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

72

IBPGR

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 International Board for Plant Genetic Resources (IBPGR) and the Plant Production and Protection Division of the Food and Agriculture Organization of the United Nations (FAO). 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.

Editor: J.T. Williams

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Cover photograph

The cover photograph was taken by Sir Otto Frankel and shows N.I. Vavilov (on the left), visiting a collection of potato near Leningrad in August 1935. A memoir of Vavilov, written by Sir Otto, starts on p. 1 of this issue.

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PLANT GENETIC RESOURCES NEWSLETTER

No. 72,
December 1987

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Nikolai Ivanovich Vavilov 1887-1943 a memoir

O.H. Frankel [1/]

"For a number of crops the geographic centres of genetic diversity have become clearly identified, with the practical significance of presenting opportunities for exploiting the genetic reservoirs in practical breeding." These, in free translation from the original German, are the words with which Vavilov announced to a world audience the discovery of geographical centres of genetic diversity, at the Fifth International Congress of Genetics of Berlin, 1927, 60 years ago.

In this paper he gave two reasons for his interest in exploring the sources of diversity. He had discovered parallel series of characters in related species of several groups of crop plants, and had called this phenomenon 'the law of homologous series in variation'. This led him to look for 'missing links', and his explorations resulted in the discovery of an unexpected wealth of genetic diversity. He realized that there were great untapped reservoirs of raw materials for an unprecedented effort in plant breeding which would enormously enhance the productivity of his country.

These were his incentives, as set out in many of his publications. However, motivating and directing his endeavour was his passionate drive to identify and explore systems, or general principles. This led to the identification of the 'homologous series', to the discovery and extensive study of the geographical centres of genetic diversity, to the establishment of representative collections as against mission-oriented or novelty collections.

His quest for the general principles in genetic diversity was what he called his 'philosophy'. S.C. Harland recalls that Vavilov used to ask scientists he met "What is your philosophy?" The story goes that he did not care for Professor (later Sir Rowland) Biffen (the discoverer of Mendelian inheritance of disease resistance) because "he had no philosophy".

It was his 'philosophy', expressed in the law of homologous series, which was his undoing at the hands of his adversary, Lysenko. "Variation", Vavilov wrote, "does not take place in all directions,...but in distinct systems and classes analogous to those of crystallography and chemistry". It was easy for Lysenko to show that Vavilov's theory was 'idealist' because evolution and development were preordained by the genetic system rather than resulting from the interaction between organism and environment. In fact, it conformed neither with Darwinism nor with Lysenko's – and official Soviet – dogmatic Lamarckism.

Vavilov's theories failed to make an impact; in the era of neo-Darwinism they were ignored. But his observation on geographic centres of genetic diversity and his achievement in assembling, maintaining and studying large plant collections representing the genetic diversity of crops, attracted great interest and attention. But for many years there were few attempts to follow in the footsteps of the Russian collecting expeditions of the twenties and the thirties. The major exception was the British Empire Collecting Expedition to South America in 1939, led, like many expeditions of later years, by J.G. Hawkes. The inspiration came from the discovery by Vavilov and Bukasov of many until then unknown potato species of great practical importance.

Vavilov's works became widely known. They stimulated plant breeders and geneticists to establish and study collections of their own crops. A.E. Watkins was assembling a collection of wheat at the Cambridge Plant Breeding Institute, and I started one in New Zealand in 1929, based on material I brought from Cambridge. Anxious to learn from the guiding spirit, I visited the Soviet Union in 1935, mainly to meet Vavilov. He was welcoming and most generous with his time and his ideas – I was able to spend nearly all of my 6 or 7 days in Leningrad with him, either at the institute or visiting research stations. He was of middle height, broad-shouldered, very dark, an impressive but not obtrusive personality, unhurried yet very active mentally and physically – one of his constant phrases was "Let's go – life is short." He told me he never slept more than 2 hours; when he dropped me at my hotel late in the evening he usually had an armful of journals to look through during the night.

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Vavilov and Bukasov on the potato collection, near Leningrad, August 1935 (photo by O.H. Frankel)

There are many accounts of Vavilov's endurance and immense working capacity in his expeditions: the record of his collections is still without parallel. Equally astonishing is his literary output and the breadth and depth of his publications, as is evident from the selected writings published in English in Chronica Botarica, 1949-50. Among his books was a broadly based textbook of plant breeding, including a world-wide survey of plant breeding achievements. A list distributed at the XVth International Congress of Genetics, Moscow 1978, contained 578 titles of publications written or inspired by Vavilov.

As director of the Institute of Plant Industry and President of the Lenin Academy of Agricultural Science he had enormous power and influence. Yet his achievement in establishing a network of over 400 research institutes and experiment stations covering the entire Soviet Union is astonishing. He describes previous plant breeding work as unco-ordinated and haphazard. His institutes, located in different climatic regions, were to evaluate the vast collections which were being assembled, and to develop cultivars for the different regions excelling in yield, disease resistance, and quality, based on biochemical characteristics. I find it hard to believe that Vavilov or his institute closely directed such a far-flung empire. At least I saw no evidence of a bureaucratic establishment at his Institute. Rather, it seems he guided the general trends and knew many of the people and provided leadership and inspiration. He generated intense loyalty. Leonid Brezhnew recalled that the curator of the rice collection preserved the stored grain throughout the siege of Leningrad and the terrible famine it caused, though knowing that the vitality of the seed had fatally declined. She and many others died of hunger.

One hundred years after his birth and 45 after his death, Vavilov remains a giant in the field of the genetic diversity of plants used by man. He discovered its amplitude and geographical distribution. He emphasized its connection with the evolution of civilization. He stressed its enormous significance for the continuing survival and welfare of mankind. He amassed large and representative collections and initiated their evaluation and exploitation. He advocated an international co-operative effort in all these activities. That he overstated in some of his generalizations was soon obvious, as in his identification of centres of diversity with centres of the origin of crops. As J.R. Harlan pointed out, Vavilov simply was less interested in the origin than in the diversification of crop plants.

Vavilov is generally regarded as the founder of the scientific approach to genetic resources. It is with gratitude for his founding achievement that Erna Bennet and I dedicated to him the first book on genetic resources in the current era.

N.I. Vavilov the man and his work

J.G. Hawkes [1/]

In this brief paper [2/] I cannot hope to cover all the many facets of Vavilov's interests and specialities, but only to present a brief sketch of the major aspects of his work and personality. Vavilov was probably the most distinguished plant breeder, agro-ecologist and applied geneticist of his generation. I had the privilege of knowing him personally, and was extremely impressed by his scientific and personal qualities, as was everyone else who knew him. I will come back to this later, but first, it will be useful to set out some biographical details.

Nikolai Ivanovich Vavilov was born in Moscow on 26 November (13 November old style), 1887. His father was a cloth merchant, and his brother Serge was a eminent physicist who became President of the Academy of Sciences of the USSR. Of his two sisters, Lidia was a microbiologist who died young and Aleksandra was a physician. Vavilov married Elena Ivanovna Barulina, a research scientist in the Institute of Plant Industry who monographed the wild and cultivated lentils. They had two sons, Oleg and Yuri. Oleg, an outstanding physicist and enthusiastic alpinist, died in an accident whilst climbing in the Caucasus. Yuri was also a physicist and is still living.

Vavilov entered the Petrovsky (later, Timiryazev) Academy of Agricultural Sciences in 1906, presenting his graduation thesis in 1910. After some further studies he was appointed in 1911 as assistant in economic botany at Petersburg (Leningrad) under Regel and Yachevsky, continuing his studies on the immunity of cereals to fungal diseases.

He was then offered a period abroad in 1913, which he spent chiefly in England, where he studied at the John Innes Institute with Bateson and at Cambridge with Punnet and Biffen, thus broadening his knowledge of genetics and plant breeding. He also visited Vilmorin in Paris and Haeckel in Germany.

His MSc degree was taken in the Petrovsky Institute at Moscow, the thesis being 'The Immunity of Plants to Infectious Diseases'.

In 1917 Vavilov was appointed as Professor of Genetics at the University of Saratov and at the Agricultural Institute at Voronezh. He attracted the favourable attention of Lenin and in 1920 returned to Leningrad as the Director of what was to become (in 1930) the All-Union Institute of Plant Industry and which is now named after him as the N.I. Vavilov All-Union Institute of Plant Industry (VIR).

During his 20-year period as Director, up to 1940, Vavilov pioneered new approaches to the breeding, origin and phylogeny of cultivated plants, linking together the disciplines of plant geography, cytology, genetics, taxonomy, biochemistry and archaeology in these studies. He was also a practical breeder and field worker – facts that are often overlooked by the outside world, which generally thinks of him as a theoretician rather than a man devoted to improving agricultural production in the USSR. Perhaps to scientists at large his reputation was based more than anything else on his theories of agricultural origins and plant domestication, together with innovatory ideas on what we now call 'genetic resources'.

What seems to us so obvious today, namely, that in order to breed higher yielding, better adapted and more resistant crop varieties, we should study and use the total genetic diversity of the crops themselves and related wild species. This innovative concept was Vavilov's own, and had previously been barely understood by other breeders.

The idea of studying and using crop plant diversity came into Vavilov's mind quite early in his career, from collecting expeditions when he was still a student. Thus, his first expedition to the North Caucasus and Transcaucasia took place in 1908 when he was 21 years old, and he often returned to this extremely interesting region, where he found the highly resistant wheat species Triticum timopheevii, as well as other primitive species of cereals.

Once having begun to understand the genetic diversity of crops in relatively unknown parts of the USSR as a young man, he continued to travel, explore and collect throughout the rest

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2/ Paper given at a meeting on 26 November, 1987 to celebrate the centenary of the birth of N.I. Vavilov organized by the Linnean Society and the Institute of Archaeology, London

of his working life. Thus in 1916 he collected in northern Iran and the Pamirs, where he studied the cereals, finding amongst other variants ligule-less mutants.

In 1917-21 on various occasions he studied the agriculture and collected samples in southeastern Europe. In 1921 and 1922 he visited the USA and Canada. 1924 saw expeditions to Afghanistan, Bukhara and Kafiristan. In 1925 he was at the Khivin Oasis and Uzbekistan, while in 1926 he visited and collected in many Mediterranean countries. In 1927 Vavilov travelled and collected in Italy, Abyssinia (Ethiopia) and Eritrea, concentrating again on the cereals of those regions. 1929 marked a long visit to Western China, Japan, Korea and Taiwan, whilst in 1930 he was in Mexico and Central America. In 1931 he visited Denmark and Sweden; he then returned in 1932 and 1933 to the New World, making extensive collections in Cuba, Yucatán, Peru, Bolivia, Argentina, Uruguay, Trinidad and Puerto Rico.

These, of course, were his own expeditions, but he promoted others undertaken by his distinguished colleagues, such as Juzepczuk and Bukasov to Mexico and South America, and Zhukovsky to Turkey. The results of these and other expeditions were presented in detailed publications on not only the crops, but weed and wild species, agricultural practices, agro-ecological conditions and the peoples and archaeology of the regions visited. No one had attempted such work before. These publications were in turn followed by detailed monographs on the taxonomy and breeding value of the plants collected, written by Vavilov and his colleagues.

According to Zhukovsky there were at one time some 250,000 collections at Leningrad and at the more than 400 research institutes and experimental stations under his control. This was a gargantuan task for one man but Vavilov was a 'larger than life' personality and as Harland and Darlington (1945) said "wherever he went he took sunshine and courage, approaching his problems in a spirit of youthful inquiry and optimism". His energy was immense since at the Leningrad headquarters and all the subsidiary stations already mentioned he is said to have had a staff of some 20,000 people under his control.

Vavilov's theoretical concepts were for cultivated plants a step or two forward from Darwin and de Candolle. Thus, he believed that the area of the world where the greatest diversity of a crop was found was where it had first been domesticated. Such areas - and he established eight of them - were designated centres of crop origins. In each of such centres he found similar or homologous variation in several crops, developing these observations into what he termed 'The Law of Homologous Series'. We find both these concepts of great use today in our search for pest and disease resistance in related wild species.

Certain criticisms have been directed against Vavilov's Gene Centre theories, and no doubt had he lived longer he would have modified them himself. Be that as it may, Vavilov opened the eyes of the world to the importance of multidisciplinary studies on crop plants, and these have been of immense value to plant breeders.

Vavilov also distinguished primary crops, developed directly from wild species, and secondary crops such as rye and oats, that became cultivated through their ability to become weeds of existing crops, gradually taking over from the original crop as it was moved into areas to which it was less well adapted. These ideas had also been set out by the German geographer Engelbrecht, but without the practical importance that Vavilov brought to them. Mangelsdorf (1953) described Vavilov's contributions as characterized more by breadth of scope, sheer magnitude and grandeur, than by precision. This, however, seems to have been due to the nature of the problems he tackled and to his own enthusiastic nature and expansive personality. Nevertheless, we can hardly fail to be astounded by the creativity of his mind and his breadth of vision.

Perhaps enough has been said of his work for us to formulate an idea of Vavilov as a man. Those who knew him well describe him as a thick-set man of above average height, with a genial personality and an ability to inspire his colleagues with his own knowledge, energy and enthusiasm. He had "a mind that never slept and a body which for its capacity for enduring physical hardships can seldom have been matched", as S.C. Harland described him.

I, myself, was fortunate enough to have known him in 1938, when I visited his Institute to study the potato work of S.M. Bukasov. Vavilov's boundless energy, friendliness and charisma made a lasting impression on me as a raw postgraduate student. In fact, I was treated by him as an equal and deferred to as if I were a learned colleague of his own age. I was invited to lunch or dinner at all three of his houses (at Leningrad, Moscow and the experiment station at Pushkin), taken as a personal guest to the opera, with seats in the front row of the circle, and personally shown round his Institute and research stations, both in Leningrad and Moscow. Here was a man of an open-hearted and engaging personality, of complete intellectual integrity and of sympathetic understanding. A few hours' sleep a night were enough for him. "Life is short - one must hurry" he used to say. What a tragic forecast of the future this was to be.

An ominous shadow grew around him in the mid-thirties, through the critical attacks and slanderous accusations of Prezent, Lysenko and others, which ultimately led to his downfall. At the time of my visit I suggested to Vavilov that

he should fight Lysenko by argument and retaliation. His innocent reply was that Lysenko had some good ideas and should be allowed to develop them.

In 1940 Vavilov was arrested and imprisoned – it was thought in Moscow or Siberia, but later found to be Leningrad. The date of his death has been a matter of some doubt; Pavlovskii (1966) records it as 26 January, 1943, while Leppik (1969) almost coincides, with 6 January, 1943. Pavlovskii's date seems to be more likely than any others.

Let us not end, however, on this tragic note, but remind ourselves that as a scientist Vavilov's reputation still lives, and his influence on the large and important task of genetic resources conservation and use in plant breeding is as strong as ever. Thus S.C. Harland (1954) quotes Vavilov as saying:

> "The Institute of Plant Industry has organized some seventy expeditions to various parts of the world. The objects . . were, briefly, to collect practically every variety of economic plant which might be of use to the USSR, and to study the diversity of varieties of cultivated plants by employing the methods of the taxonomist, cytologist, and biochemist. In understanding this work we have been prompted by the actual needs of plant breeding, which involves some of the most pressing practical problems in our large scale agriculture ... It was necessary to master exhaustively the whole initial varietal potentialities of the world as well as to learn about the nearest wild relatives of our useful plants."

That this activity is still under way, throughout the world in nearly every country, and that geneticists, environmental archaeologists, agronomists, crop plant taxonomists and breeders still benefit from and constantly refer to Vavilov's work and ideas is clear evidence of his genius.

Vavilov received many honours during his lifetime, including the Presidency of the Lenin Academy of Sciences. He was also elected a Foreign Member of the Royal Society in 1942 and a member of the USSR Academy of Sciences. It is fitting that we are able to pay tribute to a great scientist and a great personality, whom not only the USSR but all the world regards with pride and admiration.

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Vavilov's centres of diversity and the conservation of genetic resources [1/]

J.T. Williams [2/]

The centres of diversity which Academician Vavilov described were not discreet but overlapped for a number of crops. They were regions which have concentrations of variation assessed in terms of recognizable botanical varieties and races.

Vavilov attempted to describe, in broad terms, agro-ecotypes based on a compilation of properties. For instance, for cereals and legumes, he considered the main properties to include growing period, rate of development, rate of grain filling during maturation, response to heat and cold, winter hardiness, response to drought, edaphic differences, incidence of diseases, cultivation priorities including harvesting methods; mostly characters not countenanced by taxonomists. In fact, for wheat and flax he used 29 characters. Vavilov recorded data at the collection site and after repeated grow-outs under different conditions. Hence whether or not he wrote about genotype/environment interaction, he opted towards heritable characteristics that characterize the genotype.

It is salient to quote Vavilov's own words "Thus we arrived at an ecological classification of cultivated plants and a differentiation of the species not only according to the usual morphological features, but also according to a complex of properties, which to a considerable extent, includes the physiological and biological characteristics most intimately connected with the conditions of the environment".

Two other factors affected Vavilov's thinking towards the end of his life, the first was the concept of the ecotype. In fact, he was in contact with scientists developing the concept, even some of the early thinking leading to the concept of 'demes'. He was well aware of the work of Turesson and Gregor. He quoted the former's definition of an ecotype as "a group of plants from within a species which share an adaptation to a definite set of climatic conditions or a type of habitat within a certain climatic region". Vavilov's concept of an agro-ecotype thus embodied similar views of botanists. Secondly, his voracious reading had brought him into contact with early work on agricultural ecology and he was in the latter days much influenced by Azzi of Italy.

Yet another factor was inherent to the work of Vavilov, the concept of internationality, in the sense not of man but of utilization of plants. In his words in talking about cross breeding he stressed "the successes of selection on a global scale have been determined to a considerable extent by the international character of the process".

So Vavilov set the scene for the exploration and use of genetic resources, the essential building blocks for plant breeding. To synthesize his achievements in this area he laid down basic agro-ecological principles. When, in the New Systematics in 1940 edited by Huxley, Vavilov described his 95 agro-ecological regions based on large territories characterized by climatic, soil and broad ecogeographical conditions (and described agro-ecological territories which were smaller) the foundation was laid for genetic resources exploration and sampling. Nonetheless this exploration was not to gather momentum until 2 or 3 decades later.

In the early days of genetics it was logical for Vavilov to define his great centres of diversity on the assumption that they are marked by a high frequency of dominant alleles. Controversy arose between centres of origin of crop species and centres of diversity as work accelerated on our knowledge of the origin and evolution of domesticated species which went hand in hand with research on the origins of agriculture. Thus knowledge evolved and resulted in the concept of gene centres. Much of the writings by Darlington on this subject in the 1940s and 1950s are probably still valid. It has become abundantly clear that the genetic resources of much wider areas than those of the primary centres of agriculture following expansion of agriculture and crops to cover vast tracts of the earth, are indeed rich areas for exploration for useful material. These wider areas are not by any means all in developing countries. The European landraces of cereals

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1/ This paper was given at a meeting on 26 November, 1987 to celebrate the centenary of the birth of N.I. Vavilov. The meeting was organized by the Linnean Society and the Institute of Archaeology, London

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have been the basis for most development of wheat and barley varieties for decades.

I need to say a few words about the genetic resources collection and conservation campaign that started in the 1960s. Until that time, breeders, just like Vavilov, could travel to find the primitive forms they required for breeding and great gains were to be made in crossing diverse forms from diverse geographical areas. The much-needed and greatly accelerating modernization of agriculture, resulting in the loss of primitive forms, made scientists recognize and press for collection and conservation. Also, since the materials were to be made available to all who could use them, it was a truly international imperative to establish a programme to salvage the evolutionary products of man's domesticates. These products were the landraces (and other primitive cultivars) which had for long periods been associated with traditional small-scale peasant farming and selection which had not been directed by modern aims and techniques. After many discussions the International Board for Plant Genetic Resources was created in 1974 by the Consultative Group on International Agricultural Research to take on this international task and to see that a global system developed which would husband these resources through collection, conservation and training of scientists and see that the resources are described and used. When I once described this as a daunting task, I never realized how daunting it would be and despite over a decade of work world-wide, much remains to be done.

I would like to summarize in general the achievements, to identify the constraints and point out a few areas of scientific thinking that I feel require re-thought. In other words, to look at the 'philosophy' and ideas so dear to Vavilov's way of thinking.

In the first instance, IBPGR had to establish some priorities. With a trivial annual budget for such a responsible task and with so few programmes available on which to bulid, it had to take a two-pronged attack: one to build up institutional and human resources capabilities and the other to decide what was most urgent on what crops in which areas. Priorities for the latter were firmly based on Vavilovian concepts as modified in the succeeding decades. But in the early 1970s genetic erosion, the loss of the primitive forms, was widespread for only a limited number of crops, such as major cereals in regions like the Mediterranean and Southwest Asia, tree fruits in limited areas of the tropics and a number of industrial crops. Within 5 years of the creation of IBPGR, genetic erosion was becoming severe for food legumes, vegetables and within 10 years for numerous other crop groupings including forages.

In the first decade IBPGR put emphasis on salvaging genetic diversity of important staple crops for two reasons, one because of loss and two because more comprehensive collections were needed for those breeders active in breeding new cultivars to help feed the rural poor. For the first time (except perhaps for potato, maize and rice) where systematic collection had been initiated, and wheat where large collections had been built up without any overt planning, substantial collections became ready-to-hand to breeders.

Looking back on this period, despite urgings by numerous scientists, the new generation of germplasm botanists took off in their vehicles and gathered materials - often without sufficient regard to the ecological principles beloved by Vavilov and others. But it was, in many cases, a race against time, and the work perhaps could not have awaited long and painstaking planning although the data on the collections would have benefited. The newer generation of germplasm botanists around the world needs now to take stock and put more scientific principles into their work.

Additionally, the real threat of genetic erosion was to the landraces and in the 1960s there became a passion for collection and genetic conservation of these landraces largely because they contain unique adaptive complexes. Two points are relevant.

Firstly, it is known that these complexes are usually broken as soon as crossing takes place and so the reason for their conservation in modern sophisticated breeding has become less apparent - although they are of course, vital in less sophisticated work such as plant introduction or forage development. Could it be that the scientific community had become too imbued with the pure ecotype concept as, for instance, in the translated work of Sinskaya, or was it just not thought through?

Secondly, genetic conservation has been based on the population sample and the continued maintenance of the genotypes in the samples, not on the search for plants with rare alleles. This, I believe, has been right but too little attention is given by scientists to the continued maintenance of the former and the literature is extremely sparse with relevant research.

These constraints and areas for re-thought and research have not detracted from the remarkable activities which have resulted from the IBPGR's initiation and stimulation. Here I must pay tribute to the hundreds of scientists who have willingly cooperated and assisted in the rapid establishment of a global network of genetic resources centres. The number of centres has grown from activities in a handful of countries to those in more than 100 countries of the world. Of these, more than half have some form of conservation facility and over the period IBPGR has sought the collaboration of over a third of these to form a security network of base collections for seed crops. So the framework for collection, conservation and exploitation of seed

crop germplasm is well in place, largely because of the goodwill of the scientific community in all parts of the world and not least the International Agricultural Research Centers of the Consultative Group on International Agricultural Research, which collectively still remain the largest plant breeding concern the world has seen.

There are, however, numerous crops which need to be conserved vegetatively. For staple foods they are limited and banana is an example. Most roots such as potato, cassava and sweet potato, even yams if more research is done, can be conserved as seed and only a limited number of clones are needed for long-term genetic conservation. However, there are many tropical species of economic use for which vegetative propagation and medium-term conservation in the vegetative form will be necessary for some time. For all of these, safety will be assured with correct in vitro techniques, especially if tissues and other explants can be cryopreserved.

So far I have talked about crops. Apart from forest species which are receiving attention through the Food and Agriculture Organization, all the other non-crop species, such as medicinal plants, etc., have no international coordinated mechanism to ensure their continued existence except through nature conservation efforts and a few small emerging programmes.

I have ranged in my comments from domesticates to minor economic species and this brings me to the role of wild species related to crops. A whole new era has opened up due to the enhanced importance placed on these species by breeders. Also, these species are under threat in many parts of the world. Hence, IBPGR has charted a new direction to encompass these so that collections available for breeding and research will be as comprehensive and representative as possible. These species are more and more useful as breeders seek for and transfer single genes for particular traits.

However, there is a paradox. Currently most breeders are not fully aware of the fuller use of the landraces in collections. We have to be careful not to skew efforts too far to wild species when other materials can be used and the time taken and problems encountered in breeding might be less.

I have purposely avoided describing in detail the programme of IBPGR because the overall importance and the concepts of genetic conservation override the operational aspects. Nonetheless I am proud, and at the same time humble, in reminiscing on what has been achieved and on how the conceptual framework was laid down. I am, moreover, somewhat intimidated by the responsibility in defining the research which is so urgent to safeguard such a wealth of diversity for the future of mankind. I suspect Nikolai Vavilov would have been less intimidated.

Germination of seeds of different strains of *Cenchrus*

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SUMMARY

The germination of buffelgrass (Cenchrus ciliaris) seeds from Texas, USA, and North Africa, two areas with very different climates, was measured in a total of 55 constant or alternating temperature regimes. The seeds from North Africa showed higher germination than those from Texas, although a cultivar (Nueces) bred in Texas behaved in a rather similar way to the North African material.

INTRODUCTION

Buffelgrass (Cenchrus ciliaris) is a valuable forage species that has been used to improve ranges in many of the warmer parts of the world from southern Africa and India to Australia (Davies and Hutton, 1970). Recently, some collections of buffelgrass seeds which are adapted to a Mediterranean environment, where there is no precipitation during the summer and germination occurs in the autumn under cool temperature conditions, were introduced from North Africa.

According to Le Houérou (1969), buffelgrass is native to parts of North Africa that have mild winters, i.e. central and southern Tunisia, southern Morocco, Libya and northern Egypt. In these areas it grows in various soils that are usually more or less sandy textured and often shallow. The North African forms of buffelgrass are resistant to soil moisture stress, growing naturally in areas having 100-500 mm annual precipitation. This falls during the winter and is highly variable in amount and distribution. The North African populations of buffelgrass are sensitive to temperatures below 0°C and do not often occur above 600 m elevation or further than 200-300 km from the coast.

The distribution of buffelgrass in North Africa is probably greatly restricted by excessive grazing. Negre (1962) listed buffelgrass as an important forage plant of the central coastal plains of Morocco. Although it is now often restricted to national parks and forest reserves, buffelgrass was considered one of the two most important forage species in North Africa by Villas (1963).

Lahiri and Kharbanda (1963) thought water-soluble germination inhibitors were located in the spikelets of buffelgrass. Le Houérou (1979) reported that the germination of North African strains of buffelgrass was poor, but if the lemmas and paleas were removed, the seeds germinated readily.

Anderson (1974) enhanced the germination of seeds of the cultivar Biloela of buffelgrass by prescaking them before sowing. Standards of the Association of Official Seed Analysis of the United States specify incubation at 30°C in the light and with seeds pressed into well-packed soil (Anon., 1970). Before incubation, the seeds should be pre-chilled at 5°C for 7 days.

The aim of the present work was to compare the germination of seeds of buffelgrass of northern African origin and sources of seed currently in use in North America in relation to a broad range of constant and alternating temperatures. Such comparisons will provide plant breeders with an estimate of the potential for selection for plants that can germinate at low seedbed temperature.

METHODS

In all experiments, 4 replications of 25 seeds each were used. Seeds were placed on top of one thickness of standard germination paper in petri dishes. The seeds were kept damp with tap water. Seeds were considered germinated when the radicle was 0.5 cm long. Germinated seeds were counted at 1, 2 and 4 weeks. The seeds were incubated in dark germinators. To avoid germination inhibitors, seeds were threshed from their lemmas and paleas and testing delayed for at least 6 months after harvest (E.C. Bashaw, ARS/USDA, College Station, Texas, pers. comm.).

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Seeds were incubated at constant 0, 2, 5, 10, 15, 20, 25, 30, 35 and 40°C. In addition, each constant temperature was alternated with all possible higher temperatures. For example, 0°C was alternated with 2, 5, 10, 15, 20, 25, 30, 35 and 40°C, while 35°C was alternated with 40°C only. The alternating temperature regimes consisted of 16 h at the lower and 8 h at the higher temperature in each 24-h period.

Seeds of two collections of buffelgrass from Tunisia collected in the summer of 1980 were tested in 1982. Accession T-137 was collected at El-Grine (latitude 35°41'N, longitude 9°53'E) about 100 km inland from the Mediterranean coast of Tunisia at 100 m elevation where the annual precipitation averaged 300 mm. Accession T-151 was collected in the coastal area of southern Tunisia near Sekhira (latitude 34°16'N, longitude 10°31'E). The elevation of this collection site was 25 m and the average annual precipitation was 150 mm. Precipitation at both sites occurs primarily in the winter.

Seeds of accession T-4464, which is known as common buffelgrass, were collected in Texas; this accession originated in southern Africa in an area of summer dominant rainfall. In 1982, two seedlots of accession T-4464 produced in southern Texas were tested. Most of the seeds in the first lot were dead, so the results reported were from the second lot of seeds harvested in the summer of 1981. The cultivar Nueces was developed for improved tolerance to cold and drought, and is adapted to the summer rainfall zone of southern Texas.

The effects of constant and alternating temperatures on percentage germination were statistically analyzed using a quadratic response surface. This surface was developed for each cultivar or accession using multiple regression techniques. Estimated germination values and their confidence limits were derived from the surface for each species for each cold period (16 h) temperature through the series of warm period (8 h) temperatures. Calculated regression lines with confidence limits were compared with actual data of seed germination for the sources tested (Evans et al., 1982).

Table 1. Germination parameters synthesized from quadratic response surfaces for germination at 55 constant or alternating temperatures for accessions or cultivars of buffelgrass from winter (Tunisian) or summer (Texas) rainfall areas

Means for profile germination followed by the same letter are not significantly different at the 0.01 level of probability as determined by Duncan's multiple range test

Germination parameter	Accession or cultivar (% germination)			
	Tunisian winter rainfall		Texas summer rainfall	
	T-151	T-137	T-4464	Nueces
Mean germination	81a	71b	25c	75b
Regimes with some germination	96	95	93	95
Mean germination of temperature regimes with some germination	84	75	27	79
Mean of optima	98	93	37	95
Regimes with optimum germination	60	35	31	45
Maximum germination	100	99	40	99
Coefficient of determination	84	79	60	84
Germination percentiles				
< 10	5	7	16	9
10-25	4	5	24	2
26-50	5	7	60	7
51-75	9	13	0	13
76-90	15	27	0	22
> 90	62	35	0	47
Germination class	Good	Very	Very good	High low

RESULTS AND DISCUSSION

Seeds of the two Tunisian accessions and the cultivar Nueces of buffelgrass had high germination with average germination for the 55 temperature regimes from 71 to 81% (Table 1), and maximum germination of 99% or 100%. Only seeds of the accession T-4464 had low germination.

Seeds of all of the material tested had some germination at more than 90% of the temperature regimes tested (Table 1). There was no sudden threshold temperature that inhibited germination until very cold (0-5°C) temperatures were reached. Accessions T-151, T-137 and Nueces had less than 10% germination at 5-9% of the temperature regimes. These accessions and Nueces had less than 25% germination at 9-12% of the temperature regimes and germination less than 50% at only 14-19% of the regimes. In contrast, 26-50% of the regimes tested supported greater than 50% germination for accession T-4464.

Germination of accession T-151 from Tunisia was greater than 90% for 62% of the temperature regimes (Table 1). The germination of Nueces and accession T-137 was greater than 90% with 47% and 35% respectively of the temperature regimes tested. The germination rating class system (Young and Evans, 1982) was used to compare seedlots only and these rated the overall germination of accession T-151 as good because of the penalty placed on having low numbers of regimes with germination in the 51-90% category. This is an unforeseen problem with the rating system. The germination of all three grasses was remarkably high when compared to most cool-season range grasses (Young and Evans, 1982).

Seeds of accession T-151 also had very high germination at 60% of the temperature regimes (Table 1). Germination was not statistically ($P<0.01$) different from the maximum possible (100%). Accession T-137 and Nueces had optimum germination at 35% and 45% of the temperature regimes, respectively. The very low germinating accession T-4464 had 31% of the temperature regimes supporting germination, but the mean of the optimum was only 37% compared to 98%, 95%, and 93% for T-151, Nueces and T-137. For a large number of temperatures, seeds of these three sources of buffelgrass had exceptionally high germination.

The range of temperature regimes that supported optimum germination for buffelgrass seed was as remarkable as the mean germination of the optima (Table 2). A group of 12 temperature regimes from a minimum of 15/25°C to a maximum of 10/40°C supported optimum germination with 100% frequency for all four sources of plant material tested. The only constant temperature with 100% frequency of optimum germination was 25°C. The constant incubation temperatures of 20°C and 30°C had 75% frequency of optimum germination and 35°C had 50%.

The most unusual characteristic about the range of the temperature regimes with optimum germination was that it extended for accession T-151 and Nueces and, to a lesser extent, accession T-137 into very cold fluctuating temperature regimes with 0°C cold-period temperatures (Table 3). When optimum temperature regimes for germination extend into these widely fluctuating temperature regimes there are usually two possible explanations: (a) stratification requirements are met during the cold period, termed self-stratification, or (b)

Table 2. Frequency of temperature regimes that supported optimum germination of buffelgrass from all sources tested

Values expressed as percentages

Cold period (°C - 16 h)	Warm period (°C - 8 h)									
	0	2	5	10	15	20	25	30	35	40
0							25	50	50	50
2							25	50	50	50
5							25	50	50	50
10						25	25	100	100	100
15						25	100	100	100	75
20						75	100	100	100	50
25							100	100	100	25
30								75	75	
35									50	
40										

Table 3. Comparison of germination of buffelgrass seeds to seedbed temperatures occurring in the initial fall germination period in a warm Mediterranean-type environment

Means within columns followed by the same letter are not significantly different at the 0.01 level of probability as determined by Duncan's multiple range test

Accession or cultivar	Seedbed temperature classes					
	Moderate	Cold	Very cold	Fluctuating	Cold fluctuating	Warmer
	Tunisian winter precipitation					
T-151	98a	63a	22a	95a	93a	92a
T-137	91a	49a	13ab	84a	79b	81a
	Texas summer precipitation					
Nueces	92a	50a	14ab	89a	7ab	88a
T-4464	36b	16b	2b	29b	22c	27b

germination occurs during the warm part of the widely fluctuating temperature regimes.

In the case of the seeds of buffelgrass tested, the latter explanation appears plausible, because the widely fluctuating temperature regimes had to have at least a 25°C warm period for germination optima to occur and the frequency of optima did increase with increasing temperatures. At the 12 temperature regimes of 0, 2 and 5/25°C through 0, 2 and 5/40°C, 98.7% of total germination occurred in the first week with only 1% and 0.3% in the second and fourth weeks respectively (data not shown). Apparently, germination occurred during the warm periods rather than a slow satisfying of stratification requirements.

Buffelgrass seeds in a warm-winter precipitation environment must germinate in the autumn with the first effective rain to avoid being at a competitive disadvantage with other species (Evans et al., 1970).

Delayed germination brings the threat of cold temperatures. In southern Texas, buffelgrass is seeded in the spring because the seedlings are not particularly tolerant to frost (E.C. Bashaw, ARS/USDA, College Station, Texas, pers. comm.). Buffelgrass is usually seeded in Texas about the same time as cotton (Gossypium hirsutum). A rough standard for cotton planting is when the daytime maximum reaches 17°C (Martin and Leonard, 1949). The germination-temperature profiles of the Tunisian strains indicate that they may be valuable additions to the buffelgrass genetic pool that could extend the climatic adaptability and versatility of this important forage grass.

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RESUME

Conchrus ciliaris est une espèce fourragère précieuse utilisée pour améliorer les parcours dans beaucoup de zones à climat chaud. Des semences provenant de diverses sources ont été soumises à des tests de germination en vue de fournir aux sélectionneurs une estimation des possibilités de sélection pour la germination dans les lits de semences à faible température. La germination de semences provenant d'Afrique du Nord et du Sud du Texas (Etats-Unis d'Amérique) a été comparée à 55 températures, constantes ou alternantes. La germination maximale de deux échantillons provenant de Tunisie et d'un échantillon provenant du Texas a atteint 100 pour cent ou presque entre 35 et 60 pour cent des régimes thermiques, ce qui a fourni des indications sur les portions du matériel potentiellement intéressantes du patrimoine génétique de la plante.

RESUMEN

Conchrus ciliaris es una especie forrajera de gran valor, utilizada para mejorar los pastos en numerosas zonas de clima cálido. Se realizaron pruebas de germinación de semillas procedentes de distintos orígenes con objeto de proporcionar a los fitogenetistas una estimación de las posibilidades de selección en función de la germinación en un suelo con temperatura baja. Se comparó la germinación de semillas procedentes de Africa del norte y del sur de Texas, Estados Unidos a 55 temperaturas constantes o alternas. La germinación máxima de dos procedencias de Túnez y una de Texas fue del 100 por ciento o muy próxima al 35-60 por ciento de los regímenes de temperaturas, lo cual indica la presencia de porciones posiblemente valiosas del acervo genético de la planta.

Czechoslovak information system for genetic resources

Vladimir Rogalewicz [1/] and Ivo Bares [1/]

SUMMARY

Czechoslovakia is developing an extensive computerized information system to handle its 55,000 accessions kept in active collections in 26 institutes. COMECON descriptor lists are being published and efforts are being made to establish close national and international avenues of information exchange.

HISTORY

The first attempts to computerize passport and evaluation data on genetic resources began in Czechoslovakia in the late 1960s (Bares and Skorpik, 1969, 1974). Developing descriptor lists based on the 0-9 scale was recommended from the beginning. Czechoslovakia was also among the leading members of the Council for Mutual Economic Assistance (COMECON) in making efforts to establish a common documentation system.

Routine use of a computer began in 1976 when a program for documentation of germplasm introductions was developed. The logical structure of the system has not changed since (Bares and Martinkova, 1985).

Starting from this experience, a new logical structure for both passport and evaluation was designed, together with code lists for coded descriptors. A series of 'zero-th' editions of descriptor lists also appeared in research reports at that time. The information system (called EVIGEZ) ran on an EC1030 computer and software was written in ASSEMBLER and COBOL (Bares et al., 1982).

The system was tested on data on 450 wheat cultivars, and a third, updated version of the program was based on the Czechoslovak data base-management system SOFIS. Without changing the logical structure of the genetic resources description, a completely new computer program was developed. There had been many problems in the regular use of SOFIS, which did not appear to be the best tool. Nevertheless, a data base of passport and evaluation data was successfully tested and, since 1985, it has operated routinely.

In July 1985, an Apple IIe microcomputer was installed in the Research Institute for Crop Production in Prague (RICP) by the International Board for Plant Genetic Resources (IBPGR), and this made it possible to systematize the documentation of genetic resources. This process began by transferring the documentation on introduction to run into the Apple IIe. This will be finished by the end of 1987, when the Czechoslovak genebank in RICP will start operation. EVIGEZ will play an important role in the management of the genebank in gathering, retrieving and administering data, not only on accessions in the genebank, but also on all germplasm activities in the country.

THE PRESENT SITUATION

The information systems of various genebanks have been designed to fulfil a number of requirements (compare Knupffer, 1983; Kosmachev, 1985; Konopka and Hanson, 1985). EVIGEZ will cover the following areas:

(i) passport, characterization and evaluation data of all genetic resources in Czechoslovak collections;
(ii) management of the genebank, including receipt, storing, regular control and distribution of seed;
(iii) documentation of germplasm introduction into Czechoslovakia, and its export;
(iv) information on Czechoslovak collections (location, curator, composition, etc.); and
(v) contacts with documentation centres abroad.

Passport and evaluation data are kept in separate files which are linked by accession numbers. There are separate files for crops - it has never been necessary to combine data from more than one crop. The passport section has 17 descriptors, as listed in Table 1. There is a unique identifier for each accession, the national

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Table 1. List of descriptors in the passport file

NATIONAL ACCESSION NUMBER
SCIENTIFIC NAME - coded taxonomical determination including ploidy level (the first digit)
NAME OF THE GENETIC RESOURCE
COUNTRY OF ORIGIN
DONOR COUNTRY
ACCESSION NUMBER OF DONOR COUNTRY (may contain also an accession number of another important genebank, e.g. American P.I.)
STATUS OF SAMPLE (COMECON code list)
BREEDING METHOD (COMECON code list)
YEAR OF INCLUSION INTO COLLECTION
GROWTH HABIT (spring, winter, alternative)
HABITUS (annual, biennial, perennial)
INTRODUCTION NUMBER (linking the record with the documentation of introduction)
FINAL YEAR OF BREEDING (for cultivars)
YEAR OF REGISTRATION (for cultivars)
ORIGINATOR
PEDIGREE
DATE OF THE LAST UPDATING OF THE RECORD

Table 2. List of descriptors of the documentation of introduction

INTRODUCTION NUMBER
IMPORTING INSTITUTION
CROP
GENUS, SPECIES
NAME OF THE RESOURCE
HABITUS
COUNTRY OF ORIGIN
DONOR COUNTRY
DONOR ORGANIZATION (either scientific or commercial)
STATUS OF SAMPLE
METHOD OF INTRODUCTION (exchange, purchase, collecting, other)
DATE OF INTRODUCTION
SIZE OF THE SAMPLE
DISTRIBUTION TO CZECHOSLOVAK COLLECTIONS (code of collection and size)

accession number. It has the structure 99X999999, where the first two digits represent the institute that evaluated the accessions in the respective subcollection, the letter and the next two digits indicate the crop, and the last four digits represent the number of the resource of the crop. Hence the numbers of the same resource maintained in two collections differ only in the first two digits. For each crop, one institute is charged to assign accession numbers to all Czechoslovak subcollections. For international contacts, the accession number is completed by an institute designation (see IBPGR, 1984) composed of the letters CSK and of seven letters at most, which represents an abbreviation of the location of the institute. If a COMECON information network comes into operation, the passport data will be completed with two more descriptors: country of collection within COMECON and accession number of the N.I. Vavilov Institute of Plant Industry (VIR), Leningrad. These should be the linking descriptors for all COMECON collections.

Evaluation data have up to 110 one-digit descriptors. Evaluation is made according to the Czechoslovak descriptor lists, which contain morphological description, plant development stages, resistance to stress, diseases and pests, agronomic characters (including yield and its structure) and quality descriptors. The lists are based on COMECON and IBPGR descriptor lists, and they are supplemented with descriptors important for Czechoslovak breeding. In 1986, Czechoslovak descriptor lists for wheat, barley, rye, oats, maize, potatoes, lucerne, clover and pea were published. Lists for beet, tomato, soyabean and grape are in preparation. We intend to compile Czechoslovak descriptor lists for the principal national crops, while COMECON or IBPGR lists will be used for less important crops.

Documentation of introduction involves all samples obtained by Czechoslovak institutions through exchange, purchase or collecting missions. The descriptors of this subsystem are listed in Table 2. A list of introduced genetic resources is published annually. A similar subsystem applies for documentation of distributed germplasm.

The study of genetic resources in Czechoslovakia is historically bound up with research institutes and stations aimed at breeding. Today there are 26 institutes keeping active collections of 55,000 accessions involving 30% duplication (Bares et al., 1985). The leading role is played by RIPP, which has coordinated and unified the activities in the field of germplasm research. The Czechoslovac national EVIGEZ information system is also there. Nevertheless, data originate in particular collections and then are transferred to the central system.

The technical equipment in the institutes differs. Although there are personal computers available in many institutes, they are only rarely used for documentation. Only a few curators have mini-information systems to handle germplasm data. The central system should hold basic passport data and evaluation of principal characters, while more extensive descriptions (and, if possible, also firsthand experimental data) should be kept on ocal microcomputers. The curators themselves update and check the data in the information system.

All information included in the EVIGEZ system is available to any cooperating institution either as printout or on magnetic media.

Relations between the Czechoslovak information system, curators and possible other users have been described by Rogalewicz et al., (1986)

EVIGEZ provides information to international data bases, primarily to those of the European Cooperative Programme for the Conservation and Exchange of Crop Genetic Resources (ECP/GR). As a service to Czechoslovak collections, data files received from abroad are restructurallzed and transferred between various magnetic media. Magnetic tape (800 bpi) or diskettes formated for the Apple IIe are now the optimum magnetic media for data exchange with EVIGEZ.

OUTLOOK

There are many logical, operational and technical problems concerning the functioning of information systems devoted to genetic resources. Many are common to other genebanks and we intend to discuss them elsewhere (Rogalewicz, V., Possibilities and limits of germplasm systems, to be published).

As far as hardware development goes, we intend to instal another personal computer (probably an IBM PC/XT) with a 20 Mbyte hard disk. This should be sufficient to guarantee all functions of the information system. Data input will be possible through the Apple IIe.

Programming will be completed so that EVIGEZ will support all the functions discussed above. The programs supporting routing processes in the Czechoslovak genebank are being developed so that they will be in use from the very start of the national genebank.

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RESUME

La Tchécoslovaquie est en train de mettre au point un vaste système informatisé pour traiter les 55,000 entrées qu'elle détient dans des collections actives dans 26 instituts. Des listes de descripteurs COMECON sont en train d'être publiées et le pays fait des efforts pour établir des circuits d'échange d'informations au niveau national et international.

RESUMEN

Checoslovaquia está organizando un amplio sistema de información computerizado para manejar sus 55.000 accesos mantenido en colecciones activas en 26 institutos. Se están publicando listas de descriptores del COMECON y se están realizando esfuerzos para establecer relaciones nacionales e internacionales estrechas para el intercambio de información.

Fruit tree and vegetable germplasm in arid and semi-arid areas of northwest China

Wang Ming [1/] and Sun Yun-wei [1/]

SUMMARY

Many species of fruit trees, vegetables and cucurbits grow well in the arid and semi-arid deserts of northern China. Further development of these plants will play an important role in improving the economic situation of these regions.

INTRODUCTION

Many species of fruit trees and vegetables grow well in the arid and semi-arid areas of northwest China, which comprises 50% of the area of the country or 3,270,000 km^2. Most of the species originated in China. The main fruit tree species are: Ziziphus jujuba, Z. spinosus; Diospyros kaki, D. oleifera, D. lotus; Elaeagnus angustifolia; Amygdalus communis; Prunus armeniaca, P. davidiana, P. persica; Pyrus ussuriensis, P. bretschneideri; Punica granatum; Crataegus pinnatifida; Pistacia vera; Malus asiatica, M. prunifolia, M. sieversii, M. pumila; Cotoneaster sp. and Vitis spp. Other wild species are used for rootstocks or initial genetic stocks for breeding. The main cucurbits and vegetables are: Cucumis melo, Cucurbita moschata, Hemerocallis spp., Lilium spp., Allium spp., Dioscorea opposita and Capsicum annuum var. longrum.

'CHINA, MOTHER OF GARDENS'

Plant germplasm resources in China are extremely rich and varied. Vavilov (1951) wrote that China represents the earliest and largest independent centre for the origin of world agriculture and important cultivated plants. Wilson (1929) also described many species of Chinese fruits and vegetables and coined the term 'China, Mother of Gardens'.

More than 200 species of fruit trees and important rootstocks originated in China. Over 60 of the leading fruit tree species were derived from the country. Some of them were spread westwards to Iran via the 'Silk Road' and thence to Europe (Sun Yun-wei et al., 1983). Vavilov (1951) pointed out that "China occupies first place in the wealth of fruit species of Pyrus, Malus and Prunus ...". For instance, there are 35 species of the genus Malus in the world, more than 20 of which originated in China, especially in the northwest; 52 of the 54 species of the genus Actinidia in the world originated in China; there are 25 species of the genus Pyrus in the world and China possesses 14 of them, represented by about 3,500 varieties.

There are also numerous species of wild fruit trees of economic value widely grown in northwest China which are used either as cultivar rootstocks or for the purpose of dwarfing, cold hardiness and increasing resistance to drought, frost, salinity and diseases. Many of these wild fruits can be eaten fresh or processed, some may be used medicinally (Wang Ming, 1982).

FRUIT TREES

The history of fruit trees growing in northwest China stretches back over 3,000 years. There are about a thousand maidenhair trees (Ginkgo biloba L.) which are 2,000-3,000 years old, as well as jujube (Ziziphus jujuba Mill.) and sour jujube (Z. spinosus Hu) trees over 1,000 years old found in Shandong, Shaanxi and Shanxi Provinces. There are also walnut trees (Juglans regia L.) over 300 years old in Qinghai Province. Many pear trees that are 200 to 300 years old are still to be found growing in Gansu, Shaanxi, Shandong and Heibei Provinces, and 200 to 300-year-old persimmon trees (Diospyros kaki L.f) are also found in Shaanxi Province. Fruit trees as old as these are rarely found elsewhere in the world (Sun Yun-wei et al., 1983).

Persimmon

Thirteen species of Diospyros are native to China, the most important being persimmon; there are about 500 varieties in the country. The most important wild Diospyros species are D. lotus L. and D. oleifera Cheng. Both are used as rootstocks for persimmon in north, northwest

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and east China. The latter is also used as a source of a lacquer used in the painting of umbrellas.

Apricot

In the dry mountainous area of the Yellow River Valley, especially in north and northwest China, apricot is another popular and widely grown fruit tree. Besides the cultivated species, there are some wild species of apricot in China, such as: Armeniaca mandshurica (Koehne) Kost., A. sibirica Pers., A. vulgaris Lam. vars. ansu Maxim and pendula Jacq., and other species. They are used for cold-resistant rootstocks or as gene pools for breeding cold resistance into apricot.

Peaches

Northwest China is a very rich source of peach germplasm. Some of the cultivated and wild species originated in this area. There are about 800 peach varieties in China. P. kansuensis Rehd. is a wild species found only in Gansu and Shaanxi Provinces. It has been used as a parent for drought resistance, hardiness, resistance to green peach aphid (Myzus persicae (Sulzer)) and the peach nematode; it has also been used as a resistant rootstock for peach trees. P. kansuensis was found to be a valuable source of resistant germplasm and has been used by other countries, e.g. USA, USSR, in their peach-breeding programmes for the above-mentioned traits, from which they have developed several new peach varieties.

The other important local wild species are: P. mira Koehne, P. ferganensis (Kost. & Rjab.) Kov. x Kost., P. davidiana (Carr.) Franch. and P. persica (L.) Batsch var. densa Makino. This last has an unusual dwarf stock and is an extremely useful source of germplasm for dwarfing in peach breeding.

Almond

There are 2 species, 6 varieties and about 50 cultivars of almond grown in the Xinjiang Autonomous Region; for example: Amygdalus communis L. vars. communis, fragilis (Borkh.) Bronh., dulcis DC., amara DC., persicoides Ser., microcarpa Dierb., and A. ledebouriana Schlecht.

Walnut

There are a number of related wild species of Juglans that originated from or are grown in different regions of China; Juglans fallax Dode, J. cathayensis Dode, J. sigillata Dode, J. mandshurica Maxim., J. hopeiensis Hu (a hybrid of J. regia x Carya spp.).

CUCURBITS AND OTHER IMPORTANT VEGETABLE CROPS

Melon

Southwest Asia is believed to be the region of origin of the muskmelon, Cucumis melo subsp. melo, while the Chinese or oriental melon, C. melo subsp. orientalis Li originated in south China. In 1972, a wild melon species was found in Ningyang County, Shandong Province, which was named C. bisexualis Lu & Wang.

In 1959, Wu Mingzhu found a wild melon in Shanshan County, Xinjiang, and in 1981, a farmer again found a wild melon in Tuokesun County, Xinjiang. Of the 214 varieties of melon grown in Xinjiang, 105 are native. Approximately 95% of the melons grown for commercial production are native varieties. The most famous and popular varieties are called 'Hami melons' (C. melo var saccharinus Naud.).

Day lily

There are 14 species of the very nutritious Hemerocallis, 11 of which grow or originated in China. Several species of Hemerocallis can be used as a special kind of vegetable, of which H. citrina Baroni is the most important; others are H. fulva (L.) L., H. minor Mill., H. lilo-asphodelus L. (syn. H. flava L.), etc. Many different species or varieties are widely grown in China. Shaanxi and Gansu are the most famous producing areas in the northwest region. For example, in Dali County, Shaanxi Province, there are about 200,000 kg of dried day lily produced each year, 65,000 kg of which are for export.

Allium and Lilium species grown in Xinjiang and Tibet Autonomous Regions

The germplasm resources of the genera Allium and Lilium in Xinjiang and Tibet are very rich and varied. Xinjiang is the centre of origin for many species of Allium; 63 species are grown in Xinjiang, 99% of them are wild. These plants are widespread in grassy marshland and wilderness, especially around the mountain area and prairie of Tianshan and Altai Mountain.

Wild Allium in Xinjiang

A. altaicum Pallas (2n = 16), A. decipiens Fisch. ex Roemer & Schult (2n = 16), A. fetissovii Regel (2n = 16), A. flavidum Ledeb., A. galanthum Kar. & Kir. (2n = 16), A. lineare L. (2n = 16), A. oreoprasum Schrenk (2n = 16) A. pallasii Murr (2n = 16), A. ramosum L. (A. odorum L.) (2n = 16, 32), A. schoenoprasum L. (2n = 16, 32), A. sinkiangense Wang & Y.C. Tang.

Cultivated Allium in Xinjiang

A. cepa L. (2n = 16), A. fistulosum L. (2n = 16), A. sativum L. (2n = 16, 32, one of the most popular vegetables grown widely in China), A. tuberosum Rottl. ex Spreng. (2n = 32).

Allium and Lilium in Tibet

Many species of Lilium originated in China. The species in Tibet can grow very luxuriantly, e.g. L. brownii is a wild lily which has a large bulb that can weigh as much as 230 g.

The list of Allium and Lilium originating from or growing in Tibet are as follows (most of them are wild species) (Du Wufeng and Zhang Baoxi, 1982). A. ascalonicum L., A. astrosanguineum Schrenk, A. changduense J.M. Xu, A. chrysantum Regel, A. fasciculatum Rendle, A. hookeri Thwaites, A. macranthum Baker, A. prattii C.H. Wright, A. przewalskianum Regel, A. polyrhizum Turcz. ex Regel (syn. A. subangulatum Regel), A. tanguticum Regel, A. tuberosum Rottl. ex Sprengel, Lilium brownii F.E. Brown ex Miellez and L. lancifolium Thunb.

The main species used as a vegetable is L. tigrinum Ker-Gaul.; others are L. auratum Lindley, L. brownii var. viridulum Baker (syn. var. colchasteri (van Houtte) Wilson ex Elwes), L. concolor Salisb., L. leichtlinii Hack. f. var. maximowiczii Baker.

CONCLUSIONS

Drought-resistant economic plants are the basic resources for developing rainfed agriculture and raising the economy of the arid and semi-arid areas of China. Therefore, a complete survey, collection, evaluation, preservation and utilization of the above-mentioned germplasm resources in northwest China is of prime importance in these areas. Further research on such economic plants is needed to improve the production of these fruits, cucurbits and vegetables. Greater attention must be paid to the conservation of rare, endangered or slowly reproducing cultivated species as well as the more valuable wild species. Assistance must be given to the multiplication of desirable genotypes. It may be possible to propagate some of them using special techniques such as plant tissue culture in order to increase their importance in commercial production, while others may serve as initial gene stocks for plant breeding.

In addition, any research programme should include the selection of existing economic species adapted to dryness, the breeding of new varieties with improved drought resistance, and the acclimatization of wild species as well as the introduction of useful species from other areas of China and abroad.

The rich and varied plant germplasm resources of China are of value to the whole world. For this reason, it is important to develop and strengthen international cooperation, to engage in further exchange of materials, technical information and experiences, and to carry out cooperative research in this field. We are sure that the research and experience of China would make a valuable contribution to the development of rainfed agriculture elsewhere in the world.

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RESUME

De nombreuses espèces d'arbres fruitiers, de légumes et de cucurbitacées poussent bien dans les zones arides et semi-arides du nord de la Chine. Il est important de continuer à développer ces cultures pour améliorer l'environnement écologique et la situation économique dans ces régions.

RESUMEN

En las zonas áridas y semiáridas de China crecen numerosas especies de árboles frutales, hortalizas y cucurbitáceas. El ulterior desarrollo de esas plantas desempeñará una función importante en la mejora del medio ecológico y de la situación económica de esas regiones.

Les ignames (*Dioscorea* spp.) de Côte d'Ivoire

P. Hamon [1/] et N. Ahoussou [1/]

RESUME

La culture des ignames est importante en Côte d'Ivoire. Quatre espèces, dont une est introduite, sont largement cultivées et de nombreuses autres espèces, pas toujours commestibles, se rencontrent et peuvent constituer des ressources phytogénétiques intéressantes. Au cours de 3 missions à travers le pays, 1,359 accessions couvrant 13 espèces d'igname ont été récoltées. Des méthodes pour la culture et la conservation des ignames ainsi que les commentaires sur l'érosion génétique sont inclus.

INTRODUCTION

Les ignames cultivées sont des plantes à tubercule, dont la multiplication est exclusivement végétative. En Afrique de l'Ouest, de la Côte d'Ivoire au Cameroun, elle occupe une part importante des cultures vivrières. Quatre espèces sont principalement cultivées: Dioscorea alata (Asiatique, introduite), D. dumetorum, D. bulbifera et D. cayenensis-rotundata (endemiques). Cette dernière est la plus importante par l'intérêt que lui portent les populations autochtones.

La Côte d'Ivoire offre également une bonne représentation des espèces spontanées (sylvestres et savanicoles) d'Afrique de l'Ouest. Celles-ci ont été décrites par Chevalier (1936), Jacques-Félix (1947) et Miège (1952, 1958). Par ailleurs, on y trouve à la fois des régions de forte production, riches en formes cultivées et des régions non productrices, mais où la cueillette des formes spontanées est toujours de tradition.

Dans le but d'évaluer la variabilité génétique disponible au sein des formes cultivées et spontanées, 3 prospections ont été réalisées, en Côte d'Ivoire entre 1982 et 1985 par le laboratoire de Génétique, Université d'Abidjan (financements IBPGR).

ITINERAIRE

Sur les différentes zones de végétation ainsi que les itineraires suivis et les points de collecte ont été réprésentés.

Trois régions écologiquement différentes ont été visitées:

- La zone de forêt mésophile, dont les précipitations annuelles excèdent 1300 mm dans la moitié ouest, et sont comprises entre 1,100 et 1,600 mm dans le sud-est;
- La zone centre préforestière dite "V Baoulé" à 2 saisons des pluies bien marquées (entre 1100 et 1300 mm par an); et
- La zone sub-soudanaise et soudanaise à 1 saison des pluies, et des précipitations annuelles allant de 1100 à 1300 mm d'est en ouest.

Ces régions diffèrent également par leurs traditions de culture: le nord-est et le centre sont fortes productrices d'ignames, le nord-ouest et l'est moyennement, tandis que le centre-ouest doit sa production aux allogènes Dioula et Baoulé. A l'opposé, la pratique de la cueillette des formes spontanées est courante dans le centre ouest, entretenue dans le sud-est, et abandonnée dans les régions de culture.

METHODE D'ECHANTILLONNAGE

Chaque prospection est réalisée en 2 phases. La première se situe entre juin et octobre et constitue une étape de reconnaissance (prise de contact avec les villageois, observation du matériel végétal en champ, enquête-questionnaire). La seconde, est celle de la collecte proprement dite. Elle a lieu après la grande récolte en janvier et février.

Pour les espèces cultivées et spontanées non bulbifères y compris D. hirtiflora, seuls, des tubercules ou des fragments de tête de tubercules ont été collectés. Dans le cas d'espèces bulbifère cultivées ou spontanées seules les bulbilles ont été prélevées.

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ECHANTILLONS COLLECTES

1359 échantillons ont été récoltés au cours des 3 prospections, dont 275 D. alata, 16 D. bulbifera, 753 D. cayenensis-rotundata, 5 D. dumetorum, 1 D. esculenta, (espèces cultivées); 21 D. bulbifera, 12 D. burkilliana, 2. D. dumetorum, 46 D. hirtiflora, 22 D. mangenotiana, 37 D. minutiflora, 105 D. praehensilis et 2 D. preussii (espèces spontanées).

Ces échantillons se répartissent en 3 groupes suivant la nature des espèces, cultivées ou spontanées, et pour ces dernières, leur aptitude à être consummées.

Espèces cultivées

En Côte d'Ivoire, 2 espèces sont essentiellement cultivées: D. alata et C. cayenensis-rotundata. 3 espèces sont accessoires, D. esculenta, D. bulbifera et D. dumetorum localisée dans l'Est.

Les 2 espèces majeures sont toujours en association, mais le nombre de buttes réservées au complexe africain D. cayenensis-rotundata est plus important.

La diversité des noms vernaculaires correspondant au D. alata est importante dans l'est forestier et le centre. Dans ces régions, les paysans distinguent les types variétaux. Au contraire, dans le nord, le nombre des dénominations est réduit; les termes "Wan, Gbagara" dans le nord-ouest, "Wologo, Possié" dans le nord-est, designent l'espèce dans sa globalité.

Cette espèce est mieux adaptée aux régions forestières humides que savanicoles.

Pour D. cayenensis-rotundata, la nomenclature vernaculaire est riche. Elle se rapporte à la fois aux variétés différentes et aux types d'une même variété.

Au niveau des échantillons, nous avons remarqueé un regroupement au niveau du vocable, effectué par les paysans du nord-ouest. Le terme "Gbangan" désigne indifféremment les variétés "Kangba" du centre et de l'est et "Yaobadou" de l'est.

Des termes généraux désignent également D. cayenensis-rotundata: "Lopka' dans le Centre, "Kougbè" dans le nord-ouest. Notons que ces termes correspondent aussi à des variétés.

Enfin, certaines variétés semblent avoir des aires très restreintes en région de savane ("Vinvan" dans le nord-est), en région forestière "Kpôkpôkpôkpô" et "Cocoassié" dans l'est, "Sammancou" dans l'ouest).

Espèces spontanées consommables

Ces espèces ont été collectées uniquement en région forestière (ouest et est).

Dans l'est, une seule espèce a été échantillonée: D. praehensilis, alors que D. mangenotiana est également consummée. D'autres espèces nous ont été mentionnées, mais, faute d'échantillons nous n'avons pas pu les identifier.

Cette région est en profonde perturbation par suite de l'importante déforestation. La culture supplante progressivement la cueillette. Dans l'ouest, 5 espèces sont consommées, dont deux particulièrement appréciées et qualifiées "d'igname vraie": D. praehensilis et D. hirtiflora. Celles-ci sont annuelles et font l'objet de vente sur les marchés locaux en pays Dan.

Les trois autres espèces sont moins appréciées sans être pour autant négligées. Il s'agit de:

- D. mangenotiana ou "igname des éléphants". Cette espèce possède deux noms vernaculaires différents suivant qu'il s'agit d'un jeune plant ou d'un plant âgé. Cette différenciation existe egalement chez les pygmées de Centrafrique (Hladick et al., 1984). Dans certain villages, subsiste une règlementation pour la cueillette de cette espèce: seule l'extraction total et sans dommage du tubercule est acceptée. Les cueilleurs sont ainsi incités à la modération du fait de la taille imposante du tubercule et de sa difficulté d'extraction. N'est-ce-pas la survivance des rituels socio-religieux mis en place au début de la domestication et signalés par Coursey (1972)?

- D. burkilliana, également perenne, peu fréquente en région forestière mésophile et non signalée en forêt ombrophile. Ces caractères végétatifs aériens sont très proches de ceux du D minutiflora. Les paysans considèrent ces 2 espèces comme "parentes" tout en étant des entités bien différentes.

En région savanicole, une seule espèce a été mentionnée consommable mais réservée uniquement au temps de disette. On l'avait identifiée à D. abyssinica.

Espèces spontanées non consommables

En région forestière, 3 espèces ne sont pas consommées: D. preussi, D. bulbifera et D. dumetorum. Cette dernière nous a été signalée très toxique voire mortelle dans l'Ouest. C'est probablement la cause de la méfiance vis à vis des formes cultivées de D. dumetorum dans la région.

En région savanicole, D. sansibarensis se rencontre dans les résidus forestiers du nord-est. Les paysans la considèrent très toxique.

METHODES DE CULTURE ET TECHNIQUES TRADITIONNELLES DE CONSERVATION

Méthodes de culture

En fonction de la région, forestière ou savanicole, nous avons noté des différences portant sur la date de préparation du champ (entre Juin et Octobre dans le Nord, Mars-Avril en zone de fôret); la hauteur des buttes (beaucoup plus hautes en savane qu'en fôret); la date de plantation (Février dans la savane du Nord, d'Avril à Juin en région forestière).

Selon les zones climatiques, certaines associations de cultures sont pratiquées. Du Centre vers le Nord-Ouest, on trouve igname-banane plantain, igname-riz puis, igname-sorgho-mil. Dans l'Est, du Sud au Nord, on a igname - taro - banane plantain - café - cacao, puis igname - manioc en bordure - maïs, igname - maïs - sorgho, enfin, igname - petit mil - arrachide.

Dans toutes les régions, les petits légumes (gombo, tomate, aubergine, piment) font partie intégrante du champ d'igname.

Techniques de conservation

Les modes de conservation utilisés tendent d'une part à diminuer les zones de contact entre les tubercules et faciliter l'aération de ceux-ci dans les zones les plus humides, d'autre part, à protéger les tubercules de la chaleur dans les zones plus ensoleillées. Ainsi trouve-t-on des dispositifs de claies en région forestière (Centre et Est) et de hangars dans le Nord-Ouest et l'Est savanicole.

Dans certains villages du Nord-Est, les paysans utilisent des fosses dans lesquelles sont entassés les tubercules. Ceux-ci sont ensuite recouverts de terre.

EROSION GENETIQUE

La multiplication exclusivement végétative utilisée au cours de la domestication des espèces spontanées a conduit à la constitution de clônes.

Les systèmes d'échange par dons ou ventes des tubercules "semences" ont conduit à une large répartition géographique des meilleurs clônes.

Les divers dommages (maladies, attaques d'insectes) subis tant par la partie végétative aérienne que souterraine jouent un rôle antagoniste et auraient pu causer la disparition lente et progressive de ces clônes. Ceux, dont l'aire géographique est restreinte, étant pour des raisons évidentes, les plus vulnérables.

En fait, deux processus concourrent au maintien des clônes et au renouvellement du "pool des cultivées". Il s'agit:

- d'une part, des mutations somatiques qui s'accumulent et peuvent s'exprimer dans un tel organisme (on a des types de tubercules très nettement différenciés chez certaines variétés);
- d'autre part, de l'introduction régulière et constante de nouveaux "types de clônes" issus de la domestication en zones en Côte d'Ivoire et constatée dans la région forestière, ouest et est. Les formes que l'on a observées, possèdent des caractères végétatifs aériens, semblables à ceux des formes spontanées, tandis que les tubercules ont les caractéristiques de ceux issus de formes cultivées.

Dans l'ouest, la diffusion de ces individus a lieu probablement par l'intermédiaire des ethnies allogènes, qui emportent des tubercules au cours de leurs déplacement vers leurs villages d'origine. On a alors multiplication de ces nouveaux clônes et diffusion.

Dans le sud-est, la culture de l'igname s'installe progressivement. Une partie des formes mises en culture est puisée dans le réservoir des "spontanées".

Cependant, l'importante déforestation conduisant à la diminution des réserves alimentaires naturelles, incite à établir des systèmes d'échanges entre villages voisins.

Ceux-ci contribuent alors, tout naturellement, à "l'ennoblissement" des formes spontanées et à leur diffusion.

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SUMMARY

Yams are important crops in Côte d'Ivoire: four species, one of which is introduced, are widely grown. Several others may be grown or may be useful as genetic resources, although they may not be edible. 1,359 accessions of 13 yam species were collected in the country in three missions. Methods of growing and storing yams and comments on genetic erosion are included.

RESUMEN

El ñame es un cultivo importante en Côte d'Ivoire: se cultivan abundantemente cuatro especies, una de ellas introducida, mientras que hay algunas otras que pueden cultivarse o bien ser útiles como recursos genéticos, aunque puedan no ser comestibles. En el país se recogieron en tres misiones 1.359 accesos de 13 especies de ñame. Se incluyen los métodos de cultivo y almacenamiento del ñame y comentarios sobre la erosión genética.

Genetic variation in populations of barley and wheat in Nepal

T. Konishi [1/]

SUMMARY

Genetic variation was investigated within populations of barley and wheat collected in Nepal. 14 varieties of barley and seven varieties of wheat were found, with considerable genetic diversity existing in the samples.

INTRODUCTION

Nepal has been assigned priority status by the International Board for Plant Genetic Resources (IBPGR) as an area for collecting genetic resources of barley and wheat. Nepal is on the border of the distribution of oriental and occidental types of these crops, and there is wide genetic variation within the crops (Nakao, 1956a, 1956b; Takahashi et al., 1968). Further varieties at each collection site are frequently heterogenous (Nakao, 1956a; Witcombe and Gilani, 1979).

AREA AND METHODS

Barley and wheat seed was bought from farmers at villages of different altitudes in Kathmandu and the eastern regions of Nepal in 1983. From each sample, about 100 kernels were sown. After harvesting, ear and kernel characteristics were examined individually, and botanical varieties classified by the systems of Mansfeld (1950), Nakao (1956a) and Takahashi et al. (1968) for barley, and Mansfeld (1951) and Hosono (1954) for wheat.

The gene diversity or heterozygosity within a population (sample) was assessed statistically.

BARLEY

Farmers living in high mountainous regions grew mainly naked barley. These populations were classified into 14 varieties, based on the characteristics of covered and naked kernels, ear type, ear density, awn type and length, and kernel colour, which are controlled by major genes.

Covered barley is grown on a small scale in the lowland regions of Dharan and Kathmandu as a winter crop after rice. Most of the covered barleys belong to var. coerulescens, a 6-rowed, lax-eared form with a long awn and blue kernel.

In the Dankuta region (1,800-1,950 m) the main variety of covered barley grown was harlani, an intermedium type, characterized by lax ears with short awns in a central row of ears, but without lateral awns.

In the Dudah Kosi region, naked barley is principally grown, as the main winter crop up to 2,900 m. Barleys can be classified into philemense, nudinontanum and nudinipponicum of intermedium types. Contamination with two or more varieties was always observed within every sample of naked barley in this region.

It is clear that genetic diversity increases with altitude (Fig. 1). Wide diversity was observed in the naked barley of Dudah Kosi region above 2,600 m.

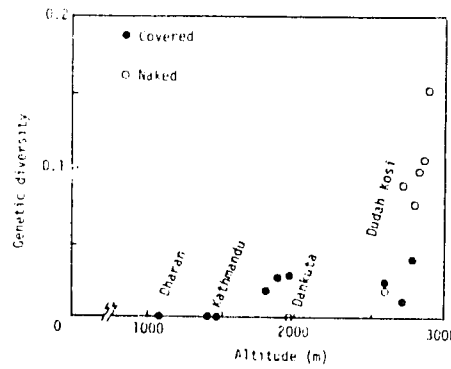

Fig. 1. Relationship between the altitude of collection site and the genetic diversity in barley samples

Fig. 1. Relationship between the altitude of collection site and genetic diversity in barley samples

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Takahashi et al. (1968) proposed classifying the Nepalese and Indian barleys into four groups; Indian, Lowland Nepal, Himalayan covered and Himalayan naked or Tibetan type, based on morphological and physiological features and geographical distribution. They suggested that the Lowland Nepal and Himalayan covered groups of barley seem to have originated by hybridization between Indian and Tibetan groups.

WHEAT

Wheat is a major winter crop in the lowlands of Nepal, and is classified into two groups, rato (red) and seto (white), by kernel colour. All of the three populations collected in Kathmandu were short-stemmed; in mountainous regions, most of the varieties had stems 30 cm longer than this.

Nepalese wheat samples were classified into six varieties, based on awn length, glume hair, glume colour and kernel colour. Ear type differs within some varieties, namely, pyramid, parallel, spindle and clavate, so the samples are subdivided into 10 groups.

In the Kathmandu region, all plants belonged either to erythroleucon or ferrugineum with long awns, red kernels and non-velvet glumes. In mountainous regions, the only sample of wheat collected was ferrugineum. Most of the varieties in the higher Dudah Kosi region were velutinum, characterized by awnless, white hairy or velvet glume and red kernel. They seem to have been introduced from Tibet (Nakao, 1956b).

The genetic diversity in wheat populations of the lowland was larger than that in mountainous regions. It is safe to conclude that no relationship between genetic diversity and the altitude of collection site exists in wheat samples.

The samples are preserved in the Barley Germplasm Center of Okayama University, and the Seed Storage Laboratory of the Institute for Agrobiological Resources, Tsukuba, Japan.

ACKNOWLEDGEMENTS

The author expresses his gratitude to Dr. R. Takahashi, Emeritus Professor, Okayama University, for many helpful suggestions and critical reading of the manuscript. The expedition was supported by the Grant-in-Aid for Overseas Scientific Survey (No. 59042066) from the Ministry of Education, Science and Culture, Japan.

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RESUME

Des recherches ont été effectuées sur la variation génétique existant à l'intérieur de populations d'orge et de blé au Népal. Quatorze variétés d'orge et sept variétés de blé ont été identifiées et on a observé une diversité génétique considérable dans les échantillons.

RESUMEN

Se ha investigado la variación genética de muestras de poblaciones de cebada y de trigo recogidas en el Nepal. Se hallaron 14 variedades de cebada y siete de trigo, con una diversidad genética considerable en las muestras.

Collecting *Gossypium raimondii* germplasm in northern Peru

B. B. Simpson 1/, J.M. Vreeland 2/ and R. Ferreyra 3/

SUMMARY

Fifty-three seed accessions of Gossypium raimondii were collected from areas in northern Peru. Populations were restricted in distribution but there is no immediate danger of extinction. However, new government regulations might change this in the future.

INTRODUCTION

Cottons (primarily the tetraploid New World Gossypium hirsutum and G. barbadense) have been given the highest priority of any non-food crop by the International Board for Plant Genetic Resources (IBPGR) for germplasm collection and maintenance.

New cotton genetic material could come from several sources, including the various 'wild' subspecies of G. hirsutum (treated in part as a separate species, e.g. G. tomentosum, by Fryxell, 1980) or of G. barbadense (also treated as separate species, G. darwinii and G. brasiliense, by Fryxell, 1980), or from the partially domesticated cottons of either species.

Other potential sources of genetic material are the wild diploid cottons of the New World that share one of the two genomes (designated the 'D' genome by Beasley, 1940) of the cultivated tetraploids.

Work started over 50 years ago (Harland, 1940; Gerstel, 1953; Phillips, 1963, 1966) has indicated that G. raimondii is the American diploid most similar to the ancestral contributor of the D genome. However, since 1966, few studies have been made on G. raimondii, and germplasm or living material for study has not been generally available for several years.

Recently, there has been a renewed interest in this species because of new methods of genetic analysis and the desire to maintain germplasm stocks. In addition, there was a suggestion that this wild species has better resistance to spider mites, aphids, scale insects, tobacco budworm and various lepidopteran larvae than its tetraploid derivatives (Boza and Madoo, 1941).

Reports indicated that the species was extinct, or at least endangered, in its native range of northern Peru. Phillips (1966) stated that the species was "represented by a relatively few individuals, and that these are confined to a narrow geographical range in a severe (very arid) environment" (p. 464). The same author later wrote that he was pessimistic about the persistence of the two populations found, because one had only about 100 individuals and was in imminent danger of extinction by encroaching agriculture. The second contained no more than 20 individuals. These suspicions seemed confirmed when a French expedition (Schwendiman and Schwendiman, 1981; unpublished internal IBPGR report ARG-PR 3/11; Ano and Schwendiman, 1984) could not find any plants despite traversing localities from which specimens had been collected within the preceding 5 years.

To assess the status of the species in northern Peru and to provide G. raimondii germplasm for study, we searched the drainage systems of the westward-flowing rivers in the departments of La Libertad, Cajamarca and Lambayeque, Peru in July, 1983.

ITINERARY AND MATERIAL COLLECTED

Geographical data provided in the original description of the species (Ulbrich, 1932) and the maps in Boza and Madoo (1941) served as guides to potential collecting sites. Other localities mentioned in the literature were also searched (Fig. 1). Because of delayed fruiting caused by anomalous rains of the 1982/83 'El Nino', seed was only collected in the southernmost area (3 collections) and the most northern locality (50 collections).

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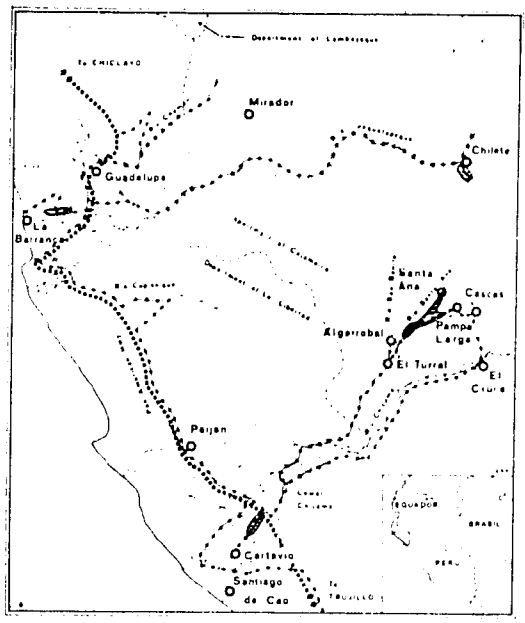

Fig. 1. Route followed in the departments of La Libertad, Cajamarca, and part of Lambayeque in July, 1983

Shaded areas indicate places in which we found populations of G. raimondii. Dashed lines show the route in the region of Peru where G. raimondii occurs. Exploratory trips south of the Chicama into the Moche and Viru valleys and north of Guadeloupe into the Rio Zana are not included since no plants were found during these forays.

THE STATUS OF G. raimondii

While populations of G. raimondii are obviously restricted in distribution, there does not seem to be any danger of immediate extinction. Large populations are growing in floodplains along the Santa Ana river, and these are not threatened by agriculture. At the base of the Chicama, adjacent to the Pan-American Highway, there is a much smaller population of perhaps 150 individuals growing on the floodplain.

Near Chilete, in the Jequetepeque drainage, the population of G. raimondii consists of a few hundred individuals. Local farming in this area is encroaching on the native stands and a large part of the local cotton population was washed away in 1982 by flooding. All of our observations indicate that the preferred habitat of the species is river beds at elevations between 550 and 1000 m. Nevertheless, plants growing at sea level in the lowermost Chicama Valley showed their ability to survive at low elevations.

It should be noted that several individuals (e.g. Boza and Madoo, 1940, and local informants) emphasized the long germination time of G. raimondii. Times from sowing to sprouting ranged from 90 to over 150 days, and germination may only be 20%.

In recent years, the Peruvian government has actively sought to destroy wild and dooryard cottons. By law, any Malvaceae that are potential harborers of cotton pests of pathogens must be eliminated (the list of 'dangerous' species including G. raimondii stems from a report by Wille et al., 1936). In the last few years, this law has been relaxed as the Peruvian agronomists began to realize that semi-federal 'algodon pais' (perennial G. barbadense) and G. raimondii represent important germplasm resources that are wholly or primarily confined to Peru. In collaboration with Mr. James Vreeland, the Fundación para el Desarrollo Algodonero (FUNDEAL) and the Institución Nacional de Investigación y Promoción Agropecuaria (INIPA), assisted in the collection of G. raimondii seeds and helped establish experimental plots of G. barbadense biotypes at several agricultural stations in northern Peru. During our collecting expedition, seeds of G. raimondii were collected for FUNDEAL as well as for the US Department of Agriculture. Herbarium vouchers were deposited at the Museum Javier Prado (USM) in Lima, Texas A. & M. University, and at the University of Texas Herbarium (TEX) at Austin, TX.

In late 1983, after this collecting expedition was completed, the pink boll worm was inadvertently introduced into northern Peru, causing a restrengthing of the eradication laws for Malvaceae related to G. hirsutum. We hope these laws will not extend to G. raimondii now that this germplasm resource has been 'rediscovered'.

ACKNOWLEDGEMENTS

The mission was funded by the University of Texas at Austin and the United States Department of Agriculture.

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RESUME

Cinquante-trois spécimens de semences de Gossypium raimondii ont été recueillis dans le nord du Pérou. La distribution de ces populations est restreinte, mais il n'y a pas de danger immédiat d'extinction. Cependant, la nouvelle réglementation gouvernementale pourrait dans l'avenir modifier la situation.

RESUMEN

En varias zonas del norte del Perú se recogieron 53 accesos de semillas de Gossipium raimondii. Las poblaciones tenían una distribución limitada pero no hay peligro inmediato de extinción. Sin embargo, las nuevas normas gubernamentales podrían modificar esta situación en el futuro.

Sampling cereal diversity in Morocco

A.B. Damania 1/

INTRODUCTION

Following up a collecting mission to the southern part of Morocco in 1984, a mission looking for wheat and barley explored in the north and east of the country during June, 1987. The teams comprised Drs. S. Miyagawa, T. Kuwabara and M. Furushou from the National Agricultural Research Center (NARC), Japan; Mr. F. Llabas and Ali Istar from Institut National de la Recherche Agronomique (INRA), Morocco; and Dr. A.B. Damania from the International Center for Agricultural Research in the Dry Areas (ICARDA).

Soils outside Rabat on the road to Meknes were mostly sand, whereas those in the mountains were stoney clay, and others were black. The Mid Atlas Mountains, which had been reported to be difficult for exploration (Perrino et al., 1986), were partially explored during this mission.

In some areas of the Rif Mountains, pine forests had been cleared for cultivation. Cereals were growing on the slopes, and the wheats, especially durum, were not yet mature. Also where irrigation was used, the crops were late maturing. Many Aegilops species, some still green, were found along the borders of fields, and mature samples were collected as populations. At one site, south of Ouda, a wild Allium species was observed growing in association with cultivated wheat.

GERMPLASM COLLECTING

Collecting coincided with the harvest in most areas. In Morocco, cereals are usually planted in October-November and harvested in May-June, the exact period depending on temperature and rainfall.

Genetic erosion in general, and for barley in particular, was found to be greater than originally thought. Germplasm was sampled essentially from standing crops but also from threshing floors and farmers' stores. The variability for wheats was highest at the extremity of distribution of cultivated cereals in the Oujda region (in the vicinity and south of Ain Bani Mattar village) bordering the Hamada Desert. Such concentrations of variability can be expected if the hypothesis of 'peripheral diversity' put forward by Yamashita (1979) is valid.

Collecting started just outside Rabat en route to Fes and ended in Rabat via Kenitra (Fig.1). Table 1 lists the samples collected. The terrain rose from sea level to about 1,800 m; sampling sites varied from saline a few metres from the sea (Tetuan area), through highly irrigated in the mountain gorges (Al-Hoceima area), to very dry near the desert (south of Oujda).

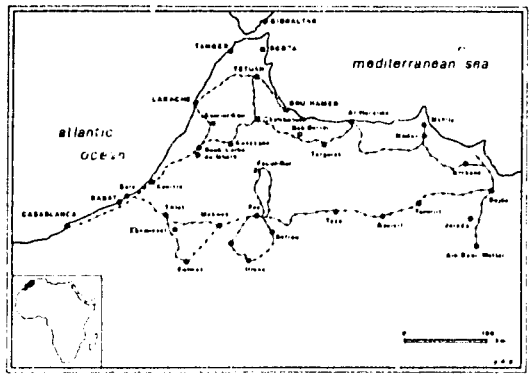

Fig. 1. Route of mission to sample cereal diversity in Morocco and the major collecting sites

Table 1. List of germplasm samples collected

Species	No. of samples
Triticum durum	57
T. aestivum	50
Triticum spp.	1
Aegilops spp.	5
Hordeum vulgare	58
H. distichum	1
H. bulbosum	7
H. murinum	3
Avena sativa	2
Vicia faba	1
Brassica spp.	2
Phaseolus spp.	1
TOTAL	188

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FAO/IBPGR Plant Genetic Resources Newsletter, 72:29-30

Some interesting germplasm was also collected from saline soils in areas where salt could be seen as a white powder on the surface of dry soils. A few samples were collected very close to salt pans, e.g. just northeast of Larache. On evaluation, these may turn out to be salt-tolerant.

Hordeum murinum is especially interesting as it forms part of the secondary gene pool of barley and may be useful in crosses. According to Grando et al. (1985), this wild form possesses genes for disease resistance, drought resistance and cold tolerance. The F_1 progenies are sterile, but the sterility can be overcome by chromosome doubling (S. Grando, pers. commun.).

Two samples of durum landraces had extremely tough rachises and stems even at maturity. The spikes could not be broken at the base, as was done on most occasions, and secateurs were used to cut the stalks. The stems proved to be completely solid, almost to the base of the plant. This trait may have special significance for resistance against wheat stem sawfly (R. Miller, pers. commun.). Other samples, especially from areas bordering deserts, separated from the soil at the slightest tug to the spikes, the root system being poorly developed and extremely shallow.

Hordeum bulbosum, which is useful for haploid breeding, was found growing on the borders of fields along the roadside. Aegilops spp. were also sometimes found in association with H. bulbosum or the other wild barley, H. murinum.

CONCLUSION

The limited variability encountered by this mission indicates that the north and east of Morocco have now been adequately covered so far as collecting of landrace germplasm of cultivated cereals is concerned. However, if particular wild species such as Aegilops or H. bulbosum are needed, collecting should be done at the end of June, by which time these are very close to maturity.

The collected germplasm was brought to INRA headquarters in Rabat. IBPGR had provided two deep freezers and some other equipment for seed cleaning and storage at INRA. The bulk of the germplasm collected during this mission was left with Moroccan scientists and will be evaluated, multiplied where required, and conserved, together with the 175 entries from previous missions repatriated by ICARDA in November, 1986.

A representative sample of each accession was taken for transportation to ICARDA where it was divided in half. One part was sent to NARC and other institutions in Japan, and was maintained for evaluation and multiplication at ICARDA.

ACKNOWLEDGEMENTS

The team members and ICARDA would like to thank the Moroccan authorities, particularly the Director General of INRA, for permission to collect germplasm, as well as for the participation of local personnel.

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Genetic resources of cereal crops in PDR Yemen. 1. Sorghum

Abdul Aziz Ahmed Bawazir 1/

PDR Yemen is located in the southwestern corner of the Arabian peninsula between 12° and 20° N latitude and 42° and 53° E longitude. About 80% of the population of ever 6 million people depend on agriculture. The country has a total area of 290,000 km^2, of which only 1.2% is potentially cultivatable. The climate is mostly arid and tropical to sub-tropical, with a hot summer and a mild winter. Average annual rainfall is 50-70 mm.

There are three distinct agricultural regions of the country, the coastal region, the mid-altitude region (600-100 metres above sea level), and the high altitude region (2000 metres above sea level and above). Summer and winter cereal crops are generally ground water irrigation. Rain-fed agriculture is practiced on only 5% of the cultivated area, in the mid and high-altitude regions where annual rainfall generally ranges between 250 and 500 mm.

The soils in the valleys where crops are grown are mostly alluvial and low in organic matter.

Cereals are the prime crops in the urban and rural areas and their cultivation is increasing.

RESEARCH

Cereal crops research so far has mainly concentrate on the improvement of wheat, sorghum and maize, in terms of varietal improvement, cultural practices and plant protection.

Genetic resources

Quite a few of the cereal crops grown in PDR Yemen are native or are early introductions to the country co-existing with related landraces and wild relatives.

Germplasm collection

The first sorghum-collecting mission was undertaken during Oct.-Dec. in 1969. Since then, collections were made periodically until November 1978, when about 96 sites were sampled. Attempts are being made to evaluate and register the entire collection.

Generally the cultivars from high altitudes appeared to be the tallest (300m) and latest (160-180 days). Three classes of ear type (open, semi-compact and compact) and six classes of grain colour (ranging from dark red to chalky white) were recorded (for details see Mu'allem, 1981).

Variability within cultivars of each climatic region is limited. This is more or less similar to the Tihama plain of the Yemen Arab Republic. A selection programme was initiated in 1977 in the coastal region of the country as a first step to improve the existing sorghum cultivar Beini.

Collections have been made of wheat (Mu'allem 1982), maize, millets and other minor cereals such as barely with the exception of sorghum (Mu'allem, 1981), no attempt has yet been made to classify these collections

GENETIC EROSION

The danger of losing available germplasm is a major problem for most of the cereals grown in the country, because of the introduction of high-yielding exotic cultivars and hybrids.

FUTURE ACTION

There is need for continuous survey, collection and classification to follow up the present situation of the genetic resources of cereals crops in the country. In particular wheat and maize should be dealt with, as the threat to local cultivars from high yielding exotic varieties is increasing.

In this respect technical and financial support is needed from IBPGR and regional and international institutes.

Long-term (ex situ) conservation is needed so cooled storage room or deep-freezer chests are required. Technical co-operation is necessary for taxonomical classification and documentation of the genetic resources data. Finally for the continuity of the programme, local staff need further training.

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Genetic resources of cereal crops in PDR Yemen. 2. Barley, millet and maize

Ab. S. Mu'allem 1/

INTRODUCTION

Barley, millet and maize are minor cereal crops in the PDR Yemen. They are used as human food. At present, maize is used also as poultry feed. Almost the entire area of barley is grown under groundwater irrigation in the extreme northwestern region of Wadi Beihan (around 1,000 metres above sea level) in the Shabwa Governorate. Millet is similar in importance to barley, and, as in the case of sorghum, it is grown under a wide variety of climatic conditions. However, it is cultivated predominantly under spate irrigation in coastal regions. A limited area is grown as a rain-fed crop in mid and higher altitudes. Maize is almost exclusively grown under groundwater irrigation in the coastal region. It is a relatively new crop and has good potential.

COLLECTION OF GERMPLASM

Eight exploration have been undertaken in 14 sites of the three agro-climatic regions of the PDR Yemen to cover as wide a variability as possible in the indigenous germplasm of the three crops (Fig. 1).

EVALUATION

The collections made and the field observations on these crops revealed the following.

Barley

Local cultivars belong to Hordeum vulgare L. and are predominantly a 2-row type (with varying amounts of mixing with plants with 6-row ears), with high susceptibility to lodging and stripe rust. Four local cultivars were identified, namely, Bakour, Bothinah, Khatrin and Marboua'a.

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FAO/IBPGR Plant Genetic Resources Newsletter, 72:32-33

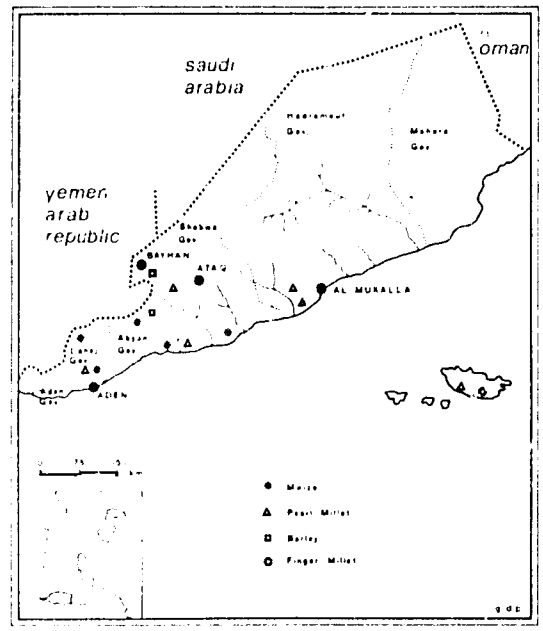

Fig. 1. The route of the collecting mission

Millet

Local cultivars belong to Pennisetum glaucum and Pennisetum setaceum (pearl millet), Panicum rigidum (little millet) and Eleusine coracana (finger millet). They are tall with small heads and reduced tillers. Finger millet is medium in height with small heads split into five branches. Three local cultivars were identified, namely Maseibli (or Dokhon), Kenab and Hibah, which are pearl millet type, finger millet type and little millet type, respectively. Maseibli is the local name for pearl millet types all over the country. Kenab is the local name for finger millet types all over the country; but is known as Dokhon in the coastal area of Hadramout Governorate. Hibah is the local name for little millet (early maturing type) in Socotra Island.

Maize

Local cultivars belong to Zea mays L. They are medium in height with small yellow-grained cobs and a low-yielding capacity. Two local cultivars were identified, namely Hind in the coastal region, and Sein in the Dhala area (around 1300 m.a.s.l.).

GENETIC EROSION

Due to the limited variation in the population of the local varieties of these crops, intrapopulation selection is not expected to lead

to a substantial improvement in yield. The farmers readily adopted the newly introduced high-yielding varieties (HYVs) of maize and millet; Keneja-6 and America Early of maize introduced from Bulgaria and Egypt, respectively, were released in 1972 after 3 years of testing. As a result of subsequent testing, the American Early HYV was withdrawn. Keneja-36 now covers almost the entire planted area, with limited areas sown to the Sein variety in the Dhala district, and the Hind variety in solitary pockets in the coastal region.

Several varieties of millet have been introduced and included in varietal trials to identify higher yields and early maturity; Dwarf Senegal (pearl millet) appeared to be most promising. In 1973-74, a mass selection was carried out in the population of this variety, which resulted in the development of two strains, Dwarf Senegal and Tall Senegal. An elite population was supplied to farmers in the Shabwa Governorate and to some Middle East countries through the FAO/UNDP Regional Project on Field Food Crops (Bakshi et al., 1974). These two varieties were released for commercial cultivation along with local cultivars.

Contrary to maize and millet, the pace of adopting the newly introduced Bonus and Nabawi HYVs of barley, which combine good brewing qualities with other characters, has been constrained because such varieties could not meet the quality of human food requirements.

The danger of losing local germplasm of barley and millet is not yet a major problem, because farmers select their seeds from good heads every season from their own fields (the two crops are not included in the Seed Multiplication Programme).

The absence of mechanization in areas where such crops are grown is another reason for the preservation of the germplasm.

The danger of losing the local germplasm of maize is increasing, because seed of the newly introduced HYVs of maize is supplied to farmers through the Seed Multiplication Project every year. Therefore, the pace of spread of newly introduced HYVs of maize is accelerating, and local cultivars are diminishing gradually

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Surveying and collecting the *Desmodium* genepool in Indonesia

K.L. Mehra [1/], L.A. Soekamto [1/], A.T. Sunarto [2/], S.J. Rijadi [2/] and D. Supriadi [2/]

Ecogeographic surveys and collecting of the Desmodium genepool were undertaken by IBPGR during 1984 and 1985 in the islands of Sulawesi (north, central and southeast), Java, east Nusa Tenggara (NNT-Timor, Rote, Flores, Sumba) and west Nusa Tenggara (Lombok, Sumbawa). A total of 430 accessions were collected of about 17 species of Desmodium and 6 species of related genera (Table 1).

Samples of seeds and vegetative parts were collected. Data were also recorded on site and plant characteristics. Duplicate samples and data sheets were sent to the Commonwealth Scientific and Industrial Research Organization (Australia), Centro Internacional de Agricoltura Tropical (CIAT) (Colombia), the Indonesian-Australian Forage Programme and Lembaga Biologi Nasional (LBN) (Indonesia).

Accessions of several species were gathered from sites differing in altitude, pH and rainfall.

Codariocalyx motarius occurred in dry islands of Flores, Timor and Sumba in grassland thickets and forest margins. Population densities at collecting sites were frequent or abundant.

Dendrolobium triangulare occurred in Timor, Sumba and Sumbawa in permanently or periodically humid localities, watersheds and forests. Distribution was rare in the target area. Collecting sites in Sumbawa were highly acidic. Collections differed in plant growth, plant height, stem thickness, leaf production, leaf-stem ratio, biomass production and seed production.

Dendrolobium umbellatum occurred in grasslands and forest margins along the coastal areas between Ende-Raya in Flores. Population densities at the sites were high.

Desmodium dichotomum occurred mostly in the agricultural fields in Timor. Accessions varied in plant height, leaf-stem ratio, stem branching and biomass production, but the seed setting was very high in all accessions.

Desmodium gangeticum occurred in a wide variety of habitats and was also distributed in all islands. Two main types were recognized, one, with broad leaves and white/pale yellow flowers, was tall with a thick stem and had high seed production. The other had short or medium-sized leaves and purple flowers. Accessions promising for use as forage plants were identified. Specimens differed in growth habit, plant height, stem branching, leaf size, leaf-stem ratio, inflorescence length, seed production and total biomass. No association between geographic distribution and plant type was observed.

Desmodium heterocarpon occurred along the roadside, in grasslands and forest margins, mostly in southeast Sulawesi, central Sulawesi, north Sulawesi and in the western region of Flores. Its populations were frequent in certain areas but otherwise rare or occasional. At individual sites the population densities were high. Accessions differed in growth habit, plant height, leaf number and size, leaf-stem ratio, stem thickness, branching, biomass production and seed production. (Accessions from highly acidic soils and those from drier areas are of special interest to the CIAT programme.)

Desmodium heterophyllum grew in rice fields, grasslands and forest margins, mostly in humid localities, watersheds and similar situations. Its populations were occasional or rare in the islands of Sulawesi (north), Timor and Java and very rare elsewhere. Desmodium intortum was collected only from Flores.

Desmodium laxiflorum occurred along the roadside and in forest margins, mostly in shaded areas, in Sulawesi, Flores and Sumba. It was widely distributed in these islands but was rare in Lombok and Sumbawa. Seed setting was poor at certain sites but high or very high at other sites, depending on the availability of pollinating insects.

Desmodium ormocarpoides, D. repandum, D. tortusum, D. trifoliastrum, D. virgatum and D. zonatum were rare and were collected from only a few islands.

Desmodium scorpiurus occurred along roadsides, grasslands, grassy wilds, forest margins and as undergrowth of coconut plantations. It was frequent in central Sulawesi, Flores and Sumbawa but rare in other islands. Accessions differed in plant spread, biomass production and seed production.

Desmodium styracifolium occurred along roadsides, roadside ridges, near rice fields, forest margins and as undergrowth of coconut plantations. Populations differed in stem thickness, leaf-stem ratio and biomass production. Seed setting was high in all populations. This species is highly stoloniferous and, being a high seed-setter, can cover extensive areas quickly in a growing season.

1/ IBPGR Forage Collector (S.E. Asia), Lembaga Biologi Nasional, Bogor, Indonesia

2/ Lembaga Biologi Nasional, Bogor, Indonesia

FAO/IBPGR Plant Genetic Resources Newsletter, 72:34-36

Table 1. Desmodium collecting in Indonesia

Species	Number of collections					Range		
	Sulawesi	NTT	NTB	Java	Total	Altitude (m)	Rainfall 1/	pH of soil
Codariocalyx motarius		9			9	10-960	3-4	6.5-8.0
Dendrolobium								
triangulare		5	4		9	10-390	3-4	4.5-7.5
umbellatum		2		1	3	20-280	2	7.5-8.0
Desmodium								
dichotomum		14			14	60-110	3-4	6.0-6.5
gangeticum	62	53	22	3	140	0-1,100	1-8	5.0-8.5
heterocarpon	26	11			37	10-970	2-6	5.0-8.0
heterophyllum	7	6		6	19	20-620	2-6	5.0-7.0
intortum		2			2	0-30	2	6.5-7.0
laxiflorum	20	13	2		35	10-840	3-6	5.5-8.0
ormocarpoides	1				1	0	4	7.5
repandum		2		1	3			
scorpiurus	8	12	6		26	0-370	3-4	5.5-8.0
styracifolium	32	4	1	4	41	0-800	2-8	5.0-8.5
tortuosum				2	2			
triflorum	4	7	3		14	20-510	2-4	6.0-8.0
trifoliastrum	1	1			2	20	4	
velutinum	3	16	12		31	25-710	3-4	5.5-8.0
virgatum				1	1		4	
zonatum	5				5	30-440	3-4	5.0-6.8
Desmodium spp.	6	7		1	14	20-1,600	3-6	6.5-8.0
Phyllodium								
elegans		5			5	150-520	2	6.5-8.5
pulchellum		6			6	120	3-4	7.5
Tadihagi								
triquetrum		1			1	120-1,007	3-8	6.5-8.0
TOTAL	175	186	50	19	430			

1/ No. of consecutive months with 100-200 mm rainfall per year

This species is highly promising and deserves systematic evaluation in pasture-improvement programmes. It can tolerate shade and in many ways it is as good as D. heterocarpon. Several accessions were made from acid soils and from different altitudes and rainfall zones.

Desmodium triflorum occurred along roadsides, roadside ridges, agricultural fields, undergrowth in coconut and clove plantations, in all islands surveyed. Populations differed in total spread, leaf size, biomass and seed production.

Desmodium velutinum occurred in grassy wilds and forest margins, in all islands except north and central Sulawesi, since this species is adapted to a dry climate. Population densities at the collecting sites were often high or very high. Two morphotypes were recognized, one with elliptic leaves and the other with broadly ovate leaves. No association was observed between leaf type and geographic location. Populations differed in growth habit, plant height, leaf number, leaf-stem ratio, stem branching, biomass production, but were mostly high seed setters.

Phyllodium elegans and P. pulchellum occurred in grasslands, forest margins and sometimes in abandoned agricultural fields, in dry islands, viz. Flores, Timor and Sumba. Within these islands its distribution was restricted.

Tadihagi triquetrum occurred along roadsides and grassland margins in Flores, Timor and Sumba. Populations differed in growth

habit, plant height, number of basal branches, leaf size, leaf–stem ratio, biomass production and seed production.

Several accessions of different species were made from acid infertile soils of all islands and some also from the alkaline soils in Timor. The accessions of all species varied in several forage attributes. The species differed in being herbs or shrubs. Even within a species like Desmodium heterocarpon and D. styracifolium, a range of forms from prostrate herbs to semierect or erect types were collected. Accessions promising for use as forage plants, soil cover and green manure were identified in D. gangeticum, D. heterocarpon, D. styracifolium, D. tortusum, D. triflorum and D. heterophyllum. Several accessions suited to problem soils (high acidity or alkalinity) can be used as straight introductions or as donor parents in hybridization programmes aimed at incorporating those traits into accessions otherwise lacking adaptation to problem soils.

Collecting minor tuber crops in the Andes

Paula Jokela [1/] and Leena Pietilä [1/]

Ulluco (Ullucus tuberosus), oca (Oxalis tuberosa) and anu (Tropaeolum tuberosum) are edible tuber crops endemic to the Andes, growing at altitudes of 3,000-4,000 m. They are high on the list of national priorities of conservation in the Andean region (Esquinas-Alcazar, 1982a-d).

A group of Finnish biologists collected additional germplasm of these tuber crops in southern Peru, Bolivia and northern Argentina in March-May, 1987 (Fig. 1). Collecting in the Department of La Paz was done with Bolivian agronomists.

The objectives of the mission were to collect tubers to augment holdings of the Peruvian and Bolivian national programmes, as well as for investigations in Finland, to study the sexual phenomena of ulluco and to make observations on wild ulluco (Ullucus aborigineus). In the University of Turku, ulluco, oca and anu have been investigated since 1982. Studies have concentrated on the variation pattern of the crops, their reaction to day length and on the formation and viability of seeds of ulluco (Rousi et al., 1986, 1987).

The collection is conserved in the Botanical Garden of the University of Turku. 123 accessions of U. tuberosus were made, 39 of O. tuberosa and 18 specimens of T. tuberosum collected. Each accession contains several morphologically distinct clones. The samples are deposited in the Universidad Mayor de San Andres, La Paz, in the Universidad Tecnica de Oruro and in the Proyecto de Investigacion de Sistemas Agropecuarios Andinos, Puno (samples from Bolivia and Argentina) and in the Universidad Nacional San Antonio Abad del Cusco (samples from around Cusco).

The tubers of the collection showed great variability, which was highest around Lake Titicaca and Cusco.

Populations of wild ulluco were found in the Department of La Paz. Sexual seeds of ulluco were also found, though only a few. In 1987 a considerable part of the flowers withered as buds because of the exceptional drought in southern Peru and Bolivia.

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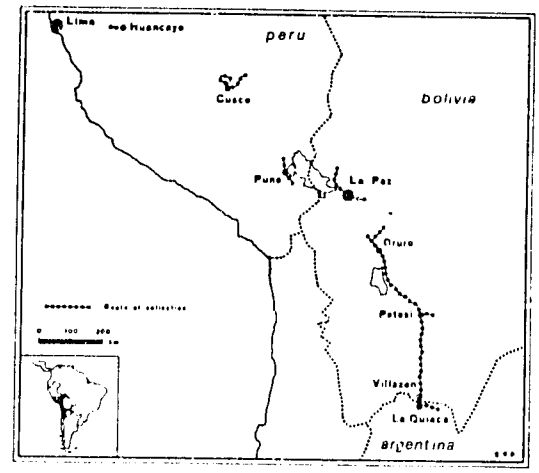

Fig. 1. The collecting route

During July-September the material was evaluated and propagated in the University of Turku, so that material is also available from there to investigators interested in these crops.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the contributions of A. Rousi, K. Lehtilä and J. Suomela. Special thanks are offered to the Peruvian and Bolivian scientists for their warm collaboration. The Academy of Finland provided financial support.

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Collecting oil palm (*Elaeis guineensis*) in Tanzania and Madagascar

N. Rajanaidu 1/

INTRODUCTION

The genus Elaeis comprises three species, E. guineensis, E. oleifera and E. odora (Barcella odora). Of these, E. guineensis is the most economically important. It is mainly endemic to Africa and E. oleifera and E. odora to south and central America. Extensive natural E. guineensis oil palm groves are found along the western seaboard of Africa from Cape Verde to Angola. Oil palm groves have also been reported in Tanzania and Madagascar (Blaak, G., pers. commun.; Jumelle and de la Bathie, 1911).

The genetic base of the current breeding material is extremely narrow. It consists of material derived from four Bogor palms planted in Java in 1848 and a limited number of E. pisiferas from Africa (Jagoe, 1952; Hardon and Thomas, 1968). Concern generated by this situation provided the initial impetus for the search for new genetic material (Hardon, 1974). The International Board for Plant Genetic Resources (IBPGR) and the Palm Oil Research Institute of Malaysia have for a number of years been coordinating the collecting of threatened germplasm.

In this paper we describe collecting missions in Tanzania and Madagascar, which are basically fringe areas of plam growth. Collecting has already been done in the major areas (Rajanaidu, 1986).

COLLECTING DETAILS

Collecting was carried out with the cooperation of the Ministries of Agriculture in Tanzania and Madagascar, and with partial financial support from IBPGR. Duplicate samples were deposited at the Ministry of Agriculture, Kigoma, Tanzania and Ministry of Agriculture, Antananarivo, Madagascar.

In Tanzania, samples were collected at 13 sites (Fig. 1) located near Kigoma along Lake Tanganika (Table 1). One bunch was harvested from each of the palms sampled, and the fruits from each bunch were kept separate. Data on ecology, bunch and fruit characters were recorded. In Madagascar, palms were sampled at 4 sites (Fig. 2). Table 1 gives the location names and the sample size at each site.

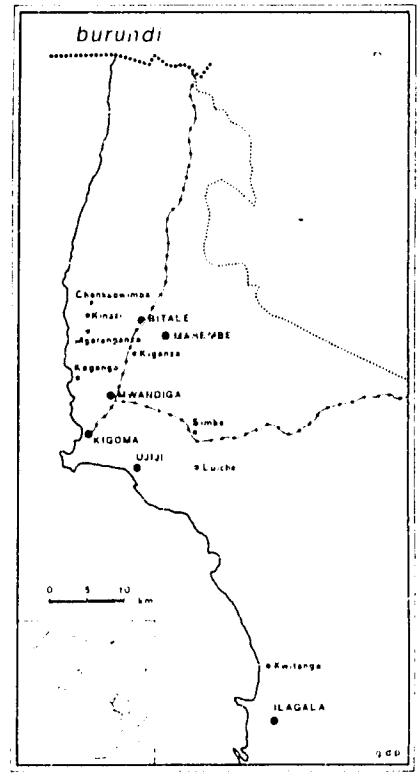

Fig. 1. Collecting sites at the Kigoma region in Tanzania

OBSERVATIONS

During the expedition the team found dense palm groves at Ujiji, Mwandiga, Kiganza and Simbo in Tanzania. Farmers harvested these palms regularly for the extraction of oil and the manufacturing of soap at the village level. The groves in Tanzania were not as dense as those found in southeast Nigeria. The frequency of palms of fruit form duras is about 90% and tenera 10%. Frequency of palms with pigmentation of the type virescens was 10% and nigrescens 90%.

The differences between sites (populations) for the characters bunch weight, bunch length, bunch breadth, bunch depth, stalk weight, mean fruit weight, mean nut weight, mesocarp to fruit, fruit length, fruit diameter, nut diameter, kernel diameter and shell thickness were statistically determined. There were no significant differences between populations for the traits scored in the field, except for stalk weight and mesocarp to fruit (%) for the teneras fruit type.

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FAO/IBPGR Plant Genetic Resources Newsletter, 72:38-40

Table 1. Collection sites and sample size of oil palm in Tanzania and Madagascar

Location	Dura	Tenera
TANZANIA		
Ujiji	3	3
Mwandiga	5	-
Kiganza	4	3
Ilagala	4	3
Kwitanga	1	5
Bitale	3	2
Chankabwimba	5	-
Kinazi	-	1
Simbo Village	3	-
Kagongo Village	3	-
Mgaranganza	4	1
Mahembe	5	-
Luiche	2	-
TOTAL	42	18
MADAGASCAR 1/		
Malaimbandy (6 km)	6	
Tuler	1	
Malaimbandy (35 km)	6	
Malaimbandy (85 km)	4	
TOTAL	17	

1/ It was difficult to determine the dura fruit forms

The distribution of natural oil palms in Madagascar was recorded by Jumelle and de la Bathie in 1911. They found palms along the coast from south of Cape St. Andre to the Manambola and Tsiribihina rivers. During our expedition, very few palms were found in that region. Most of the oil palm groves were noticed along the road from Miandrivazo to Malaimbandy. The palms were confined to sandy river valleys intermingled with forest trees. The palms were very poor in growth as compared to the palms found in the Cameroons, Nigeria, Tanzania and Zaire. The local farmers were not familiar with the use of oil palm bunches and harvesting technique. This indicates that the oil palm could have been a recent introduction to this region.

In the case of Madagascar, limited data were scored in the field for the samples collected except for nut weight and ecological information. It was not possible to identify the fruit forms because the fruits collected had very little mesocarp; mostly it was eaten by birds. Most palms of Madagascar origin are the duras type (Blaak, pers. commun.). The mean nut weight of 17 samples was 1.76 g, as compared to

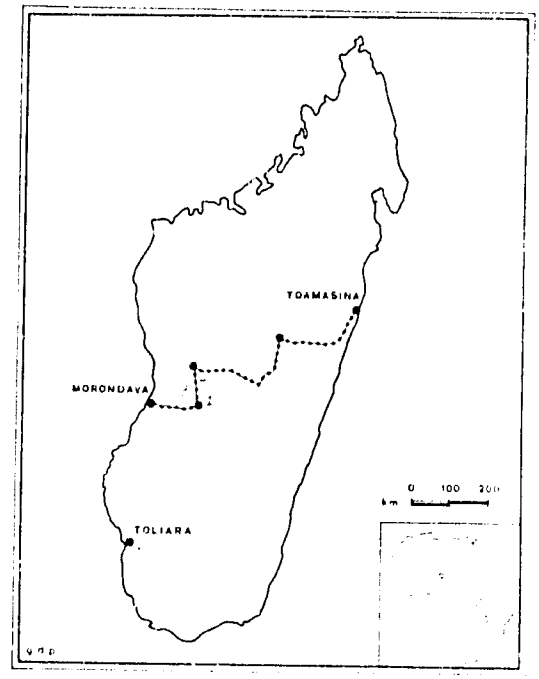

Fig. 2. Collecting sites in Madagascar
1, Malaimbandy (6 km); 2, Tuler;
3, Malaimbandy (35 km); 4, Malaimbandy (85 km)

8.5 and 8.9 g for the tenera and duras forms collected in Tanzania. In general, the growth, bunch and fruit traits were poor as compared to material found in other countries. This could be due to poor environment and low rainfall. However, the palms in Madagascar were not short or distinct enough to elevate them to a separate species level, e.g. E. madagascarensis (Beccari, 1914)

The material collected in Tanzania is comparable to that collected in the Cameroons, the Ivory Coast, Nigeria and Zaire. For instance the percentage of mesocarp to fruit of the duras type is close to that of Nigeria as is the mesocarp to fruit ratio of the teneras type. Richardson and Chavez (1986, unpublished mimeograph, Oil palm germplasm of Tanzanian origin) describe the value of Tanzanian material collected by Blaak and its performance in Costa Rica.

ACKNOWLEDGEMENTS

We are grateful to Mr. G. Blaak, FAO; Mr. Nyakimori, Regional Agricultural Development Officer, Kigoma and Mr. Razafindratsira, Antananarivo, Madagascar for assistance rendered. We appreciate the assistance given by the Agriculture Ministeries of Tanzania and Madagascar.

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Rice germplasm resources in Ghana

Richard Akromah 1/

Rice germplasm in Ghana includes three wild species and two cultivated species. The wild species are the perennial tetraploid Oryza punctata, the perennial diploid O. longistaminata and the annual diploid O. barthii. The cultivated species are the African O. glaberrima and the Asian O. sativa.

Since the introduction of O. sativa, there have been three broad categories of cultivated rice in Ghana. The first group, characterized by leaning and rather loose panicles with white grains, is associated with O. sativa; the second group, recognized by erect and compact panicles with a red seedcoat, is associated with O. glaberrima; the third, possessing slightly leaning panicles with a red seedcoat, is considered to be a hybrid of the Asian and African cultigens.

O. sativa has proven to be adaptable to Ghanaian conditions and many local varieties have been developed. Besides the group of O. sativa cultivars which may be considered as landraces, there are elite varieties/lines which have been introduced into the country and which are being tested under the International Rice Testing Program.

There have been several collections of rice germplasm made since 1970. Field work on rice germplasm collecting in Africa has been a partnership between national programmes and international centres, where the International Board for Plant Genetic Resources (IBPGR) has played a major coordinating role. The Plant Genetic Resources Unit (PGRU) of the Crops Research Institute of Ghana (CRI) has made several. In 1976 and 1978, a joint International Institute for Tropical Agriculture (IITA)-CRI team made collections with funds from IBPGR. The Faculty of Agriculture of the University of Ghana has also made separate collections. 200 accessions were gathered during a collection expedition funded by the International Rice Research Institute (IRRI) as part of a Genetic Resources Conservation and Management Training Course in 1985. Table 1 shows the number of accessions so far collected in Ghana.

These accessions are being kept under short-term storage conditions in Ghana, in aluminium foil-polyethylene envelopes in deep freezers at a seed moisture content of 6-7%. Duplicate samples are stored at IITA, Ibadan, Nigeria.

On the whole, evaluation work has not gone beyond morpho-agronomic characterization. However, the great adaptability of the O. sativa cultivars to disease and drought on the hydromorphic soils makes them a potential source of resistance or tolerance to such stresses. O. glaberrima also tolerates extremes

Table 1. Rice germplasm collected in Ghana

Institution	Year	Cultivated species		Wild species		
		sativa	glaberrima	longistaminata	barthii	punctata
CRI (PGRU)	1981/82	35	19	1		
IITA-CRI	1976,78	82	18			
University of Ghana	1970,80	160	40			
CRI-IRRI	1985	169	19	8	4	
						TOTAL = 555

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FAO/IBPGR Plant Genetic Resources Newsletter, 72:41-42

Table 2. Some accessions from Ghana having insect resistance

Accession No.	Species/variety	Insect resistance
100937	O. punctata	bph, zlh, ystb
101408	O. punctata	bph, zlh
101409	O. punctata	bph, zlh
101439	O. punctata	bph, zlh, ystb, glh
14748	Mani Coyo x Goali	glh
14749	Mango	glh
14751	Umelia	glh
14755	Kobi-Kamo	glh
14756	Bawku Red	glh
14758	Hevino	glh
14759	Mmo Kokoo	glh
14761	Mmo Tumtum	glh
14762	Mani Coyo	glh

Abbreviations: bph, brown planthopper (Nilaparvata lugens); glh, green leafhopper (Nephotettix virescens); zlh, zigzag leafhopper (Recilia dorsalis); ystb, yellow stem borer (Scirpophaga incertulas)

From: Heinrichs, E.A., Medrano, F.G. and Rapusas, H.R. 1985. Genetic Evaluation for Insect Resistance in Rice. International Rice Research Institute, Los Baños, Philippines.

of drought and water logging, especially in the low swampy areas where rivers overflow their banks during the rainy season.

IRRI received 43 accessions from Ghana by 1985 and some have been found to have resistance to some of the major insect pests of rice. Table 2 shows a list of those accessions.

EXTENT OF GENETIC EROSION

The greater adaptability of O. sativa with its superior yield has contributed to a regression of O. glaberrima in most rice fields. The characteristic of easy shattering of O. glaberrima has also made it a less-preferred cultigen. In fact, it is removed as a weed by some farmers whenever they find it mixed with their O. sativa crop. Wild O. longistaminata and O. barthii are also seen as troublesome weeds on Ghanaian rice farms. The natural habitats of these wild species are fast disappearing as a result of human pressures on virgin swampy lands, and recent devastation of the natural vegetation by bush fires arising from the careless use of fire in farm clearing. There are still some areas, especially in the west of the country, where much of the germplasm has not been collected and efforts should therefore be made to collect in these regions.

Rice germplasm from Ghana can be obtained from the following addresses:

The Officer in Charge,
Plant Genetic Resources Unit,
Crops Research Institute,
P.O. Box 7,
Bunso E/R,
Ghana

The Dean,
Faculty of Agriculture,
University of Ghana,
Legon
Ghana

Augmenting Ghana's plant genetic resources

Forson K. Ayensu 1/

New cultivars are now beginning to replace the old landraces which evolved over centuries of domestication in Ghanaian villages. Bush fires, droughts, overgrazing, construction of new roads and buildings, and overpopulation are destroying the old habitats, especially those of rice, sorghum, cowpea, pigeonpea, eggplant, pearl millet, okra, cassava, yam, Bambara groundnut and African yam bean.

The Plant Genetic Resources Unit (PGRU) holds the germplasm collection of Ghana's Crops Research Institute. The general objectives of the PGRU are to collect, evaluate, maintain, document, conserve and distribute Ghana's vast germplasm resources, but the Unit is gradually becoming a base for present and future crop improvement due to the support and close collaboration of the International Board for Plant Genetic Resources (IBPGR).

PGRU is a partner in the worldwide network of centres working to conserve genetic resources in close cooperation with IBPGR. In 1981/82, in collaboration with IBPGR and the Department of Plant Biology, University of Birmingham, UK, PGRU fielded collecting missions in Benin, Togo and Ghana for eggplant, okra and cucurbits. The status of the germplasm at the end of 1986 at PGRU is given in Table 1.

Duplicates of the germplasm of okra, groundnut, cowpea, pigeon pea and eggplant are at Institut Français de Recherche Scientifique pour le Développement en Cooperation (ORSTOM), Abijan; The University of Ghana; International Institute for Tropical Agriculture (IITA), Nigeria; Institute for Horticultural Plant Breeding (IVT), Wageningen and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India. All the germplasm currently at the Unit is being maintained and conserved in IBPGR-supplied deep freezers and

Table 1. Number of accessions in the collections of the PGRU, December, 1986

Location	Rice	Sorghum	Pigeon pea	Cowpea	Bambara groundnut	Lima bean	French beans	Egg-plant	Yam bean
Ghana	237	61	154	373	154	47		114	5
Togo								85	
Benin								40	
Colombia - CIAT							94		

Location	Ground-nut	Velvet bean	Sword bean	Maize	Cucurbits	Cassava	Yam	Okra
Ghana	40	10	9	29	32	90	279	46
Togo					3			4
Benin					2			1

1/ Plant Genetic Resources Unit, Crops Research Institute, PO Box 7, Bunso, Ghana

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chest freezers, at a seed moisture level of 5-7% at a temperature of about -20°C in sealed, laminated aluminium foil packets.

PGRU also deals with vegetatively propagated species, especially fruit trees and other economic plants. These collections are maintained as field genebanks in the form of orchards and introduction gardens. Among the list of collections are white sapote, sapodilla, jaboticaba, pawpaw, avocado, guava, citrus, simaruba, black pepper, eucalyptus, Australian nut, cashew nut, calabash nutmegs, carambola, tallow tree, Brazil nut, monkey podnut, tea, coffee and yellow mombin. A field genebank is also being maintained in the form of an arboretum, to hold collections of indigenous timber and medicinal trees.

THE FUTURE

Specific and general collecting missions into regions of genetic diversity need to be undertaken in priority areas in the near future. Characterization and evaluation of germplasm at selected locations and regeneration in areas of adaptation will be valuable in the fight for genetic conservation and utilization of Ghana's plant genetic resources.

Collecting maize in southwest Nigeria

O.S.A. Aromose [1] and J.A. Alake [1]

A mission to survey and collect maize cultivars from southwest Nigeria was made as part of a germplasm-evaluation programme initiated at the University of Benin, Nigeria to serve as a nucleus for crop improvement in the region.

Bendel State covers an area of 24,000 km^2, on low-lying coastland with some highlands towards the north. The climate is tropical. Maize is one of the staple cereal crops and is also used for animal nutrition.

The region was divided into five geographical areas for exploration. These were Bendel North, Bendel East, Bendel Central, Bendel South and Bendel Delta. Collections were made from farm stores, fields, markets and agricultural institutes using IBPGR guidelines.

A great deal of genetic variability was observed in ear length, ear diameter, seeds per ear, colour and race of corn. Flint corn was the most abundant race and was found in all geographical areas of the region (Table 1). Flint maize kernels possess good storage and germination qualities. Most of the maize in this region is produced on small farms where there are inadequate storage facilities.

Another notable observation in this collection was the preference for white endosperm corn in Bendel Central. All the accessions found in Benin City and its environs had white endosperm. In the other centres both white and yellow maize were found in different proportions.

Table 1. Number of maize accessions obtained from different regions of southwest Nigeria

Region	Flint	Dent	Pop	Floury
North	3	2	2	-
East	3	1	-	1
Central	3	-	3	1
South	3	1	-	1
Delta	3	1	1	-
TOTAL	15	5	6	3

1/ Department of Biological Sciences, University of Benin, PMB 1154, Benin City, Nigeria

More news about crops

NEWS FROM US-CAC MEETINGS

The United States Department of Agriculture's Crop Advisory Committees (CAC) have held a series of meetings.

In May, 1987 the Sugar CAC decided that all Saccharum and related species, along with intergeneric hybrids, should be included in the world collection at Miami, and the whole collection duplicated in the world collection in India. Saccharum officinarum has been intercrossed and preserved as true seed in the US National Seed Storage Laboratory (NSSL). Sugarcane seed can be maintained in liquid nitrogen with little decrease in viability. A taxonomic evaluation is being made of the world collection with data from up to 220 characters. Isozyme analysis to identify clones in the collection is also proposed and the two together should eliminate any misclassifications.

The Peanut (Arachis) CAC in July, 1987 heard that all peanut germplasm registered with Crop Science is to be included in the working collection, and that collecting is being organized in China. The wild peanut germplasm collection is to move to Experiment in Georgia.

In July, 1987 the Barley CAC decided to assemble a list of all barley genetic stock collections in the USA, with a person appointed as supervisor. Seed from the collections will be duplicated at NSSL for long term storage.

IRRI's NEW DIRECTOR GENERAL

Dr. Klaus Lampe succeeded Dr. M.S. Swaminathan as Director General of the International Rice Research Institute (IRRI) in early 1988.

Lampe was senior advisor to the German Agency for Technical Cooperation (GTZ) in Eschborn, FRG. He was head of GTZ's Department of Agriculture, Health and Rural Development from 1975 to 1986. Previously, Lampe was head of the Agriculture Section of FRG's Federal Ministry for Economic Cooperation (BMZ) and of the Agriculture Department, Federal Agency for Economic Cooperation (BFE).

Lampe has served on the Board of Trustees of several international research centres: the CGIAR International Institute of Tropical Agriculture (IITA) in Nigeria; the Asian Vegetable Research and Development Center (AVRDC) in Taiwan, China and also the International Centre for Integrated Mountain Development (ICIMOD) in Nepal. He has served on the Board of the CGIAR International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India, and was on the task force that established the CGIAR International Service for National Agricultural Research (ISNAR).

CAB INTERNATIONAL MOVES

Commonwealth Agricultural Bureaux International is moving in stages into new premises. The new address is: CAB International, Wallingford, Oxon OX10 8DE, UK, phone (0491) 32111, Telex 847964 COMAGG G. A newsletter is published monthly that often contains items dealing with plant genetic resources.

NEW LEGUME IN SOUTH AMERICA

A new pasture legume suited to the harsh soils and climatic conditions of the Colombian savannahs, called Centrosema acutifolium is being released by the Instituto Columbiano Agropecuario (ICA). A second legume will be released in 3 years. C. acutifolium was collected in 1979 by CIAT and ICA scientists in a forested savannah in eastern Colombia, growing well, between sea level and 1,400 metres. After tests throughout Latin America it is being released with a recommendation that it is grown with the bunch grass Andropogon gayanus, a combination that has produced animal weight gains up to 40% over grass alone (CIAT International, July, 1987, Vol. 6, No. 1, pp. 3-5).

SHOOTING GENES INTO PLANT CELLS

There is as yet no really suitable technique for genetic engineering of monocots. A research team in Cornell University has begun shooting genes into recipient cells. A particle gun uses gunpowder to fire 4 x 10^{-3} mm diameter tungsten microparticles into Allium epidermal cells. The cells remain viable. The DNA was a plasmid carrying a chloramphenicol acetyl transferase gene flanked by plant promoter and termination sequences. Transformation frequencies of 23-44% were observed, far higher than from other techniques. (Trends in Biotechnology, July, 1987, Vol. 5, p. 181.)

INTER-AMERICAN CONFERENCE OF MINISTERS OF AGRICULTURE

The 9th Inter-American Conference of Ministers of Agriculture, 31 August-2 September, 1987 made some specific recommendations relating to the CGIAR Centers. These are reproduced, in the original wording, below.

"HAVING SEEN:

The working documents presented as general background information for the Conference, particularly the one relating to technological innovation and agricultural development.

"CONSIDERING:

The important contributions that the international centers for agricultural research of the Consultative Group on International Agricultural Research (CGIAR) and other international research centers of the region have made to the agricultural development of the region.

The continuing need for international support at the regional level, particularly in view of the budgetary constraints resulting from the financial crisis which confronts the majority of the countries.

The natural complementarity that exists between the activities of the international centers, and research and technology transfer efforts at the national level; and

The advisability of achieving greater integration of national and international activities and of better exploiting the comparative advantages of all the institutions involved."

"RECOMMENDS:

1. To the governments of Latin America and the Caribbean, that, recognizing the contribution of the international agricultural research system to the agricultural development of the region, they implement policies and action aimed at making better use of this system for the benefit of their agricultural production.

2. To the Consultative Group on International Agricultural Research and other international research centers of the region, that they endeavour to maintain budget support for research activities related to the problems confronting the countries of Latin America and the Caribbean.

3. That the international research centers connected with the region review their working priorities, taking into account the technological requirements of the different subregions, in particular problems relating to the tropics, Andean highland crops, rain-fed agriculture and the management of phytogenetic resources, as well as examining their future role in biotechnology and the feasibility of inviting certain national systems to assume responsibility for some of the activities presently being carried out by these centers

4. That the organizations of the Inter-American system, especially the IDB and IICA, through their participation in the CGIAR and their joint activities with the international centers belonging to the system, promote greater and more effective participation by the region in guiding the activities of the Consultative Group."

Publications

THE SEPTORIA DISEASES OF WHEAT: CONCEPTS AND METHODS OF DISEASE MANAGEMENT

Z. Eyal, A.L. Scharen, J.M. Prescott and M. van Ginkel

1987. ISBN 968-6127-06-221. 21.5x28 cm. 45 pages. 20 colour plates. Softcover. Available in English and Spanish. Developed countries $15.00; less-developed countries $5.00
Published by CIMMYT, Mexico

This manual summarizes the more pertinent scientific reports on managing the two major Septoria pathogens, and is intended for wheat scientists who are unfamiliar with the diseases. Topics include the biology of the fungi, infection process, collection and handling of infected material, isolation and maintenance of the fungi, inoculum production, artificial inoculation, disease assessment, epidemiology, pathogen specialization, breeding for resistance, and means of cultural and chemical control. Each topic is followed by a recommendation of the most effective techniques or approaches. Twenty colour plates of the pathogens at different stages of development and of symptoms produced by the diseases are include.

CASSAVA BREEDING: A MULTIDISCIPLINARY REVIEW

1987. ISBN 848-9206-68-6. 15x22 cm. 312 pages. Softcover
Published by CIAT, Colombia

This proceedings of a workshop held in the Philippines in 1985 contains a number of papers of interest to plant genetic resources, including: Cassava germplasm resources, by Clair H. Hershey; Relationships between EMBRAPA (Brazil) and international research centers in cassava breeding and germplasm exchange, by Rui Americo Mendes; National programs and international centers: developing an optimal working relationship in cassava breeding research in Africa, by Marikis N. Alvarez; Recent advances in cassava genetics and cytogenetics, by Krishna Bhat V. Bai; Nontraditional techniques for genetic improvement of cassava, by W.M. Roca, L. Szabados, J. Narvaez and J. Jaynes; Workshop conclusion and recommendations, by Clair H. Hershey and Kazuo Kawano.

Roca et al.'s paper is an account of how the new genetic manipulation technologies can aid traditional cassava conservation and breeding by allowing more rapid recovery of sexual recombinants and by exploiting or creating further genetic variability. A number of conclusions and recommendations are made. In particular there is an interesting commentary on the complementary roles of the International Agricultural Research Centers and national programmes.

AGRICULTURAL ENVIRONMENTS: CHARACTERIZATION, CLASSIFICATION AND MAPPING

1987. ISBN 085-1985-82-3. 19x24cm. 335 pages. Hardback. Includes 2 maps
Published by Commonwealth Agricultural Bureaux International, UK

This is an account of a CGIAR Inter-Center workshop held in Rome in April, 1986 on agro-ecological characterization, classification and mapping. The workshop aimed at promoting an exchange of ideas on ways of characterizing environments as a means of assisting the Centers' work on crops. The book provides a comprehensive study of current developments. Below are some titles of papers of particular interest:

Address on behalf of the International Agricultural Research Centres (J.T. Williams, IBPGR)

Objectives, needs and activities in agro-ecological characterization, classification and mapping. Objectives, expectations and needs of the International Agricultural Research Centres (H.C. Harris and W. Goebel, ICARDA). Agro-ecological characterization, classification and mapping. Different approaches by the International Agricultural Research Centers (R. Brinkman, Wageningen). Agro-ecological characterization in the work of the International Board for Plant Genetic Resources (J.T. Esquinas-Alcazar, then IBPGR). Nature, sources and quality of data. Current availability and deficiencies in data relevant to agro-ecological studies in the geographic area covered by the IARCs (P.G. Jones, CIAT). Relating production and environment: the international nursery networks (D. Mulitze, R. Malhotra and P. Goldsworthy, ICARDA). Quantitative land

evaluation for agro-ecological characterization (H. van Keulen et al. (Center for World Food Studies, Wageningen). Crop geography for agro-ecological characterization in Sumatra and Costa Rica (U. Scholz, Giessen).

NEW FRONTIERS IN BREEDING RESEARCHES

1986 A4. 931 pages. Softcover. $US 28.00 (including surface mail postage). Edited by Banpot Napompeth and Suranant Subhadrabandhu Published by the Faculty of Agriculture Kasetsart University, Bangkok, Thailand

This is the proceedings of the Fifth International Society for the Advancement of Breeding Researches in Asia and Oceania (SABRAO) Congress held in Bangkok, Thailand, during November, 1985. The publication embodies 93 papers from invited guest speakers and scientists covering various aspects of breeding research, genetics and related disciplines. Main topics covered in the volume are:

genetic engineering and biotechnology;
genetic improvement of rice;
maize genetics and improvement;
genetic improvement of grain legumes and oilseed crops;
genetic improvement of plantation crops;
crop genetic resources and improvement;
genetics and breeding for resistance;
research on soyabean rust; and
animal genetic resources and improvement.

INTERNATIONAL SYMPOSIUM ON CONSERVATION OF GENETIC RESOURCES OF AROMATIC AND MEDICINAL PLANTS

Editors. Miguel Mota and José Baeta, Oeiras, 1987

This volume reports the proceedings of the EUCARPIA Genetic Resources Section meeting held in Estaçao Agronomica Nacional, Oeiras, Portugal, 9-11 May, 1984.

BIOLOGICAL DIVERSITY AND GENETIC RESOURCES: LIFE SUPPORT SPECIES

1987. A4. 25 pages. (CSC Technical Publication Series No. 232). Softcover
Published by the Commonwealth Science Council, London

This is the summary report of an international workshop on maintenance and evaluation of life support species in Asia and the Pacific region, which was held at the National Bureau of Plant Genetic Resources, New Delhi, India, April, 1987.

This regional workshop was organized to develop a strategy for action to collect information on those species which are critical for life-support in environmental extremes, e.g. drought, desertification leading to famine, flooding, pollution, soil toxicity and high salinity. The end result of the 4-day workshop was a set of recommendations. Some of these are as follows.

More information is required on origin, distribution, habitats, agro-climatic requirements, uses and benefits, as well as scientific utilization. Inventories of all life support species need to be prepared and made available to all concerned in the region.

A few important species with economic potential for use as food, forage, fuel, energy, medicine and industrial uses for specified stress and emergency situations should be selected for detailed studies.

Collection, evaluation, documentation and cataloguing of the prioritised life support species need to be taken up systematically so as to ensure their efficient utilization.

It was emphasized that the germplasm of various life support species, including those which are threatened with extinction, be conserved on a top priority basis both through in situ and ex situ means.

Steps need to be taken to establish a network of life support species between participating countries. Countries such as India might consider establishing a national network involving different organizations engaged with life support species.

An information system for Asia and the Pacific region should be developed for more effective linkages and for the dissemination of knowledge as well as materials.

Areas of biotechnology relevant for conserving and utilizing these life support species were identified. The role of biosphere reserves in every bio-climatic zone needs to be emphasized to the respective Governments. Biosphere reserves need to be established and information on aspects such as population dynamics, ethnobotany, etc. needs to be generated.

An inventory of research scientists working on life support species should be prepared.

IBPGR internal reports

GENETIC RESOURCES OF DURUM WHEAT

(87/130) Progress report on the evaluation of genetic resources of durum wheat, University of California, Riverside, USA

The project is determining whether phenotypic grouping of entries by multivariate analysis has relevance to genetic commonalities so that efficient germplasm management strategies can be devised. Fuller details are available in Spagnoletti, P.L. and Qualset, C.O. 1987. Geographical diversity for quantitative spike characters in a world collection of durum wheat. Crop Sci., 27: 235-241

SEED PHYSIOLOGY

(87/131) Interim report on seed physiology investigations at Reading University, September, 1986 - September, 1987, Reading, UK

The effects of light on seed germination to overcome dormancy and the use of ultra-dry seed storage (below 5% moisture content) are being studied. Work is in progress to produce advice on how dry the seeds of a variety of species can be. Results can thereafter be extrapolated to a wider range of species.

COLOCASIA IN THAILAND

(87/132) Final report on exploration for and collecting of Colocasia native to Thailand, Department of Agronomy, Kasetsart University, Bangkok, Thailand

This project was carried out in 1982/1983. 94 accessions of Colocasia and 8 accessions of the related genera Alocasia and Xanthosoma have been collected and characterized.

COLLECTING LYCOPERSICON IN CHILE

(87/134) Final report on collecting Lycopersicon in northern Chile, Universidad de Tarapacá, Chile

In May, 1987 this mission obtained ecotypes that had eluded previous expeditions. Material collected included 2 samples of Solanum rickii and 9 samples of Lycopersicon chilense. Seed has been deposited in the genebank of the Austral University of Chile and the Tomato Genetic Stock Center Davis, California.

PHASEOLUS GERMPLASM COLLECTING

(87/138) Final report of Phaseolus germplasm collecting and documentation, CIAT

This report details the 3 years of this IBPGR-CIAT collaborative project to increase the genetic variability of the Phaseolus world collection. After an analysis performed at the Genetic Resources Unit of CIAT, field explorations were done in selected parts of the 3 American centres of Phaseolus diversification. 1961 new accessions were gathered for more than 45 different Phaseolus species. Germplasm was obtained for the first time for 17 species. Seven samples of the material could be considered as new species for that genus. The collecting data, as recommended by IBPGR for all materials collected, were processed in a computerized data bank made available to IBPGR and CIAT. Of particular interest for future breeding and crop evolution studies were: the finding of wild P. vulgaris in eastern Mexico, in Costa Rica, and in Peru (a form different from P. aborigineus), the encounter of a new wild lima bean in Peru, and the finding of the ancestor of P. polyanthus in Guatemala.

COCOA AND WILD FRUITS IN BOLIVIA

(87/110) Interim report of the collecting mission for cacao (Theobroma) and wild tropical fruits in Bolivia

Instituto Boliviano de Tecnologia Agropecuaria conducted a mission in the Department of Beni and La Paz during February-March 1987 and collected 21 samples of Theobroma and 47 samples of wild fruit, including Achras spp., Artocarpus spp., Pisidium spp. and Spondias spp., together with a selection of palms. The material is being evaluated at the La Jota Experimental Station.

VITIS GERMPLASM IN GREECE

(87/142) Final report of the project on Vitis germplasm exploration and collecting in Greece

On the farm located at Amaroussion during the spring of 1987, 58 varieties were planted from the nursery into their final position. 163 varieties still remain to be planted into their permanent positions. Currently 293 Vitis varieties are growing in the collection.

PSOPHOCARPUS IN ZAIRE AND KENYA

(87/143) Report on collecting Psophocarpus species in Zaire and Kenya

From March to August 1987, IBPGR funded a project in collaboration with the Department of Botany, University of California, Berkeley, to collect the wild species of Psophocarpus in Zaire and Kenya. 126 sites were visited and seed, herbarium specimens, soil samples, root material, vegetative material and information on the incidence of pests and diseases were collected. The species gathered were Psophocarpus scandens, P. grandiflorus, P. lancifolius, P. lancifolius yellow-seeded form and P. lecomtei. The Trans-Nzoia district of the Rift Valley province of Kenya and Kinshasa, Bas Zaire, Kivu and Shaba Provinces of Zaire were visited. The report includes climatic, geological, ecogeographical and population information from these regions.

CHARACTERIZATION IN THE SUDAN

(87/145) Report on characterization of horticultural germplasm, from the Horticultural Research Section of Gezira Research Station, Sudan

Material collected with IBPGR support during 1982-85 is now being characterized. 13[illegible] samples of 19 species were grown in the winter months of the last season.

FOOD AND INDUSTRIAL SPECIES FROM MESO-AMERICA

(87/153) Progress report on collecting of food and industrial species of economic importance in Meso-America, J. Salazar, CATIE/IBPGR Collector, Turrialba, Costa Rica (in Spanish)

This report describes part of the second year of operation of the CATIE/IBPGR Collector, specifically collecting missions in Honduras, El Salvador and Mexico in August-October, 1987. The report describes in general terms the itineraries of the missions, the species encountered and the genetic erosion occurring. Material collected included maize, Phaseolus, Cucurbits, Capsicum, tomato and avocado.

COLLECTING ANDEAN CROPS

(88/2) Fourth progress report on the collecting of Andean crops in the Sierra Norte of Peru, Programa Nacional de Cultivos Andinos, Peru (in Spanish)

During May, 1987, material of the following species was collected: Amaranthus caudatus, Chenopodium quinoa, Lupinus mutabilis, Oxalis tuberosa, Ullucus tuberosus, Tropaeolum tuberosum, Polymnia sonchifolia, Vicia faba and Opuntia ficus-indica.

FORAGE COLLECTING IN ARGENTINA

(88/5) Report on forage collecting in the Río Negro Plateau, INTA, Río Negro, Argentina (in Spanish)

Following expeditions in 1985 and 1986, in early December, 1987 another mission was organized in the eastern part of the Río Negro Province, which collected 27 samples of the following 10 species: Poa ligularis, P. lanuginosa, Piptochaetium napostaense, Stipa clarazii, S. neaei, Elymus erianthus, Pappophorum subbulbosum, Melica violacea var. glabrescens, Bromus mollis and B. aff. unioloides.

ERRATA

It is the Genetic Resources Unit of INIAP in Ecuador, not Peru, that is carrying out IBPGR projects Nos. 86/190-192 (Newsletter No. 70:52).

Alert readers will have noted that the heading on p. 43 of report No. 87/62 in Newsletter No. 71 should have read:

OILPALM COLLECTING IN TANZANIA AND MADAGASGAR

The Editor of the Plant Genetic Resources Newsletter will be pleased to consider reports, notes and news from anyone working with plant genetic resources. Reports should be limited to approximately 1,200 words. The editor reserves the right to edit to meet space limitations.

Please send manuscripts typed double spaced. Relevant photographs would also be greatly appreciated but only high quality black and white prints rather than colour prints or slides. Colour photographs will be reproduced in black and white, but this is 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 Editor, IBPGR, c/o FAO, Via delle Terme di Caracalla, 00100 Rome, Italy.

L'editeur du Bulletin des ressources génétiques végétales serait heureux d'examiner les rapports, notes et nouvelles émanant de quiconque s'occupe de ressources génétiques. Les rapports devraient se limiter à environ 1200 mots; l'editeur se réserve le droit de réduire le texte en cas de manque de place.

Prière d'envoyer les manuscrits dactylographiés en double interligne, accompagnés le cas échéant de photographies, de préférence sous forme de bonnes épreuves en noir et blanc plutôt que de tirages en couleurs ou de diapositives. Les photographies en couleurs seront reproduites en noir et blanc, mais avec une nette perte de qualité.

Le Bulletin passera en revue les ouvrages, communications scientifiques et autres publications.

Toutes les communications doivent être adressées à la Rédaction du Bulletin, IBPGR, c/o FAO, Via delle Terme di Caracalla, 00100 Rome, Italie.

El editor del Noticiario de Recursos Genéticos Vegetales consideranrán con gusto informes, notas y noticias provenients de aquellas personas que trabajan en recursos genéticos. Los informes no deberán superar las 1200 palabras; el editor se reservan el derecho de adaptar los informes según las disponibilidades de espacio.

Agradecerámos el envio de los trabajos mecanografiados a doble espacio. También apreciaróa,ps eñ envio de fotografias relacionadas con la materia, que deberán ser de buena calidad, preferiblemente en blanco y negro. Las fotografias en color sólo serán reproducidas en blanco y negro, pero con una apreciable pérdida de calidad.

El Noticiario también hará revisiones de libros, trabajos cientificos y otras publicationes.

Todas las contribuciones deban ser enviadas a el editor, IBPGR, c/o FAO, Via delle Terme di Caracalla, 00100 Roma, Italia.