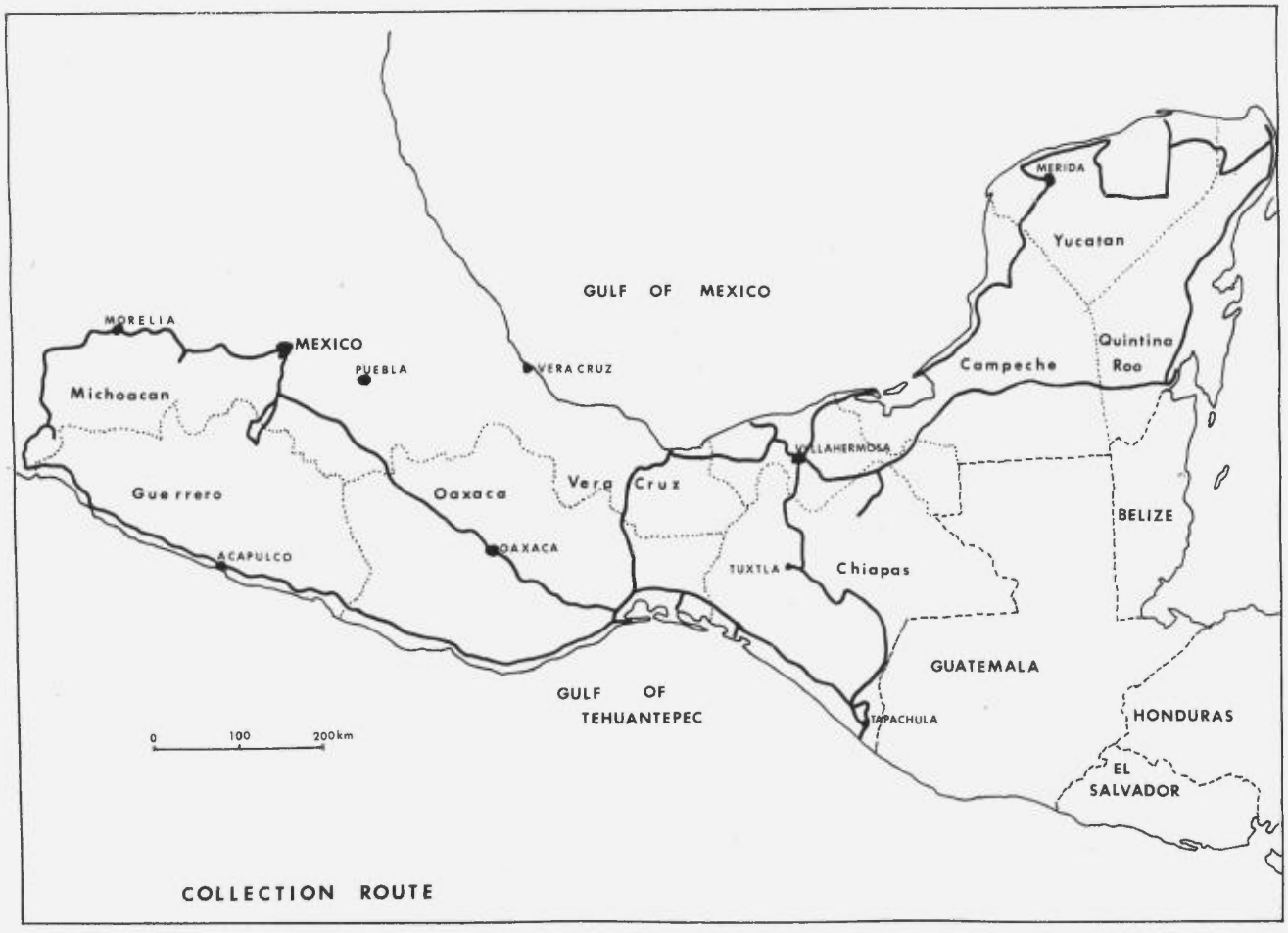

Fig. 2. Collection route in Mexico

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RESUME

Ces dernières années, le CIRP a organisé avec le concours de l'Institut français de recherches du coton et textiles exotiques (IRCT) une mission en plusieurs phases pour récolter des spécimens de cotonniers subspontanés. Les spécimens récoltés à l'intérieur du Pérou lors d'une mission effectuée en octobre 1981 variaient du point de vue de la couleur, de la fibre et de la forme des graines; lors d'une autre mission conduite dans le sud du Mexique en février-mars 1982, des échantillons de Gossypium hirsutum ont été récoltés et la gamme des G. hirsutum de la race du Yucatan a été passée en revue.

RESUMEN

En los últimos años se ha llevado a cabo en varias fases una misión de recolección de algodón subespontáneo con apoyo de CIRF y en asociación con el Instituto Francès de Investigación del Algodón y las Fibras Textiles Exóticas (IRCT). En una misión en el interior del Perú en octubre de 1981 las muestras recogidas mostraron variabilidad en el color, la fibra y la forma de la semilla; en otra misión en el sur de México, en febrero-marzo de 1982, se recogieron muestras de Gossypium hirsutum y se examinó el área de distribucción de G. hirsutum raza yucatanense.

COLECTAS DE LYCOPERSICON Y CAPSICUM EN MEXICO

G. Palomares[1/], J. Costa[2/], J. Cuartero[3/] y F. Nuez[1/]

Durante el mes de julio de 1982 una misión española formada por investigadores de la Universidad Politécnica de Valencia (UPV), Consejo Superior de Investigaciones Científicas (CSIC) e Instituto Nacional de Investigaciones Agrarias (INIA), a través de un convenio de colaboración con el INIA mexicano, realizó colectas en México de cultivares criollos de Lycopersicon esculentum y Capsicum annuum y materiales espontáneos relacionados.

El equipo estuvo formado por el Dr. F. Nuez (UPV), Dra. G. Palomares (UPV), Dr. J. Cuartero (CSIC) e Ing. J. Costa (INIA), por parte española, y por los Ingenieros J. Medina y Reyna (Zona Henequenera), A. Morales (Campeche), D. Guerrero (Valles Centrales Oaxaca), S. Poot (Costa Oaxaqueña), V. Zamudio (Centro Agrícola Experimental de Tecamachalco), A. de la Garza (Centro Agrícola Experimental de Tecamachalco), A. de la Garza (Centro Agrícola Experimental de Tantoyuca), A. Díaz y A. Terán (Centro Agrícola de Huichihuayan), E. Retes (Valle del Fuerte), G. Chaves (Valle de Culiacán) y C. Sandoval (Santiago Ixcuintla), por parte mexicana. Deseamos hacer constar el agradecimiento al apoyo institucional del INIA mexicano y, en particular, a los doctores F. Cárdenas, E. Rendon y J.A. Laborde, sin cuya ayuda no se hubiesen podido efectuar las colectas.

Zonas muestreadas

En Fig. 1 se indican las zonas exploradas correspondiendo a : I. Mérida (Yucatán); II. Valladolid (Yucatán); III. Campeche; IV. Quintana Roo; V. Oaxaca y Región de los Valles Centrales; VI. Región Costera de Oaxaca; VII. Sierra Norte de Puebla (Sierra Madre Oriental); VIII. Llanura Costera del Golfo de México; IX. Sierras de Jalpan y Zimapan (Sierra Madre Oriental) y X. Llanura Costera del Pacifico Norte.

Las cuatro primeras zonas, incluidas en la Península del Yucatán, presentan una altitud escasamente superior al nivel del mar. La mayoría de las colectas realizadas en Mérida y Valladolid se efectuaron en milpas de hortalizas constituídas sobre suelos de bagazo de henequén. En estas condiciones prácticamente no existe suelo vegetal, estando el estrato de caliza sedimentaria en superficie. En las zonas de Campeche y Quintana Roo, de mayor pluviometría que en el Norte de Yucatán, se dedica al cultivo de hortalizas una superficie bastante reducida, de ahí que disminuyera el número de colectas obtenidas.

La región de Oaxaca, en general montañosa y con baja fertilidad de sus suelos, contrasta con la Región de los Valles Centrales, más fértiles y productivos. Sin embargo, en ambas, el cultivo se realiza bajo condiciones de temporal. Junto al Pacífico la región Costera de Oaxaca muestra una vegetación subtropical exuberante. En la zona VII, Sierra Norte de Puebla (Sierra Madre Oriental) se muestrearon localidades de altitud

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superior a los 1,000 m; zona montañosa, donde los bosques de coníferas del borde del altiplano dan paso a una vegetación subtropical, alcanzando la pluviometría del orden de 4,000 mm. En la Llanura Costera del Golfo de México, dedicada en gran parte a pastizales para ganado vacuno, únicamente pudieron recolectarse muestras en las zonas lindantes con las estribaciones de la Sierra Madre Oriental. Las sierras de Jalpan y Zimapan se encuentran entre los estados de San Luis de Potosí, Guanajuato, Querétaro., Hidalgo y Veracruz; se ascendió desde los 200 m de altitud hasta alturas próximas a 3,000 m, mostrándose en este ascenso todo un gradiente de vegetación. Tanto en esta última zona como en la correspondiente a Sierra Norte de Puebla (VII) abundaban las formas de L. esculentum var. cerasiforme. Y por último se hicieron colectas en los estados de Sinaloa y Nayarit (X), zonas comprendidas entre el océano Pacífico y la Sierra Madre Oriental. Se trata de tierras muy bajas, de pastizal, con nivel freático muy próximo a la superficie y que quedan en gran parte inundadas en la estación de las lluvias. También en esta área de L. esculentum var. cerasiforme.

Colectas realizadas

En la tabla 1 se indica el número de muestras realizadas en las distintas zonas.

Tipos varietales de Lycopersicon esculentum

Considerando características de la planta y sobre todo de los frutos, se han agrupado las muestras en los siguientes tipos varietales:

L. esculentum var. cerasiforme (fruto rojo): Frutos de tamaño cereza, entre 1-2 cm. Ø, de color rojo, piel en general amarilla, redondos, lisos, 2 lóculos, sólo excepcionalmente, 3 lóculos, carne delgada, sin oquedades, sin cicatriz pistilar. Tipo de crecimiento indeterminado, pubescencia del tallo media o débil, hoja pinnada, inflorescencia unípara. Se ha observado bastante variabilidad en el color del fruto, presencia de hombros y dureza de las carne. En muy contados casos se ha observado piel del fruto blanca. Algunas formas del Norte de Sinaloa se han recogido en suelos de aluvión que mostraban eflorescencias salinas, por lo que pudieran ser altamente resistentes a la salinidad. Este tipo de tomate no se siembra en el país, pero se recolecta y consume ampliamente en forma de salsas, recibiendo distintos nombres, según comarca: "cuatomate" o "tomate milpero" en la Sierra Norte de Puebla, "tomate chico" en la Llanura del Golfo de México, "coyol" y "coyolito" en las Sierras de Jalpan y Zimapan y "tomatillo" en el estado de Sinaloa.

L. esculentum var. cerasiforme (fruto amarillo): Todas las características varietales son similares a las del tipo anterior, diferenciándose exclusivamente por el color del fruto que aquí es amarillo dorado. Se le conoce con el nombre de "tomatillo" o "tomate chico".

Otros tipos de L. esculentum recolectados fueron: Coyol ciruela, Zocato, Manzano o macizo, Criollo de Oaxaca, Manzano chico, Molpec, Tomate riñón, Ojo venado, Comala, Guaco, Tomate indio, Guajito o Tuchito.

Se recolectaron también algunas formas que no encajan en los tipos anteriormente descritos y que van desde formas similares a la var. cerasiforme de fruto rojo pero con fuerte acostillado, a tipos criollos similares a la variedad Roma. Algunas de estas formas pueden también derivar de alguna variedad moderna.

Puede encontrarse cómo algunos tipos se encuentran en áreas muy localizadas. Este es el caso de los tipos "comala" y "guaco" en la Llanura del Pacífico Norte, o del "ojo de venado" en la Costa de Oaxaca. Sin embargo, existen tipos que pueden presentarse en varias áreas distintas. En este sentido parece existir una mayor relación entre el Yucatán con Oaxaca, estando más aisladas las otras zonas muestreadas.

Cuadro I

Número de colectas obtenidas

Zonas	L. esculentum	L. esculentum var. cerasiforme	C. annuum	C. chinense
Mérida (Yucatán)	26	2	10	2
Valladolid (Yucatán)	11			
Campeche	6	1	7	
Quintana Roo	8		5	1
Oaxaca y Región de los Valles Centrales	21		11	
Región Costera de Oaxaca	12	1	1	
Sierra Norte de Puebla	6	5	3	
Llanura Costera del Golfo de México	2	6 (1*)	2	
Sierra de Jalpan y Zimatlan	1	6		
Llanura Costera del Pacífico Norte	11	12 (2*)		
Total	104	33 (3*)	39	3

* Se indica el número de colectas de Lycopersicon esculentum var. cerasiforme de fruto amarillo. Las restantes tienen el fruto rojo.

Tipos varietales de Capsicum

Se recogieron únicamente dos especies bien definidas: C. chinense y C. annum.

Dentro de C. chinense se han obtenido dos tipos varietales: Habanero rojo y Habanero naranja. Ambos presentan frutos de forma oblonga, encontrándose éstos en número de 3-4 por axila que es característico de la especie. Se diferencian exclusivamente por el color.

La mayor cantidad de tipos distintos colectados pertenecen, sin embargo, a la especie C. annum. Sobre el terreno se clasificaron los siguientes:

- Piquin, mach o chiltepin y Tusta: ambos son bastante similares en cuanto al pequeño tamaño del fruto, siendo generalmente, de color rojo.

- Xcatic largo y Xcatic corto: estos tipos se diferencian por la longitud y peso del fruto, presentando en ambos casos forma alargada triangular.

- Yatchic y Chile poblano o ancho: existe dentro de esta denominación gran variabilidad. Son de carne gruesa.

- Guajillo: sus frutos son lisos cilíndricos y muy picantes.

- Serranito, Huauchinango y De árbol o cola de rata: por su forma alargada y curva, recibe también el nombre de "pico de pájaro" y por su alta pungencia el de "brana".

- Costeño, Criollo del agua, Tabiche y Pasilla.

También se recolectaron otras formas que no corresponden a los tipos anteriormente descritos y que van desde formas similares a los tipos silvestres de fruto pequeño "piquines" o similares a los cultivares de mayor/peso de fruto, de forma alargada, triangular como los "xcatic" y "yatchich". También se presentan algunos cultivares de frutos grandes que posiblemente, deriven del chile "bucho o poblano".

Erosión genética

Se ha constatado la existencia de erosión genética, más o menos acusada según la zona muestreada por su importancia agrícola e industrial, pues sobre todo los tipos criollos de L. esculentum, están siendo desplazados por variedades mejoradas. Este hecho, confirmado por alguno de los ingenieros mexicanos acompañantes, se pone claramente de manifiesto incluso en zonas de agricultura menos avanzadas como Oaxaca y Yucatán, ya que hace sólo cinco o diez años, podría colectarse tomate criollo en prácticamente todas las localidades del área, y ésto no ocurre en la actualidad.

Conservación y planes futuros

Dentro de los planes de investigación de este grupo de trabajo se encuentra, entre otros, el de caracterizar todas las colectas realizadas. En el presente año, ya se ha iniciado este objetivo, disponiendo de datos, tanto en condiciones de cultivo bajo invernadero de polietileno sin calefacción como en cultivo al aire libre. En el género Lycopersicon se han considerado características vegetativas y características de flores y frutos, pero sobre todo su capacidad de cuajar a bajas temperaturas, resistencia al agrietado y calidad

Fig. 1. Zonas exploradas durante la expediccion

del fruto. En el género Capsicum, se han estudiado, entre otras características, las aptitudes relativas a la deshidratación o facilidad de secado, por su gran importancia en la fabricación de pimentón, así como resistencia a plagas y enfermedades, en especial a Phytophthora capsici Leon, ("tristeza"), Leveillula taurica ("oideo"), TMV ("virus del mosaico del tabaco"), PVY ("virus de la patata") y CMV ("virus del mosaico del pepino").

Se prevee también el mantenimiento de semillas de las muestras obtenidas.

SUMMARY

A project of cooperation between Spanish research organizations and INIA, Mexico, has collected 104 creole cultivars of tomato (Lycopersicon esculentum) and 34 forms of L. esculentum var. cerasiforme (including forms of golden type) and 42 creole cultivars and spontaneous forms of Capsicum annuum and chinense in Mexico.

RESUME

Un projet en collaboration entre des instituions de recherche espagnoles et l'INIA a permis de collecter au Mexique 104 variétés locales de tomate (Lycopersicon esculentum) et 34 formes de L. esculentum var. cerasiforme (y compris des formes dorées) et 42 variétés locales et formes spontanées de Capsicum annuum et chinense.

CULTIVATED AND WILD SPECIES OF RICE COLLECTED IN GUINEA

G. Bezancon [1/], A. de Kochko [1/] and Koffi Goli [2/]

Collecting rices in Guinea has become important for three principal reasons:

- in 1956 R. Porteres described the Guinean ridge (Macenta area) as a secondary segregating centre for the African cultivated species (Oryza glaberrima);
- rice culture is found everywhere in the country and the ecological diversity has led to a great variation in cultivation of the two species, O. glaberrima and O. sativa;
- the wild species related to O. glaberrima are also found in Guinea.

The first collecting mission was carried out from 15 November to 30 December 1979 by G. Bezancon, Koffi Goli, Mamady Camara and Mamadou Diallo from the Guinean Ministry of Agriculture. Because of the delay in this first expedition it was decided to organize a second one (from 17 November to 24 December 1982) for the purpose of visiting Upper Guinea and the Fouta Djalon areas. The participants were A. de Kochko, Koffi Goli, R. Balla, Sekou Keita and Bayero Barry from the Guinean Ministry of Agriculture. These two expeditions were sponsored by the IBPGR.

Material collected

Samples of the different species were collected from all regions of the country. The itinerary and the collecting points are shown in Figure 1. Collections were made from farmers' stores and fields. Sampling methods varied according to the species concerned.

Cultivated species - With regard to both pure and mixed varieties, the authors collected seeds in bulk and about 10 individual panicles for each sample (which corresponds to one field). But frequently, when plants had already been harvested, we were obliged to take samples in farmers' stores with the name and characteristics given by the farmers.

O. breviligulata - Panicles could often not be sampled due to shattering, but the seeds were picked up off the ground.

O. longistaminata - when it was possible, seeds were collected in bulk; otherwise only rhizomes or cuttings were taken about every 20 m in the population.

In total, 770 samples were collected, with the following breakdown:

1/ Office de la Recherche Scientifique et Technique Outre-mer (ORSTOM), B.P. V-51, Abidjan, Ivory Coast

2/ Institut des Savannes (IDESSA), C.V., B.P. 635 Bouake, Ivory Coast

573 O. sativa

172 O. glaberrima

7 O. breviligulata (spontaneous form)

9 O. breviligulata (weed form)

9 O. longistaminata

The material collected was divided into two parts: one was deposited at the Ministry of Agriculture in Conakry and the other was introduced in Ivory Coast for evaluation and multiplication. Duplicate samples will be sent for long-term preservation to the International Rice Research Institute (IRRI) in the Philippines, to the West African Rice Development Association (WARDA) in Liberia and the International Institute of Tropical Agriculture (IITA) in Nigeria, the latter two for medium-term preservation.

Physical Geography of Guinea

Guinea is located at the limit of the so-called Guinean sub-equatorial and Sudanian classical tropical climate and at the limit of the moist forest and savannah. Guinea has an exceptionally varied climate and each of the four main areas is unique.

(a) Maritime Guinea: Guinea's coast is seasonally flooded and extends from Sierra Leone in the south to the Gambia in the north. On a coastline 30 to 50 km wide, mud is colonized by mangrove swamps. Huge estuaries and arms of the sea form an important series of meanders, and the tide can penetrate very far inland.

The climate is of a tropical type and is modified by the monsoon. More than 3,000 mm fall in this area and over 4,000 mm in Conakry. The dry woodland areas have been highly degraded by man and have been converted into tree savannah, and swampy areas in the plains are partly developed into rice fields.

(b) Middle Guinea (the Fouta Djalon): This is a mountainous area; altitude is often above 1,000 m. It consists of mountains and plateaux at different levels. The climate is of a tropical type but it is modified by altitude. The relief and rainfall make the Fouta Djalon a water reservoir for West Africa. The richer soils are those which are accumulated at the foot of scarps. Slopes are often very steep but upland rice is grown on them.

(c) Upper Guinea (the valleys of the large rivers): This area is a vast plateau. Elevations are about 400 m. The large rivers such as Niger, Milo and Tinkisso are deeply incised in this plateau (15-20 m). The valleys so formed have a "step relief" and are progressively less covered with alluvium from the flood plain to the laterite plateau. Climate is of a classical Guinean type with opposed seasons. Rainfall does not exceed 1,500 mm. Aquatic rice cultivation is developed in the large river plains.

(d) Forest Guinea (the Guinean ridge): This consists of a series of secondary chains, plateaux and valleys. In the forest area the climate is of an equatorial type. Rainfall is abundant (2,700 mm), with two extremes: the higher in September and the lower in June-July. Because of the climate, the Guinea forest area has extremely good agricultural potential. The rain forest predominates but is being cleared for upland rice cultivation.

Rice Species in Guinea

(a) Cultivated species: Throughout Guinea, two cultivated species, O. glaberrima

ot African origin and O. sativa of Asian origin, are found. Both species are morphologically quite different and have two distinct characteristics: O. glaberrima has a short truncated ligule and erect panicles at maturity while O. sativa has a long sharp ligule and recumbent crooked panicles.

A large number of landraces can be found but there has been a tendency for the African species to disappear in West Africa. However, the authors found it grown rather frequently either in mixed culture with the Asian species or as a pure stand. In this case, the cultivars are highly adapted to well-defined agricultural practices. For example, the Baga-Male variety (floating type) is cultivated almost everywhere in Maritime Guinea despite a great number of introduced cultivars. This cultivar is highly composite and the components can be cultivated as pure stands or partly grouped. According to Porteres (1966) this cultivar would have come from inland a long time ago, when the Baga people were obliged to leave the Fouta Djalon and went to the coast.

Another example is the Gbaye-Gbaye upland cultivar - widely grown in the Guinea forest area. Even when not mixed with other species, several types are often found in the same field; Porteres (1956) called it the "agrarian combination". On the basis of simple characters (lemma colour, glume length, etc.) the farmer gathers different forms having the same physio-ecological requirements. Because of the migrations and exchanges of cultivars between villages and regions, these mixtures are more or less reduced. During the whole prospection we could see that the cultivars "travel" a great deal. For this reason it is often very difficult to identify a cultivar by its local name (a cultivar is renamed when it is introduced in a village or in a region).

(b) Wild species: There are two wild species closely related to the African cultivated species: O. longistaminata and O. breviligulata.

O. longistaminata - This is an allogamous perennial species which reproduces both by seeds and rhizomes. This species is typical of the seasonally flooded African plains. Large populations of O. longistaminata are present in Upper Guinea and some other small populations can be found along the irrigation canals.

Another sample was collected from a small multi-specific population growing in a swamp, where O. longistaminata, O. breviligulata, O. glaberrima and also some plants of O. sativa coexisted. O. longistaminata plants were highly sterile and only a few seeds could be collected.

O. breviligulata - This autogamous annual species is found under a spontaneous form in a well-defined habitat: savannah pools temporarily flooded by rain and run-off waters, plant earliness being determined by pool depth. The authors sampled some populations of this type and others as weeds mixed with the cultivated species in rice fields.

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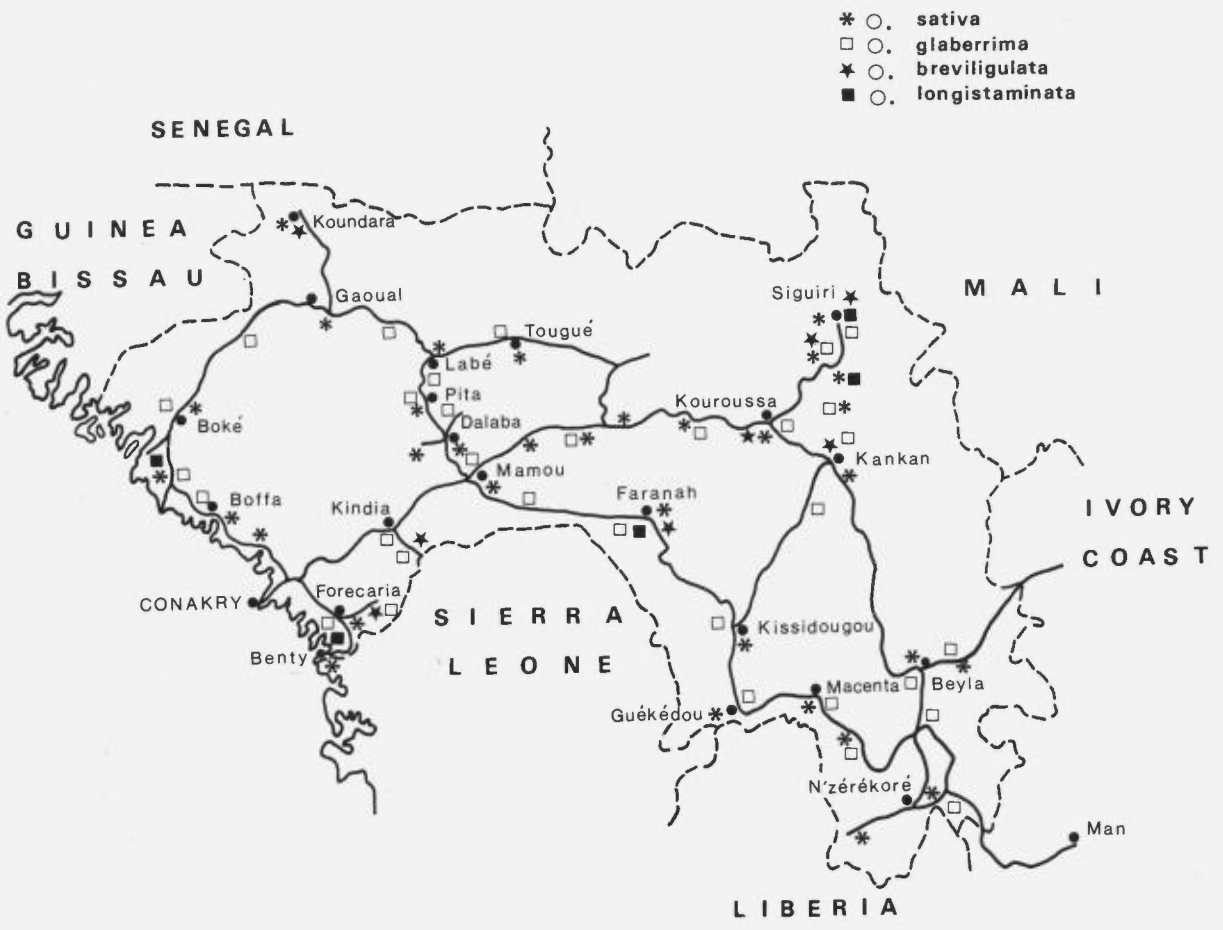

Fig. 1. Collecting points for each species of Oryza in Guinea

RESUME

Une mission de collecte de riz a été organisée en Guinée parce que la zone de Macenta est considérée comme un centre secondaire de l'espèce cultivée africaine (Oryza glaberrima) et parce qu'il existe en Guinée des varietés d'Oryza sativa et des espèces sauvages apparentées à O. glaberrima. Au total, 770 échantillons ont été collectés au cours de cette mission, qui est la deuxième mission de ce type parrainée par le CIRP.

RESUMEN

Se organizó una misión de recolección de arroz en Guinea por tres razones principales: la zona de Macenta se considera como el segundo centro para las especies Oryza glaberrima y O. sativa cultivadas en Africa, y en Guinea se puedem encontrar las especies silvestres afínes a la O. glaberrima. Se tomaron 770 muestras en total, en la segunda de las dos misiones patrocinadas por el CIRF.

PUBLICATIONS

BOOKS AND REPORTS

Forages

McIvor, J.G. & Bray, R.A. (eds.) 1983. Genetic Resources of Forage Plants. CSIRO, Melbourne, Australia. 377 pp. (The Symposium on which this book is based was organized by the Division of Tropical Crops and Pastures, CSIRO. It was co-sponsored by the IBPGR and provides much information; readers interested in the topics and the contributors will find them listed, by permission, below:

Part I - The Problems
The scope for collection and improvement of forage plants. J.R. Harlan.

Part II - The Resources
Tropical legumes. R.J. Williams.
Tropical grasses. W.D. Clayton.
Mediterranean and temperate grasses. R. Knight.
Mediterranean and temperate forage legumes. M.J. Mathison.

PART III - Adaptation
Adaptation to grazing in forage plants. K.C. Hodgkinson and O.B. Williams.
Genetic adaptation in pasture plants. R.J. Clements, M.D. Hayward and D.E. Byth.
Adaptation to short and long-term stress. F.L. Milthorpe.

PART IV - Collection
Theory of forage plant collection. D.R. Marshall and A.H.D. Brown.
Forage plant collection in practice. R. Reid and R.W. Strickland.
Strategies for gene maintenance. R.A. Bray.
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The Editors of the Plant Genetic Resources Newsletter will be pleased to consider reports, notes and news from anyone working with genetic resources. Reports should be limited to approximately 1200 words; the editors reserve the right to edit to meet space limitations.

Please send manuscripts, typed in double space. Relevant photographs would also be greatly appreciated but only high quality black and white prints rather than colour prints or slides. Colour photographs will reproduce, but not without a considerable loss of quality.

The Newsletter will also review salient books, scientific papers and other publications.

All contributions should be sent to the Editors, AGPG, FAO, Via delle Terme di Caracalla, 00100 Rome, Italy.

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M/Q8268/TRI/5.84/1/4500