GROUNDNUT,
PEANUT, MANÍ,
ARACHIDE,
AMENDOIM,
MUNGPHALI.

International Arachis Newsletter

Prepared by
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. 1. May 198

● ICRISAT Center, Patancheru
• Other ICRISAT Locations
■ Peanut CRSP, Georgia
▪ Other CRSP Locations

International Arachis Newsletter

Publishing Objectives

The International Arachis Newsletter is issued twice a year (in May and November) by the Legumes Program, ICRISAT in cooperation with the Peanut Collaborative Research Support Program, USA. It is intended as a communication link for workers throughout the world who are interested in the research and development of groundnut Arachis hypogaea, or peanut, and its wild relatives. The Newsletter is therefore a vehicle for the publication of brief statements of advances in scientific research that have current-awareness value to peer scientists, particularly those working in developing countries. Contributions to the Newsletter are selected for their news interest as well as their scientific content, in the expectation that the work reported may be further developed and formally published later in refereed journals. It is thus assumed that Newsletter contributions will not be cited unless no alternative reference is available.

Style and Form for Contributions

We will carefully consider all submitted contributions and will include in the Newsletter those that are of acceptable scientific standard and conform to the requirements given below.

The language for the Newsletter is English, but we will do our best to translate articles submitted in other languages. Authors should closely follow the style of the reports in this issue. Contributions that deviate markedly from this style will be returned for revision. Submission of a contribution that does not meet these requirements can result in missing the publication date. Contributions received by 1 February or 1 August will normally be included in the next issue.

If necessary, we will edit communications so as to preserve a uniform style throughout the Newsletter. This editing may lead to the shortening of some contributions, but particular care will be taken to ensure that the editing will not change the meaning and scientific content of the article. Wherever we consider that substantial editing is required, we will send a draft copy of the edited version to the contributor for approval before printing.

A communication should not exceed 600 words, and may contain a maximum of two relevant and well-prepared tables, figures, diagrams, or photographs.

Each communication should normally be confined to a single subject and should be of primary interest to Arachis workers.

The references cited should be directly relevant and necessary to supplement the article's content.

All contributions should be typed in double spacing.

SI units should be used. Yield should be reported in kg ha^{-1}. A "Guide to Authors" is available from the Editor.

Address all communications, and requests for inclusion in the mailing list, to:

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INDIA

Cover Illustration: Arachis hypogaea and some alternative names for groundnut.

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International Arachis Newsletter

FOREWORD

I am pleased to welcome the first issue of the International Arachis Newsletter. The Newsletter will be produced at ICRISAT in the Legumes Program. The Peanut Collaborative Research Support Program (Peanut CRSP), with whom we have close links, is collaborating in its production.

The newsletter aims to bring up-to-date information to the attention of research scientists, and to bridge the gap between the regular personal contacts that exist between scientists and the long delays in publishing research results in many of the established scientific journals. This first issue summarizes the work of ICRISAT and of Peanut CRSP; please send reports on your work to the editor for inclusion in later issues.

Dr L.D. Swindale
Director General
ICRISAT

MESSAGE

It is indeed an honor for the Peanut CRSP to be able to participate in this Newsletter. The international role of agricultural research will be aided considerably by facilitating the exchange of embryonic ideas and information among fellow scientists in all areas of our common world.

We hope that it will also lead to increasing mutual efforts among friends to alleviate the problems of poverty and hunger.

Dr Tommy Nakayama
Program Director
Peanut Collaborative Research Support Program

News and Views

Editorial

This inaugural issue of the International Arachis Newsletter has been produced by the Legumes Program, ICRISAT, which also produces the International Chickpea Newsletter and the International Pigeonpea Newsletter. The Legumes Program was formed in 1986 by merging the former Pulses (Chickpea and Pigeonpea) Program and the Groundnut Program.

The Arachis Newsletter also reflects ICRISAT's close links with the Peanut Collaborative Research Support Program, as ICRISAT and Peanut CRSP cooperate fully to help increase production of groundnut. The reports in this issue show the similarity of approach in identifying constraints and working to overcome them. The informal links between individual scientists have continued, and are reinforced by the membership of R W Gibbons, the former Leader of the Groundnut Program, now Director, ICRISAT Sahelian Center, on the board of Peanut CRSP.

This issue of International Arachis Newsletter contains reports on the organization and operations of the ICRISAT groundnut group and of Peanut CRSP, and reports on meetings. It follows the style of the sister newsletters and will be similar in contents as well. However, a newsletter is only as good as its contributors, and the Editor looks to you to send information, not only results of experiments and trials, but also reports on what you are doing, of meetings, disease surveys, machinery you have used, and details of books published.

We have not included in this issue a list of recent literature, though this has been a feature in other newsletters. The technology for information retrieval has improved, and ICRISAT and other organizations are expanding their capabilities in this field. In future, ICRISAT will try to provide literature citations tailored to your specific needs, and is beginning to develop data bases that will facilitate this.

Sources of information, which are sometimes difficult to trace, are proceedings of meetings, annual reports of research stations, and theses of advanced-degree students. Please send the editor details of these, with abstracts, summaries, or contents pages where possible, or send a copy to the Librarian, ICRISAT.

A list of ICRISAT scientists, and Peanut CRSP investigators in USA and host countries is included. It is not the intention to publish the full International Arachis Newsletter mailing lists, but the editor hopes to be able to respond individually to requests for information on this topic.

J.P.Moss
Editor

Research on Groundnut at the International Crops Research Institute for the Semi-Arid Tropics

INTRODUCTION

In 1976, ICRISAT was designated as a world center for the improvement of yield and quality of groundnut and to act as a world repository for the genetic resources of the cultivated groundnut, Arachis hypogaea L., and its wild relatives in the genus Arachis. ICRISAT's interest in groundnut is not limited to the semi-arid tropics (SAT) but extends to all parts of the world where the crop is grown.

There are several serious constraints to groundnut production. Diseases and pests are important worldwide and cause serious losses. The unreliable rainfall patterns of the SAT and recurring droughts are also important factors limiting groundnut production. Other adverse factors are lack of high-yielding adapted cultivars, poor agronomic practices, and very limited use of fertilizers.

GERMPLASM BASE

ICRISAT has been designated as a world center for the collection, preservation and documentation of the genus Arachis.

Arachis genetic resources include all A. hypogaea cultivars and all the wild species of this genus. The total now stands at 11 641 germplasm accessions and there are another 115 awaiting plant quarantine clearance. Also in the collection are 206 accessions of 35 described and undescribed Arachis species and 2 interspecific hybrids. The collection also includes derivatives of interspecific crosses generated by the ICRISAT groundnut cytogeneticists, which are stabilized at the tetraploid level and are fully crossable with A. hypogaea. Germplasm has been distributed to scientists in many countries. Numbers of seed samples given to ICRISAT scientists total 43 910, and to cooperating scientists now total 26 999.

DISEASES

Foliar Diseases

The most important foliar diseases of groundnut caused by fungi are the leaf spots (Cercospora arachidicola and Phaeoisariopsis personata) and rust (Puccinia arachidis). All released Indian cultivars are susceptible. At ICRISAT, over 9 000 germplasm accessions have now been examined. Some 34 genotypes have been found to have good resistance to rust, 24 have resistance to late leaf spot and 17 of the genotypes have good resistance to both diseases. Fourteen germplasm lines with rust resistance have been jointly released by ICRISAT and the United States Department of Agriculture (USDA).

The stability of the resistance to rust and late leaf spot has been checked by comparing results of screening carried out at ICRISAT over several seasons and by conducting an International Groundnut Foliar Diseases Nursery. The resistances appear to be stable. The biology of the pathogens has also been investigated and components of resistance have been measured. The physiological implications of disease resistance are now being examined and the findings may influence breeding and disease-control strategies.

At ICRISAT, the early leaf spot disease caused by C. arachidicola does not normally become severe enough to permit reliable screening, but is commonly present in epidemic form at Chitedze Agricultural Research Station, Lilongwe, Malawi, where the ICRISAT Regional Groundnut Program for Southern Africa has been operating since 1982. ICRISAT germplasm is now being screened for resistance to this disease at Chitedze.

Near-tetraploid derivatives have been developed from crosses between wild Arachis species immune or highly

resistant to late leafspot and rust diseases, and high-yielding groundnut cultivars. These derivatives have useful resistance to one or more of these important foliar diseases, and are now in use in the resistance breeding programs at ICRISAT, and have been distributed to other breeders.

Pod Rot Diseases

Pod rots caused by a complex of soil-inhabiting fungi have been found to cause serious reduction in both yield and quality of groundnuts in a number of countries. Losses of over 20% have been recorded at ICRISAT for some genotypes. Eleven genotypes have been shown to have significantly lower incidence of rotted pods than susceptible control cultivars.

Aspergillus flavus and Aflatoxins

Invasion of groundnut seeds by toxigenic fungi of the Aspergillus flavus group and subsequent production of aflatoxins is favored by damage to the developing pods by pathogenic fungi, insects, drought stress and by cultivation. Damage to harvested and stored pods and seeds can also increase risk of fungal invasion as also can wetting of stored seeds. Attention has been concentrated on utilization of genetic resistance, and genotypes with pre- and post-harvest resistance to pod and seed invasion by A. flavus have been identified. It is of interest that some of these genotypes were also found to be resistant to pod rot.

Several genotypes have been extensively crossed with susceptible but high-yielding cultivars. Derivatives of these crosses that have good yield and seed quality and have levels of seed resistance to Aspergillus flavus colonization comparable to those of the resistant parents have been selected.

A number of germplasm lines have also been tested for their capacity to support aflatoxin production, and significant varietal differences in the rate of accumulation and total toxin produced were found.

Virus Diseases

Several groundnut virus diseases occur in the SAT and some are economically important. Peanut mottle is the most widespread and is economically important in several countries in eastern Asia and Africa. Other economically important groundnut virus diseases have restricted distribution -- rosette is important in Africa; peanut stripe in eastern Asia; peanut clump in West Africa and India; and tomato spotted wilt in India and People's Republic of China. In addition, a witches' broom disease, caused by a mycoplasma-like organism, is economically important in eastern Asia.

In the past, identification of groundnut virus diseases in the SAT has depended on visual symptoms. Thus, at ICRISAT, emphasis has been placed on virus characterization, and development of simple and sensitive methods to detect viruses. Methods for virus detection have been developed and antisera produced to all the major groundnut viruses in India.

To be able to develop methods for integrated management of virus diseases, ICRISAT has undertaken research into epidemiology of bud necrosis disease and peanut clump, evaluation of germplasm lines for resistance or tolerance to bud necrosis disease and peanut mottle, and evaluation of germplasm lines for nonseed transmission of peanut mottle virus. As a result, integrated management practices have been developed for bud necrosis and peanut clump diseases.

ICRISAT virologists have established a network to link scientists in technically advanced countries with those who do not have facilities for virus research, to investigate such important virus diseases as groundnut rosette and peanut stripe.

PESTS

Insect pests may be important because of the direct damage they do in the field and in storage, or because they are vectors of disease. Of more than 300 species that attack groundnut, few are of importance worldwide; these are termites, aphids (vectors of groundnut rosette, peanut stripe, and peanut mottle viruses) thrips (vector of tomato spotted wilt virus), jassid, groundnut leaf miner, and Spodoptera litura. The emphasis at ICRISAT has been to combine cultural practices and host-plant resistance to develop integrated pest management (IPM). Intensive screening of germplasm accessions identified genotypes resistant to one or more insect pests and vectors. These genotypes are being used in breeding to combine resistance to the above pests into high-yielding genotypes.

We have successfully used thrips resistance to develop high-yielding genotypes with field resistance to tomato spotted wilt virus. These field-resistant genotypes form the basis of integrated management of this virus disease; the other components being cultural practices, early sowing, close planting, and intercropping.

A genotype resistant to aphid showed field resistance to chlorotic rosette in Malawi.

ICRISAT entomologists are developing IPM for leafminer and Spodoptera. The biology of these two species, the role of abiotic and biotic factors, the effect of resistant genotypes on the population fluctuations of these pests, and economic injury levels, are being studied.

Termites

Research on termites is carried out at ICRISAT in collaboration with the Tropical Development and Research Institute, UK. The particular importance of termites as pests of groundnut in Africa is recognized, pod losses in excess of 30% having been recorded. Their role in predisposing groundnuts to invasion by A. flavus and subsequent aflatoxin contamination by scarifying pods is also known. Current research is aimed at finding insecticides and fungicides that control the pest but do not harm the environment.

Breeding for Pest Resistance

Breeding for pest resistance was started in 1980 with the objective of combining resistance to leaf hoppers, thrips, and termites into high-yielding genotypes. An extensive hybridization program was initiated and a large number of single and multiple crosses made.

PHYSICAL CONSTRAINTS

Drought

Drought is a serious problem in most groundnut-growing areas of the SAT. Research at ICRISAT has been carried out mainly in the postrainy season because of lack of water control in the rainy season. A rain shelter has recently been constructed and is now being used for drought studies in the rainy season.

We have utilized a line source screening system that permits large numbers of germplasm accessions to be screened for drought tolerance. Using this, several lines have been identified as tolerant to midseason or end-of-season droughts. Several lines have yielded over 1 t ha^{-1} dried pods in a drought year with only 200 mm rainfall at one station in India compared to yields of less than 500 kg ha^{-1} from control cultivars. The International Drought Trials have been conducted in India, and in African and Southeast Asian countries. Trial results have been encouraging, and research to produce drought-resistant genotypes continues. Trials have also been carried

out to investigate the effects of time and intensity of drought, effects of plant population, and effects of release of stress. Early stress may even lead to increase in yield. Establishment of an ICRISAT Regional Groundnut Program in West Africa in 1987 has provided the opportunity of working on this problem in that region.

Biological Nitrogen Fixation

There are several reports of Rhizobium inoculation leading to increased groundnut yields in fields where the crop had not previously been grown. In trials at ICRISAT Center, it has been shown that inoculation of groundnut genotypes with a very effective strain of Rhizobium could increase nitrogen fixation and pod yield when the crops were grown in fields well populated with effective strains of Rhizobium. The Rhizobium strain NC 92 was found to be very efficient, and has been recommended by the All India Coordinated Project on Oilseeds (AICORPO) for use with two released cultivars.

The method of inoculum application was found to be important. Groundnut seeds are fragile; and direct application of Rhizobium inoculum to them can cause significant damage and actually lead to decrease in yields. It was found better to directly apply the inoculum to the soil, and this was done easily and cheaply by mixing the peat containing Rhizobium with water and pouring the resulting mixture into the furrow just before the seed was sown. This method is also effective in reducing problems arising from incompatibility of Rhizobium inoculum and fungicidal seed protectants.

Calcium Nutrition Research

Calcium deficiency of groundnut is a major limiting factor in many parts of the world and gypsum application has been recommended in most groundnut-producing areas.

Research was initiated to investigate reported genetic differences in calcium uptake efficiency of pods of different genotypes. The work concentrated on the interactions of drought, gypsum, and genotype. Consistent and significant genotype x drought x calcium level interactions have been found.

Mycorrhizae

Groundnut roots usually show extensive colonization by vesicular arbuscular mycorrhizae (VAM). The symbiotic relationship between the VAM fungi and the root augments phosphorus uptake from soils.

Preliminary pot culture studies have shown that groundnut derives considerable benefits from VAM inoculation. VAM colonization and phosphorus nutrition are likely to be components in genotype and site interactions, and selections of groundnut genotypes with increased susceptibility to VAM could improve adaptation to varying nutritional environments.

DEVELOPMENT OF GENOTYPES WITH SPECIFIC ATTRIBUTES

High Yield and Quality

Although breeding for stability of production over years and locations by breeding for resistance to various constraints has the highest priority, breeding for yield per se is important, particularly for areas where constraints do not occur or where progressive farmers can afford inputs such as pesticides and fungicides.

Advanced breeding populations are evaluated in two different seasons at ICRISAT Center. In the rainy season they are evaluated under high input and low input but in the postrainy season only under high input. Several high-yielding lines with acceptable pod and seed

characteristics and good shelling percentage have been developed.

In the early years of the program it was observed that cultivars that yielded well in the rainy season did not necessarily yield well in the postrainy season and vice versa, indicating a strong genotype x environment interaction. It was therefore decided to make selections in the postrainy season to develop cultivars suitable for postrainy season irrigated cultivation. Several high-yielding lines suitable for this purpose have now been bred, and one of them, ICGS 11, has been released to farmers in India. High-yielding lines suitable for use in the rainy season have also been developed.

The research on quality has concentrated on oil content; several lines have higher oil and protein content than the standard control cultivars.

Earliness and Dormancy

In the SAT, growing seasons can be very short due to early cessation of rains. Earliness coupled with good seed size and yield would provide stability for production in such situations.

Short-duration cultivars would also be of value to fit into the gaps between rice crops in the multicropping rice-based systems of some Asian countries. Efforts are in progress to identify early maturing groundnuts and to breed for increase in their yield levels. Use of early maturing groundnuts increases the probability of rain falling on the crop at or after maturity, so it is necessary that the early-maturing groundnuts should have fresh seed dormancy. Such lines have been identified.

PHOTOPERIOD

Photoperiod effects have been demonstrated in groundnut cultivars. In some cultivars, yield could be decreased by 50% because of long days, while in others, long days gave slight yield increases. Research has shown that modification of photoperiod can increase both shoot and root growth, and its interaction with drought stress has assumed great significance. We have established the fundamental basis for photoperiod sensitivity and are starting to develop methods of screening and exploiting the phenomenon.

COOPERATION WITH NATIONAL PROGRAMS

ICRISAT breeding materials are made available to groundnut scientists throughout the world. In addition, international trials are sent to our cooperators in many countries.

In India, selected lines are entered in the AICORPO evaluation network. In 1986, ICRISAT variety ICGS 11 was released in central and peninsular India for general cultivation with irrigation in the postrainy season. A mass selection from ICRISAT line ICGS 1 has been released for spring season cultivation in Punjab State in northern India. ICRISAT supplied an F_4 population of a cross between TMV 7 x FSB 7-2 to national breeders, and a selection from it was released for general cultivation in Tamil Nadu, India, (as VRI 1). Five more ICRISAT lines have progressed through AICORPO trials and are now being tested in prerelease adaptive trials in various zones of India.

A confectionery selection ICG(CG)S 49 is under consideration for possible release in Cyprus. Another ICRISAT selection ICGMS 42, from the Malawi Regional Program has performed very well in the southern African region and is under consideration for promotion in the Zambian national program.

UTILIZATION OF WILD *ARACHIS* SPECIES

Cytogeneticists have investigated the genomic constitution and examined phylogenetic interrelationships between

the cultivated groundnut, A. hypogaea, and wild Arachis species. This information has been utilized in planning the most effective routes for gene transfer. All of these routes have been used, and a range of interspecific hybrids, from diploid to hexaploid, with many combinations of genomes, have been produced and backcrossed to A. hypogaea. Many stable tetraploid derivatives have been produced. Hybrids and derivatives are screened in the field against the major foliar diseases, and selected lines further backcrossed to produce uniform, resistant lines. Some of these lines have been further selected for yield and agronomic characteristics, and lines with high yield, disease resistance, or good confectionery characters have been entered into AICORPO trials. The selected tetraploid lines are resistant to rust and late leaf spot, and have good yield; they also retain leaves until harvest, and produce good haulm yields, which provide valuable hay for animals.

Some wild species are not compatible with A. hypogaea, and several methods are being used to obtain hybrids. Pollinated flowers are treated with a number of hormones and young hybrid embryos are excised and cultured in vitro. Several tissue culture techniques are used to produce hybrid callus and shoots. This work will be expanded in the hope of eventually obtaining access to useful traits.

The most immediate target of the wild species work is to transfer resistance to early leaf spot disease from immune or highly resistant species into a tetraploid A. hypogaea-like genotype. This has high priority as there has been only very limited success in obtaining early leaf spot resistance in the cultivated groundnut.

TRAINING

Since the commencement of the Groundnut Program in 1976, 275 scientists and technicians have been trained within the program. Of these 193 have been from the ICRISAT In-Service Trainee courses and they have been given 1-2 weeks of lectures and practicals. The remaining 82 included students studying for M.Sc. or Ph.D. degrees, Postdoctoral Fellows, Apprentices, and short term In-service Fellows who received specialist training.

Of the 275 trainees, 135 were from 26 countries in Africa, 120 from 15 countries in Asia, 1 from Australia, 15 from 6 countries in Europe, 1 from Mexico, and 3 from USA.

The ICRISAT Sahelian Center Groundnut Improvement Program

ICRISAT has recently started a groundnut improvement program in the West African region, based at Sadoré in Niger. Three principal staff have been assigned to this program: Bruno Ndunguru, agronomist; David Greenberg, plant breeder; and Pala Subrahmanyam, plant pathologist. All three had taken up their positions in Niger by mid-February 1987.

The program intends to operate in close cooperation with national and regional groundnut programs in West Africa to address problems identified by the national programs and by ICRISAT and other scientists. Groundnut crops in the region often show great variability, ranging from reasonable yields to no production over short distances. It is intended to investigate the biotic and abiotic factors which may cause this variability. The program will investigate the effect of pests, diseases, nutrients, drought, and soil management on groundnut crops in the region with the aim of stabilizing and increasing yields under resource-poor farmer's conditions.

Previous trials have shown that some groundnut lines generated by the ICRISAT program in India have shown great promise in Niger and Burkina Faso, but many lines that perform well in India have not done well in Africa. Thus further selection

and breeding work needs to be done on material from the ICRISAT Center Groundnut Program. Initially, it is intended to begin a crossing program between early--maturing groundnut lines carrying resistance to rust and late leaf spot from ICRISAT Center and adapted lines with rosette resistance from breeding programs in the West African region.

ICRISAT's Regional Groundnut Improvement Program for Southern Africa

INTRODUCTION

ICRISAT established a regional groundnut program for southern Africa in Malawi in July 1982.

The program was established in response to an invitation by the southern African Heads of State at the Lusaka Summit Conference in 1980.

The program has been funded by the International Development Research Centre (IDRC) from July 1982 to December 1986. During 1986, the status of the program was changed to an ICRISAT Core Program, supported by the IDRC grant.

In October 1984, the Southern African Development Coordination Conference (SADCC) Consultative Technical Committee for Agricultural Research approved the subsuming and future expansion of the ICRISAT Regional Groundnut Program into a regional Grain Legume Improvement Program. This will take effect in 1987, with ICRISAT retaining responsibility as executing agency for regional groundnut research.

GROUNDNUT CULTIVATION AND RESEARCH IN SOUTHERN AFRICA

Constraints to increased production are many and vary within and between each country. Those most amenable to amelioration through the efforts of a regional program of only modest strength are (1) lack of good suitably adapted varieties (particularly in Mozambique, Tanzania, and Botswana) and (2) yield loss due to diseases, particularly leafspots (Cercospora arachidicola and Phaeoisariopsis personata), rust (Puccinia arachidis), and groundnut rosette virus.

While groundnut has received research attention because of its export potential for SADCC Countries, varieties developed for high-elevation high-rainfall areas (Malawi, Zambia, Zimbabwe) are not suitable for low-elevation, low-rainfall areas, where groundnut is at present primarily a food crop. A great deal of effort is now urgently required to develop short-duration varieties appropriate for farmers with small landholding.

Thus a great scope exists for enhancing groundnut research in the region. Most of the varieties released through the national programs were and continue to be direct introductions or reselections from these: hybridization and selection from a greatly expanded germplasm base is now imperative for further significant progress.

STAFF AND FACILITIES

The project staff consists of two groundnut scientists (a breeder and a pathologist) supported by two technical officers (with agricultural college diplomas), four technical assistants (agriculture school certificate holders), and one clerical officer.

Chitedze Research Station, our regional base is located 16 km west of Lilongwe, Malawi, at 14° S and 33° 45' E, and at an altitude of 1050 m. Chitedze is situated on the Lilongwe Plain, the major groundnut-producing area of Malawi.

The Malawi Department of Agricultural Research has provided laboratory and office accommodation for the program within the Chitedze Research Station Complex. ICRISAT will develop its own research facility at Chitedze during 1987.

Our experimental land area is about 8 ha. We enjoy excellent cooperation from Chitedze in the allocation and preparation of land, and in many other respects.

REVIEW OF PROGRESS

Objectives and Strategies

We acknowledge the farmer with small landholdings as our principal target. He has extremely limited financial and other resources and it is unlikely that his situation will alter significantly in the foreseeable future. Recognizing this, we conduct our research under conditions of low input, and our initial evaluation of germplasm is made under rainfed conditions without any form of crop protection. We also acknowledge the national groundnut improvement programs of the region as our immediate clients and recognize that their needs are of paramount importance. Our work is, therefore, directed towards these needs.

Our objectives continue to be the development of high-yielding breeding lines and populations adapted to the region and containing tolerance to factors limiting production by small-scale farmers. We are therefore primarily concerned with the effective broadening of the genetic resources of southern Africa, and our priorities are vested in breeding and selecting for increased yields, quality, and earliness.

Research Progress

We have built up and continue to broaden our genetic base by introducing selected germplasm lines from ICRISAT Center and elsewhere. Over the past four crop seasons, we have evaluated over 2 500 accessions, from which we have already selected over 100 lines, which are being tested in preliminary, advanced, and elite yield trials.

Material has already been released to national programs in Angola, Botswana, Malawi, Mozambique, Tanzania, Zambia, and Zimbabwe, where, in cooperative regional trials, promising selections are being tested against recommended local varieties. The Zimbabwe and Malawi national programs have already selected and included some of these superior lines in their national district trials. Response to and results of our cooperation with national programs have, therefore, been most encouraging and augur well for the future.

We consider hybridization a priority area and consequently have trained 20 field assistants who have attained an acceptable level of expertise. They have assisted in making over 400 crosses for the high yield and quality breeding program, for rosette disease resistance and for early leaf spot disease tolerance. We offer this service to national programs and are currently assisting Mozambique and Zimbabwe with selected hybridizations.

We also assist national programs by evaluating and documenting landraces, and have evaluated 345 Zambian, 60 Tanzanian and 45 Mozambican lines.

We have made progress with our studies on rosette disease and early leaf spot. By studying natural disease distribution patterns of rosette virus and by simulating these, we have developed a highly successful screening technique. We have also identified a number of high-yielding lines that apparently contain tolerance to early leaf spot. Several of these are Valencia landraces of South American origin, a group of great interest, but one hitherto largely neglected by breeders in our region.

Regional Activities

We have developed an effective regional network linking together groundnut scientists of the SADCC Countries.

We organized two multidisciplinary workshops, the first in Lilongwe, Malawi in 1984 and the second in Harare, Zimbabwe in 1986. These have facilitated and sustained close professional contact between all research scientists engaged in national improvement programs and have engendered a spirit of regional cooperation. The workshops have also provided invaluable opportunities for periodic reviews of the regional program by national programs when, as an active regional forum, national scientists have discussed how ICRISAT might best continue to respond to the needs of the region. We supplemented the workshops with a Groundnut Breeders, Group Meeting in 1985, which visited national breeding programs in Zimbabwe, Zambia, and Malawi.

In order to facilitate the exchange of information on results and techniques, we initiated an annual newsletter (Regional Groundnut News), based entirely on contributions from the national programs themselves. We also distribute groundnut abstracts and other literature to all national programs, several of which have limited access to relevant scientific literature.

Our small professional officer strength and other research and regional commitments have precluded any venture into training schemes. However, we assist where necessary with the placement of national program technicians in the ICRISAT Center 6-month In-service Training Scheme. During the past 3 years, groundnut research support technicians from Botswana, Malawi, Mozambique, Tanzania, and Zambia attended the course, which has led to a steady strengthening of the national program research capability. We also offer local training in hybridization and disease-screening techniques.

Peanut CRSP: The Peanut Collaborative Research Support Program

INTRODUCTION

Peanut CRSP has identified constraints to production, and linked host-country scientists with the U.S. institutions for collaborative research to overcome constraints.

Four U.S. universities were identified for collaborative research: Alabama A&M (AAMU), Georgia (UGA), North Carolina State (NCSU), and Texas A&M (TAMU). University at Florida (UFL) has some participation as a subgrantee to AAMU. The collaboration with 9 host countries provides an impact on three major regions: SAT Africa, Southeast Asia, and the Caribbean. The countries that benefit are: Burkina Faso, Niger, Nigeria, Philippines, Senegal, Thailand, and the English-speaking Caribbean countries through the Caribbean Agricultural Research and Development Institute (CARDI).

The program is funded through "Title XII--Famine Prevention and Freedom from Hunger" under the "International Development and Food Assistance Act of 1975", and the participating U.S. and host-country institutions. The Peanut CRSP was implemented 1 July 1982 and continues through 30 June 1987. A 3-year extension was approved by Board for International Food and Agricultural Development on 13 May 1986.

OBJECTIVES

General

The Peanut CRSP has two general objectives common to all projects.

1. Enhance research programs in the U.S. and host-country institutions through

- development of cultivars, management practices, and utilization processes that would lower costs and enhance groundnut use,
- support of programs in terms of equipment, supplies, travel, and personnel.

2. Improve the research capability of host-country institutions by

- offering short term and degree oriented training programs for host-country staff at U.S. institutions,
- providing on-site consultation in the host-countries by U.S. scientists.

Specific

The specific research objectives of the projects that comprise the Peanut CRSP were developed around prioritized constraints identified during the planning process. The constraints, program strategy, and research projects designed to gain information to relieve them follow.

1. Constraint identification. During the planning of the Peanut CRSP, 13 potential constraints to groundnut production and utilization were identified. Questionnaires were widely distributed in the U.S. and around the world; and a representative response was received. The Planning Grant Panel and Team evaluated the responses and summarized the most-important researchable constraints. Six constraint areas were included in the CRSP plan, which were reviewed and approved by BIFAD for the CRSP. The constraints are:

a. low yields because of unadapted varieties and lack of varietal resistance to diseases, insects, and drought;

b. health hazards and economic losses due to mycotoxin contamination;

c. yield losses due to infestation of weeds, insects, diseases, and nematodes;

d. inadequate food supplies since groundnuts are not generally considered a primary food source;

e. economic and sociological problems preventing efficient production and utilization;

f. physiological and soil microbiological barriers to higher yields.

2. Program strategy. The individual Peanut CRSP projects are designed to keep the host-country needs in the forefront, and simultaneously focus on regional problems (Table 1). Information is shared on a regional basis by means of reports, publications, and appropriate meetings. An international scope will be assured through information exchange and close coordination with International Agricultural Research Centers, The World Bank, The United Nation's organizations, and other United States Agency for International Development (USAID) programs from developed countries. Formal linkage was developed with ICRISAT to avoid program duplication or unnecessary overlap and insure maximum complementarity.

PEANUT CRSP ORGANIZATION

Peanut CRSP administration comprises a Management Entry, a Board of Directors, a Technical Committee, and an External Evaluation Panel.

Management

Dr Tommy Nakayama is the Program Director, and he is assisted by support

staff and Mr Ted Proffer, Business Manager, University of Georgia, College of Agriculture; Dr Darl Snyder is the Director of International Development and Title XII Representative, University of Georgia.

Responsibilities. The University of Georgia Management Entity office is located in the College of Agriculture at the Georgia Station, Experiment, Georgia. The major role is responsibility to USAID for technical and administrative matters for the CRSP. Duties include negotiating agreements, fiscal, management, progress reports, and project modification.

Board of Directors

The Board consists of five members. They include one administrative representative from each of the four participating U.S. institutions (4) and one from ICRISAT.
The tenure of members is at the discretion of the individual institutions. A chairman and a secretary are elected.

The present board is:

Dudley T. Smith (Chairman), Texas A&M University; Billy E. Caldwell (Secretary), North Carolina State University; Charles W. Laughlin, University of Georgia; B. Onuma Okezie, Alabama A&M University; Ron W. Gibbons, Director of the ICRISAT Sahelian Center and Executive Director of ICRISAT's West African Programs.

Technical Committee

The committee consists of one principal investigator from each participating U.S. institution.

The present Technical Committee is : Johnny C. Wynne (Chairman), North Carolina State University; Bharat Singh, Alabama A&M University; James W. Demski, University of Georgia; Craig Kvien, University of Georgia; Olin D. Smith, Texas A&M University. The Program Director/Administrative Secretary of the Management Entity serves as Secretary to the Committee.

Responsibilities. The Technical Committee acts in an advisory role to the Board of Directors and Management Entity. Primary duties are to review and recommend plans for research, training, and budgetary components of the projects; to establish mechanisms for program coordination in host countries; and to assist in planning annual reviews.

External Evaluation Panel

The External Evaluation Panel was described in the CRSP Plan to consist of three to five eminent scientists recommended by the Management Entity for review and approval by USAID.

The present five-member Panel consists of:
Donald C. Pickering, Assistant Director, Agriculture and Rural Development, World Bank, Washington DC, USA; Arthur Hugh Bunting, Professor Emeritus of Agricultural Development Overseas, University of Reading, UK; Pierre Gillier, Head of Annual Oil Crops Department of the IRHO, (Retired) Paris, France; Kenneth H. Garren, Research Leader (Retired), Suffolk, USA; Max Milner, Executive Officer (Retired), American Institute of Nutrition, Rockville, MD, USA.

Responsibilities. The role of the external evaluation panel is to monitor and evaluate program direction and accomplishments. Duties include a review of projects and programs of the CRSP and provide a written evaluation, and recommendation for addition, elimination, or modification of component projects and overall objectives to include retention, elimination, or addition of new overseas sites.

TABLE 1. Relationship of Peanut CRSP research projects to constraints in developing countries, and priorities for implementation.

Project/USA Institute	Country/Region	Constraint
Economic Survey: Short term contract studies/ CRSP management.		O Economic Problems
International Peanut Evaluation Program/ UGA	Niger, Burkina Faso, the Caribbean	O Low-yielding cultivars
Breeding for resistance to foliar and soilborne diseases/ TAMU	Senegal	O Low-yielding cultivars O Yield losses from pests o Health hazards from mycotoxins
Mycotoxin management/ TAMU	Senegal	O Health hazards from mycotoxins
Viruses: etiology, epidemiology, and nature of resistance/ UGA	Nigeria	O Yield losses from pests
Peanut varietal improvement/ NCSU	Thailand, the Philippines	O Low-yielding cultivars O Yield losses from pests o Soil microbiological barriers
Management of arthropods/ NCSU	Thailand, the Philippines	O Yield losses from pests
Integrated Pest Management strategies/ UGA	Burkina Faso	O Yield losses from pests
Consumption of peanuts as food and appropriate technology for storage and utilization/ UGA	Thailand, the Philippines	O Inadequate food supplies o Health hazards from mycotoxins o Economic problems
Peanut utilization in food systems/ AAMU (FL)	The Caribbean	O Inadequate food supplies o Health hazards from mycotoxins o Economic problems
Rhizobia and mycorrhizae influence on nitrogen fixation and growth/ NCSU, TAMU	Thailand, the Philippines	O Soil microbiological barriers

O Primary objective of the project o Secondary objective

Training

One objective of the Peanut CRSP is to improve the research capability of host country institutions by offering short term and degree-oriented training programs for host-country staff at the U.S. institutions and providing on-site consultation in the host countries by U.S. scientists. In addition, U.S. university phases of the research programs are enhanced through support of U.S. graduate students. Accomplishments during the year are as follows:

1. A total of 19 scientists visited collaborators at the U.S. institutions on a scientist-to-scientist basis. Activities included:
   a. Laboratory and field training in research methodologies.
   b. Review of research accomplishments.
   c. Planning of future research activities.

2. Seven host-country students are enrolled in programs leading to graduate degrees at NCSU, UGA, TAMU, and AAMU.

3. Thirty U.S. students are provided either full-time or partial support for graduate degree programs at AAMU, UGA, TAMU, and NCSU.

4. A total of 18 site visits were made by 22 U.S. scientists during the year. Total time spent was 323 days or 1.25 man years. The scientists reviewed research progress, discussed and developed future research plans, participated in field and laboratory research, and provided training in specific field and laboratory research techniques.

Report on a Group Meeting in Malawi on Groundnut Rosette Disease

Following earlier meetings in Georgia, USA, in 1983, and in Cambridge, UK, in 1985, the third Consultative Group Meeting to discuss Collaborative Research on Groundnut Rosette Virus Disease was held 8-10 March, 1987, in Lilongwe, Malawi.

Eighteen participants working on groundnut virus diseases represented ICRISAT (ICRISAT Center and the Regional Groundnut Program for Southern Africa), and research institutions in France, the Federal Republic of Germany, Malawi, Nigeria, UK, and USA.

Scientists from outside Africa were able to see groundnut rosette disease in the field and to examine on-going research at ICRISAT's Regional Groundnut Program for Southern Africa at Chitedze Agricultural Research Station of the Malawi Ministry of Agriculture. Much interest was shown in the method of field resistance screening that ensured levels of over 90% incidence of rosette disease in susceptible test genotypes. Several rosette-resistant breeding lines were shown to participants and arrangements were made to provide seed of these lines to the different groups. There were also requests made for seed of RG 1, a rosette-resistant cultivar released by Malawi more than 10 years ago. There are excellent prospects of breeding rosette-resistant cultivars suited to the needs of farmers in various agroecological zones of southern Africa. Resistant cultivars will also be tested in Nigeria, and in ICRISAT's recently established West African Groundnut Network.

A field visit was arranged by the Malawi Ministry of Agriculture to groundnut farms in the Lilongwe District. The incidence of rosette disease was low, but participants were able to meet farmers and extension

workers and discuss rosette and other virus disease problems.

In a final discussion session, participants agreed to continue collaborative research, with increased emphasis on resistance breeding and on vector ecology to develop effective disease management systems. The proposal for ICRISAT to produce a comprehensive Information Bulletin on Groundnut Rosette Disease was strongly supported. As most participants had general interest in groundnut virus diseases, it was suggested that the collaboration on rosette virus diseases should be expanded to include other important virus diseases of groundnut in Africa.

A summary Proceedings of the Group Meeting will be produced by ICRISAT in the near future.

Report on the Regional Plant Protection Group Meeting and Tour in Zimbabwe, Zambia, and Malawi, 16-20 February 1987

The ICRISAT Regional Groundnut Program for Southern Africa organized the Regional Plant Protection Group Meeting and Tour in Zimbabwe, Zambia, and Malawi, from 16 to 20 February 1987. Seventeen scientists from seven countries (Zimbabwe, Zambia, Malawi, Mozambique, Swaziland, Tanzania, and India) participated in the meeting and field tours.

The major objectives of the meeting and tour were : (i) to sustain and to strengthen further the professional contacts made between scientists during the Regional Groundnut Workshops for Southern Africa held in Lilongwe, Malawi, in 1984, and in Harare, Zimbabwe, in 1986, (ii) to provide all active groundnut Pathologists and Entomologists in the region an opportunity to discuss their problems and progress, and observe and discuss the plant protection and breeding programs in the field in Zimbabwe, Zambia, and Malawi, and (iii) to emphasize the role of pathologists and entomologists in groundnut improvement programs.

The meeting program included reports from the respective countries, and in-depth discussions on pests, and on fungal, viral, and nematode diseases of groundnut. Discussions were also held on disease rating scales, on international/regional disease nurseries, and on procedures for field screening germplasm and breeding lines for resistance to the major diseases of groundnut in the SADCC region. Special papers were presented on "The Aflatoxin Contamination Problem in Groundnut--Control with emphasis on Host Plant Resistance" and "Analytical Methods for Detection and Estimation of Aflatoxins". Laboratory demonstrations were organized on methods to test groundnut genotypes for resistance to seed invasion and colonization by Aspergillus flavus. The participants also visited various field trials at the Chitedze Agricultural Research Station, Lilongwe, Malawi, and the Msekera Regional Research Station, Chipata, Zambia, to get acquainted with symptoms of various diseases and pests, and with management of disease-sick plots and nurseries.

ICRISAT's Asian Grain Legumes Network

The Asian Grain Legumes Network (AGLN) was initiated by ICRISAT at the beginning of 1986 to intensify its input into legume research programs in Asian countries, including those working with groundnut. Guidance for its structure was provided by two Consultants' Meetings at ICRISAT of representatives from Asian countries, one in December 1983 and one in December 1985. A major recommendation was that a Coordinator be appointed by ICRISAT, which was done on 1 January 1986.

Since his appointment as Coordinator, Dr D.G. Faris has visited all nine countries in the network (Bangladesh, Burma, Indonesia, Nepal, Pakistan, the People's Republic of

China, the Philippines, Sri Lanka, and Thailand). India has a special relationship in the Network through the close ties ICRISAT has with the Indian Council of Agricultural Research (ICAR). These visits have been used to explain the purposes of the Network and to help forge stronger links between the groundnut program at ICRISAT and the groundnut research program in each member country.

The objectives of the AGLN are to:

- produce a directory of AGLN cooperators;
- operate an information bank for the cooperators;
- support identification of adapted grain legume lines and the appropriate agronomy for their cultivation in each AGLN country through such means as trial networks;
- promote training of legume scientists for AGLN countries;
- foster special research projects to support the AGLN.

The AGLN helps to make available information on groundnut at ICRISAT to scientists and institutions with groundnut research, supplies breeding and germplasm material, and supports testing networks in member countries.

A special feature of the AGLN is the coordination of its activities with those of other regional and international research organizations and donor groups operating in AGLN countries, such as International Development Research Centre (IDRC), Canada and Peanut CRSP. This is aimed at minimizing overlap of effort.

The main activities of the AGLN at present are to identify and recruit groundnut researchers as cooperators for the Network, organize appropriate trial networks on groundnut in each country, facilitate dispatch of seed material, information, and literature from ICRISAT, and encourage the training at ICRISAT of Asian scientists, technicians, and advanced-degree students working on groundnut. The AGLN encourages each country to ask ICRISAT staff to attend their national groundnut planning meetings so that ICRISAT material and trials can be effectively integrated into national programs. The AGLN is also attempting to identify funds to help support its activities in each country.

INVITATION TO JOIN THE AGLN

If you are working on the improvement of groundnut in Asia and are interested in receiving information about literature, breeding and germplasm material, and training that is available at ICRISAT, you are invited to become a cooperator in the Asian Grain Legumes Network (AGLN). Application forms are available from:

The Coordinator
Asian Grain Legumes Network
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
Patancheru
Andhra Pradesh 502 324, INDIA

ICRISAT Publications Relevant to Groundnuts

ORDERING INSTRUCTIONS

Per-copy prices are listed separately for:
- highly developed countries (HDCs), expressed in U.S. dollars;
- less-developed countries (LDCs), also expressed in U.S. dollars;
- India and other countries in the Indian subcontinent (India), expressed in rupees at a rate equivalent to the LDC price.

Out-of-print publications are available as microfiche copies, at flat-rate page charges inclusive of postage.

Requests for publications should be sent to:
Information Services
International Crops Research Institute for the Semi-Arid Tropics
Patancheru
Andhra Pradesh 502 324, INDIA

Give short title, ICRISAT order code, and number of copies requested for each publication.

Please use ICRISAT order codes, given in bold type, when ordering or requesting publications. Third letters in these codes -- E, F, and S -- refer to English, French, and Spanish editions.

Organizations that formally exchange publications with ICRISAT Library, libraries of key agricultural universities and research institutes, journal editors who review ICRISAT publications, and national program staff who collaborate with ICRISAT research programs are entitled to receive single free copies. Please indicate if you collaborate in the work of the Institute, and therefore request the free supply of the publications; and if you are willing to pay the postage and handling costs. Also indicate if you do not have access to dollars or rupees and therefore cannot defray those costs.

For other clients ICRISAT will send a proforma invoice offering a choice between air bookpost and surface mail. Experience shows that surface packages are often delayed for months, do not always reach their destinations, and may be damaged. We therefore recommend air bookpost as the best option, even though it is the more expensive.

RESEARCH BULLETINS

A series of occasional bulletins by which Institute staff and consultants report their research findings, including the results of long-term projects, that do not readily lend themselves to publication in a journal or similar scientific literature outlets. The target audience is peer scientists worldwide.

Norman, D.W., Newman, M.D., and Ouedraogo, I. 1981. Farm and village production systems in the semi-arid tropics of West Africa: an interpretive review of research. (Summary in Fr.) Research Bulletin no.4, Vol. 1. 100 pp. 264 ref. ISBN 92-9066-033-3.
RBE 003 LDC: $ 1.90 HDC: $ 5.70 India: Rs.24.00

Ouedraogo, I., Newman, M.D., and Norman, D.W. 1982. The farmer in the semi-arid tropics of West Africa: a partially annotated bibliography. (Summary in Fr.) Research Bulletin no. 4, Vol. 2. 132 pp. ISBN 92-9066-045-7.
RBE 004 LDC: $ 2.50 HDC: $ 7.50 India: Rs.32.00

INFORMATION BULLETINS

This occasional series of short, well-illustrated bulletins is the main vehicle for information derived from ICRISAT research findings that has immediate application. The target audience is national agricultural program scientists and extension staff in countries of the semi-arid tropics.

Yadav, S.R., Prasannalakshmi, S., and Jadhav, P.S. 1978. Indian theses on groundnut: a bibliography 1948-1977. Information Bulletin no. 4. 54 pp. 303 ref.
ISBN 92-9066-010-4.
BE 004 Free: postage to be prepaid

Sivakumar, M.V.K., Virmani, S.M., and Reddy, S.J. 1980. Rainfall climatology of West Africa: Niger. Information Bulletin no. 5. 72 pp. ISBN 92-9066-021-X.
IBE 005 Microfiche only LDC & HDC: $ 4.80 India: Rs. 60.00

Virmani, S.M., Reddy, S.J., and Bose, M.N.S. 1980. A handbook on the rainfall climatology of West Africa: data for selected locations: Information Bulletin no. 7. 56 pp. ISBN 92-9066-023-5.
IBE 007 Microfiche only LDC & HDC: $ 4.20 India: Rs. 53.00

Virmani, S.M., Reddy, S.J., and Bose, M.N.S. 1980.Manuel de climatologie pluviale de l'Afrique Occidentale: donnes pour des stations selectionees. Bulletin d'information no. 7. 56 pp. ISBN 92-9066-024-4.
IBF 007 Microfiche only LDC & HDC: $ 4.20 India: Rs. 53.00

Subrahmanyam, P., and McDonald, D. 1983. Rust disease of groundnut. (Summary in Fr.) Information Bulletin no. 13. 20 pp. 38 ref. ISBN 92-9066-058-9.
IBE 013 LDC: $ 1.00 HDC: $ 3.00 India: Rs. 13.00

Thompson, J.A. 1984. Production and quality control of carrier-based legume inoculants. (Summary in Fr.) Information Bulletin no. 17. 40 pp. 88 ref. ISBN 92-9066-071-6.
IBE 017 LDC: $ 1.00 HDC: $ 3.00 India: Rs. 13.00

Sivakumar, M.V.K., Konate, M., and Virmani, S.M. 1984. Agroclimatology of West Africa: Mali. (Summary in Fr.) Information Bulletin no. 19. 300 pp. 20 ref. ISBN 92-9066-073-2.
IBE 019 Microfiche only LDC & HDC: $ 19.20 India: Rs. 240.00

Sivakumar, M.V.K., Konate, M., and Virmani, S.M. 1984. Agroclimatologie de l'Afrique de l'Ouest: le Mali. (Resume in Fr.) Bulletin d'information no. 19. 300 pp. 20 ref. ISBN 92-9066-073-2.
IBF 019 LDC: $ 7.90 HDC: $23.70 India: Rs. 99.00

McDonald, D., Subrahmanyam, P., Gibbons, R.W., and Smith, D.H. 1985. Early and late leaf spots of groundnut. (Summary in Fr.) Information Bulletin no. 21. 24 pp. 56 ref. ISBN 92-9066-090-2.
IBE 021 LDC: $ 1.30 HDC: $ 3.80 India: Rs. 17.00

Dick, K.M. (In press). Pest management in stored groundnuts. (Summary in Fr.) Information Bulletin no.22. ISBN 92-9066-124-0.
IBE 022.

WORKSHOP/SYMPOSIUM/MEETING PROCEEDINGS

ICRISAT 1980. Proceedings of the Consultants' Group Discussion on the Resistance to Soil-borne Diseases of Legumes, 8-11 Jan 1979, ICRISAT Center, India. 176 pp. ISBN 92-9066-027-9.
CPE 006 LDC: $ 3.40 HDC: $10.20 India: Rs. 43.00

ICRISAT 1980. Proceedings of the International Workshop on Groundnuts, 13-17 Oct 1980, ICRISAT Center, India. 334 pp. ISBN 92-9066-032-5.
CPE 012 Microfiche only. LDC & HDC: $ 21.00 India: Rs. 263.00

ICRISAT 1980. Abstracts of the Workshop on Groundnuts, 13-17 Oct 1980, ICRISAT Center, India. (In En, Fr.) 100 pp. ISBN 92-9066-039-2.
CPE 013 LDC: $ 1.90 HDC: $ 5.70 India: Rs. 24.00

ICRISAT 1984. Grain legumes in Asia: Summary Proceedings of the Consultative Group Meeting for Asian Regional Research on Grain Legumes (Groundnut, Chickpea, Pigeonpea), 11-15 Dec 1983, ICRISAT Center, India. 102 pp. ISBN 92-9066-080-5.
CPE 028 LDC: $ 2.00 HDC: $ 6.00 India: Rs. 25.00

ICRISAT 1985. Proceedings of the International Workshop on Cytogenetics of Arachis, 31-Oct 2 Nov 1983 ICRISAT Center 198 pp. ISBN 92-9066-091-0.
CPE 025 LDC: $ 5.00 HDC: $15.00 India: Rs. 63.00

ICRISAT 1985. Proceedings of the Regional Groundnut Workshop for Southern Africa, 26-29 Mar 1984, Lilongwe, Malawi. 196 pp. ISBN 92-9066-092-9.
CPE 029 LDC: $ 5.00 HDC: $15.00 India: Rs. 63.00

ICRISAT 1985. Collaborative research on groundnut rosette virus: summary proceedings of the Consultative Meeting to Discuss Collaborative Research on Groundnut Rosette Virus Disease, 13-14 Apr 1985, Cambridge, UK. ICRISAT. 28 pp. ISBN 92-9066-113-5.
CPE 033 LDC: $ 1.30 HDC: $ 3.80 India: Rs. 17.00

ICRISAT 1986. Agrometeorology of Groundnut: proceedings of the International Symposium, 21-26 Aug 1985, ICRISAT Sahelian Center, Niamey, Niger. 292 pp. ISBN 92-9066-112-7.
CPE 038 LDC: $ 7.40 HDC: $22.00 India: Rs. 93.00

ICRISAT 1987. Coordination of grain legumes research in Asia: Summary Proceedings of the Review and Planning Meeting for Asian Regional Research on Grain Legumes (Groundnut, Chickpea, and Pigeonpea), 16-18 Dec 1985, ICRISAT Center, India. 96 pp. ISBN 92-9066-120-8.
CPE 040 LDC: $ 4.60 HDC: $ 13.80 India: Rs. 58.00

GENERAL AUDIENCE PUBLICATIONS

(Single copies issued free)

ICRISAT 1983. Training at ICRISAT. Patancheru, A.P. 502 324, India: ICRISAT. 2 pp.
GAE 004

ICRISAT 1984. Plant quarantine at ICRISAT. Patancheru, A.P. 502 324, India: ICRISAT. 2 pp.
GAE 011

ICRISAT 1986. ICRISAT in Africa. Patancheru, A.P. 502 324, India: ICRISAT. 60 pp.
GAE 012

ICRISAT 1986. l'ICRISAT en Afrique. Patancheru, A.P. 502 324, India: ICRISAT. 60 pp.
GAF 012

CATALOGS OF ICRISAT PUBLICATIONS

ICRISAT 1987. ICRISAT Publications 1987.
GAE 009

ICRISAT 1987. Publications de l'ICRISAT 1987.
GAF 009

R & D LEAFLETS

An unnumbered series of R&D Leaflets, each one two pages long, comprising brief statements of potentially adoptable ICRISAT research findings, and summaries of forthcoming publications. Single copies issued free.

Proceedings of the Regional Groundnut Workshop for Southern Africa, Lilongwe, 1984. 1985.
RLE 005

Early and late leaf spots of groundnut. 1985.
RLE 006

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