ISSN 1010-5824

International Arachis Newsletter

Prepared by
LEGUMES PROGRAM
Patancheru, Andhra Pradesh 502 324, India

No. 7 May 1990

● 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 (Supported by USAID Grant No.DAN-4048-G-SS-2065-00). 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 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 shorten 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 include a maximum of two relevant and well-prepared tables, *or* figures, *or* diagrams, *or* photographs. Tables must not exceed 85 characters in width. All photographs should be good quality black-and-white prints on matt (nonglossy) surface paper in 85 mm or 180 mm width; send with negatives if possible. Color transparencies or color prints will not be accepted. Do not fold the photo or write on it, but identify each photo on the back with author's name and figure number. Type captions or legends on separate sheets, also clearly identified. Electron micrographs or photo micrographs should indicate the magnification in the caption. 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 (See ICRISAT Style Guide Section of References reproduced at end of this issue.). All contributions should be typed in double spacing and two copies submitted.

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

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

The Editor
International Arachis Newsletter
Legumes Program
ICRISAT, Patancheru
Andhra Pradesh 502 324
INDIA

Cover illustration: *Arachis hypogaea* and some alternative names for groundnut.

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News and Views

Editorial

At the outset, we wish to record our sincere appreciation and thanks to Dr J.P. Moss, who as the Senior Scientific Editor ensured the smooth publication of the IAN for about 2.5 years from its inception. The new team now consists of Drs L.J. Reddy and P. Subrahmanyam as scientific editors, and Mr J.J. Abraham and Mr B.B. Sahni as technical editors. We wish to assure our readers, that we will try our best to uphold the proud tradition set by Dr Moss through his excellent work, which made the IAN very popular around the globe, within a short span.

The seventh newsletter contains reports on groundnut production in Indonesia and China, disease surveys in Guinea, Zambia, and Vietnam apart from other short research communications. We request scientists from other groundnut-growing countries--especially those in southern Africa, eastern Africa, and Latin America to send us reports on groundnut production constraints, disease and insect surveys they might have conducted.

While, there have been innumerable requests for inclusion in the IAN mailing list, the articles received for inclusion in the newsletter are few. So we request our readers to actively contribute articles to the newsletter. For the benefit of our contributors we have enclosed, "Guide for Authors"--an excerpt from ICRISAT Style Guide at the end of this newsletter. Please follow it while preparing manuscripts for the newsletter.

L.J. Reddy
P. Subrahmanyam

News from ICRISAT Center

Report on Collaborative Research Planning Meeting for Bacterial Wilt of Groundnut

This meeting, cosponsored by the Australian Centre for International Agricultural Research (ACIAR) and ICRISAT was held at Genting highlands, Malaysia 18-19 Mar 1990. Thirty scientists, from Australia (4), AVRDC (1), China (4), India (1), Indonesia (5), Malaysia (4), Nepal (1), the Philippines (1), Sri Lanka (1), Thailand (1), UK (2), USA (1), and ICRISAT (4) participated in the meeting.

Five papers reviewing the present state of knowledge on the bacterial wilt of groundnut caused by *Pseudomonas solanacearum* were presented by specialists in the field:

- Diagnosis, distribution and status of groundnut bacterial wilt (by A.C. Hayward);
- Host-plant resistance to *Pseudomonas solanacearum* (by K.Y. Lum);
- Control of bacterial wilt of groundnut in China, with emphasis on biological and cultural methods (by He Li-Yuan);
- Monoclonal antibodies for identification of plant pathogenic bacteria--potential for application to *P. solanacearum* (by A. Alvarez and A.A. Benedict); and
- Molecular biology and research on *P. solanacearum* (by Qing Sheng Ma).

The participants held group discussions to plan future research activities, and make recommendations. The discussion and groups were:

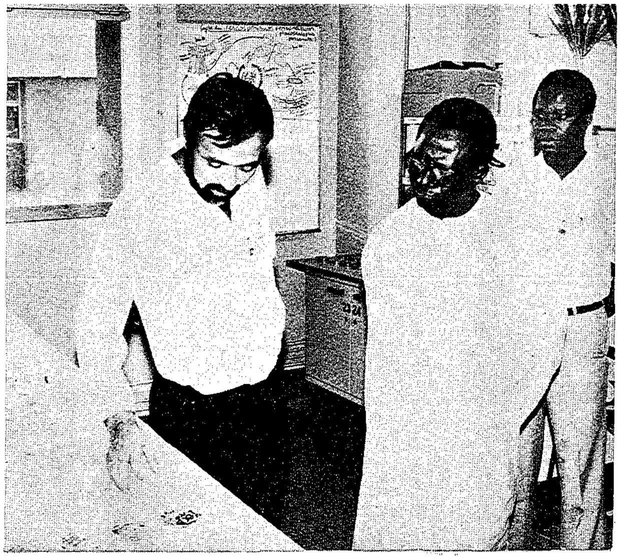
- Host-plant resistance (led by G. Hartman)
- Detection and diagnosis (led by S. Eden-Green)
- Disease management (led by V.K. Mehan)

Based on the reports from each group, the participants prepared and approved the recommendations. Some of the recommendations are given below:

1. Dr A.C. Hayward, University of Queensland, Brisbane, Australia, requested to act as Technical Coordinator for studies pertaining to *P. solanacearum* including characterization, etc. (Dr Hayward has accepted this responsibility),
2. The Asian Grain Legumes Network (ICRISAT) Coordinator to act as Administrative Coordinator and begin a collaborative network for germplasm exchange, technical assistance, and information exchange,

3. Network participants in each country to coordinate work on bacterial wilt have been identified,
4. Host-plant resistance breeding be given greater emphasis as a means of control of bacterial wilt,
5. Scientists in People's Republic of China and Indonesia be asked to take the lead in research on cultural and biological control methods of bacterial wilt,
6. Standardization of available techniques be emphasized, and new techniques be developed to assist in detection, diagnosis, and characterization of *P. solanacearum,*
7. Studies related to seed transmission, importance of weed hosts, biological control, and role of nematodes and insects on the development of disease be explored, and
8. Training, particularly in pathogen detection, disease diagnosis and disease management, be imparted to assist interested scientists in developing countries.

The Proceedings of the meeting will be published jointly by ACIAR and ICRISAT.



Prof. Hamidou Sekou, Minister for Higher Education, Research and Technology, Niger (Center) being shown research work on *A. flavus* contamination of groundnut by an ICRISAT scientist.

News about ICRISAT Groundnut Scientists

Dr M.J. Vasudeva Rao, Groundnut Breeder, ICRISAT Center, left ICRISAT effective 30 Jan 1990 to become a Plant Breeder with ICI (India) Ltd. He is stationed at Bangalore, India, with the Agrochemicals Unit of the company.

Dr P.T.C. Nambiar, Cell Biologist, ICRISAT Center, left ICRISAT on 6 Apr 1990 to take up an assignment in the Microbial Biotechnology Division, University of Waterloo, Ontario, Canada.

News from the ICRISAT Sahelian Center

Niger Minister visits ICRISAT Sahelian Center.

The Minister for Higher Education, Research and Technology, Government of Niger, Prof. Hamidou Sekou visited the ICRISAT Sahelian Center on 31 Jan 1990. He was briefed on the ICRISAT activities worldwide and in particular West Africa.

Second Regional Groundnut Meeting for West Africa

ICRISAT, in collaboration with Peanut CRSP, is organizing the Second Regional Groundnut Meeting for West Africa at ICRISAT Sahelian Center, Sadore (near Niamey), Niger, from 11 to 14 Sep 1990.

The country reports and deliberations of the first meeting that was held at Niamey in 1988 were most encouraging. The purpose of this meeting is to follow up the recommendations made during the first meeting as well as to look into the progress made in groundnut research since then.

The workshop is planned for 4 days including field visits. Contributions will be on current research on the following subjects: Groundnut Agronomy, Groundnut Breeding, Groundnut Pathology/Entomology, and Groundnut Quality and Food Technology.

SADCC/ICRISAT Groundnut Project

Fourth Regional Groundnut Workshop for Southern Africa Held

Twenty-three out of 32 national program scientists actively engaged in groundnut improvement in the Southern African Development Coordination Conference (SADCC) region participated in the Regional Workshop held 19-23 Mar at Arusha, Tanzania. Angola and Zimbabwe were the only countries of the region that were not represented. (A paper from Zimbabwe was received by the organizers after the conclusion of the Workshop.)

Also participating were groundnut scientists from Kenya, Mauritius, Uganda, ICRISAT Center, ICRISAT Sahelian Center, SADCC/ICRISAT Groundnut Project (Malawi), and ICRISAT's Eastern Africa Regional Cereals and Legumes Network (Kenya). Papers reviewed groundnut research on breeding, entomology, agronomy, leaf spot diseases, and cropping systems. The recommendations of the Workshop provide valuable guidelines for regional project activities.

The Workshop was declared open by Tanzania's Deputy Principal Secretary Mr Ludovick Rimisho, on behalf of the Minister of Agriculture and Livestock Development Mr S. Wassira.

News from Peanut CRSP (Collaborative Research Support Program)

North Carolina State University (NCSU). Dr T. Isleib will assume the duties of groundnut breeder/geneticist and Peanut CRSP Project Leader in the Crop Science Department in late March. He replaces Dr J.C. Wynne, who earlier was appointed Head of the Crop Science Department. Dr Isleib comes to NCSU from Michigan State University where he is soybean breeder/geneticist. His Ph.D. was from NCSU in groundnut breeding/genetics.

Dr W.V. Campbell has retired as entomologist at NCSU. He has part-time duties in the Entomology Department to continue Peanut CRSP research until 30 Jun 1990.

Program Extension. The Peanut CRSP has been extended for another 5 years. The Board for International Food and Agricultural Development (BIFAD), a joint University, Industry, and USAID Board, recommended the extension following presentation of a 5-year plan by the CRSP that culminated in a year of review and planning.

"Buy-in" Arrangement. The Peanut CRSP now has a Basic Ordering Agreement with U.S. Agency for International Development (USAID), which will allow "buy-ins" into the program. Interested countries can address the CRSP through support of the local USAID missions with mutually acceptable proposals. The agreement is on a contractual basis with specific outputs defined. Objectives must be in the present scope of the CRSP, which includes breeding, cultural practices, pathological and insect pests, mycotoxins, postharvest practices, and food technology. Interested individuals in either host- or nonhost countries should discuss and develop plans with the local USAID mission and initiate contact with the Peanut CRSP Management Office. Funds to support these expanded activities would have to come from the local USAID mission and would contract for a particular service in research, training, outreach, or technical assistance.

Award. Peanut CRSP collaborators at Khon Kaen were awarded the Outstanding Research Accomplishment Award for 1988 by the Thailand Department of Agriculture for the release of the cultivar Khon Kaen 60-3.

Workshop. The Peanut CRSP sponsored a Workshop on Breeding for Acid Soil and Shade Tolerance and Entomology at Philippine Council for Agriculture and Resources Research and Development (PCARRD), Los Baños, the Philippines, 3-5 Apr 1990.

Dr R.E. Lynch, University of Georgia entomology project, traveled to Burkina Faso and ICRISAT Sahelian Center, Niamey, for collaborative research and planning from 30 Oct to 10 Nov 1989.

Dr M. Chinnan traveled to Jamaica from 4 to 7 Dec 1989 for a collaborators planning conference for the Caribbean Agricultural Research and Development Institute (CARDI) postharvest project collaboration with the University of Georgia, USA.

Dr A. Resurreccion, University of Georgia food technology project, traveled to the Philippines and Thailand from 17 Feb to 4 Mar 1990 for work on the collaborative project. She was accompanied to the Philippines by graduate student K. Muego to initiate a 6-month effort to establish a processing and marketing pilot program for a groundnut-based cheese spread developed under the project.

Mr T. Oz-Ari, University of Georgia postharvest project, traveled to Belize from 10 to 19 Oct 1989 to assist in postharvest research.

Dr L. Wilding, Texas A&M University TROPSOILS (Soil Management CRSP), traveled to Burkina Faso from 4 to 21 Dec 1989 to conduct a soil survey of peanut research areas to enable extrapolation of research results to production areas. The inter-CRSP work was financed by the Peanut CRSP breeding cultural practices project in collaboration with Senegal, Mali, Burkina Faso, and Niger, and led by Dr O. Smith of Texas A&M University. He also visited Niger and the ICRISAT Sahelian Center.

Dr D. Cummins, Program Director, participated in CRSP Council Meetings in Washington, D.C., in Feb 1990. The CRSP Council is a cooperative effort of the eight CRSPs to seek collaboration among the programs to increase efficiency and impact of research and outreach in areas appropriate for cooperation.

Reports

Groundnut in Indonesia

A.K. Singh[1], **K. Soetjipto**[2], and **M.H. Mengesha**[1] (1. ICRISAT Center; 2. Bogor Research Institute of Food Crops, Indonesia)

History. Groundnut was introduced into Indonesia between 1521 and 1529 from south America by the spaniards (Rais Sri Astuti 1988). In 18th century runner-type groundnut was cultivated by Chinese farmers in West Java. Later erect types from England were introduced by Holle in 1863 and from Egypt by Scheffer in 1864.

The credit for popularizing groundnut in Indonesia goes to the Dutch; they introduced cultivars from different parts of the world, and also attempted improved selections and populations bred from hybridization between introductions and local selections. Locally, groundnut is called kacan tana (underground nuts). Many of the local varieties are named after animals, e.g., "Gajah" refers to elephant. The major cultivation of groundnut is confined to uplands (as an arable crop on slopes at high altitude) which cover about 66% of the cultivated area.

Areas and production. Groundnut is the second most important grain legume after soybean (Fig. 1). In recent years the crop has received more attention of the farming community. The production has increased from 437 000 t in 1982 to 642 000 t in 1986, because of increased area and productivity (Table 1). In 1989, groundnut was cultivated on

Table 1. Groundnut in Indonesia: area harvested, average yield, and total production, 1982-86.

Year	Area harvested ('000 ha)	Yield (t ha^{-1})	Production ('000 t)
1982	461	0.95	437
1983	481	0.96	460
1984	538	0.99	535
1985	510	1.04	528
1986	601	1.07	642

Source: Central Bureau of Statistics, (1987).

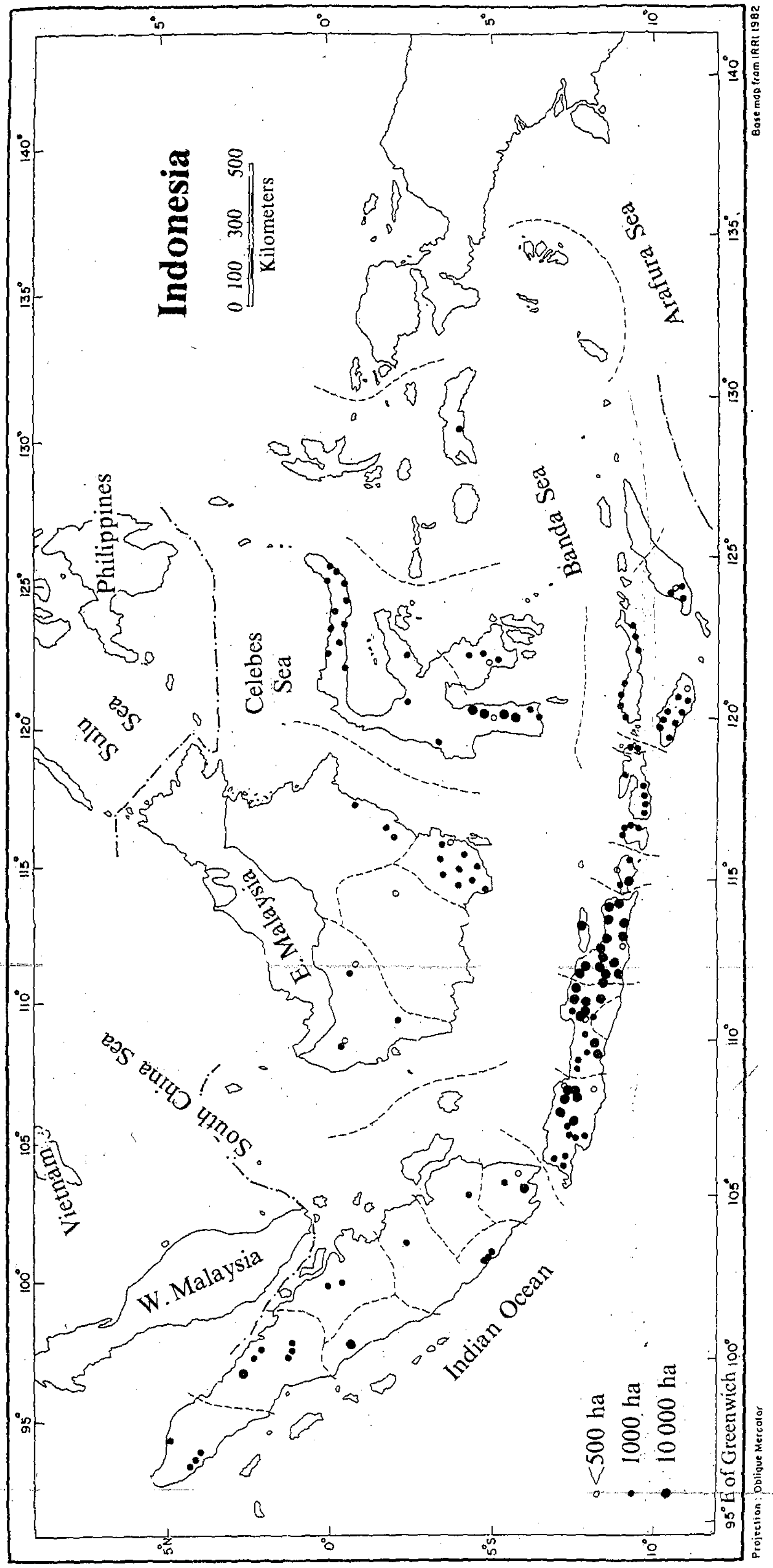


Figure 1. Groundnut distribution in Indonesia.

approximately 510 000 ha, 69% of which was in Java and the rest on the other major islands, such as, Sumatra, Sulawesi, Kalimantan, Bali, and Nusa Tenggara (province) (Table 2).

Table 2. Area harvested, production, and average yield of groundnuts in different regions of Indonesia, 1985.

Region	Area harvested ('000 ha)	Production ('000 t)	Yield (t ha^{-1})
Java	337	344	1.02
Sumatra	60	65	1.09
Kalmantan	15	16	1.06
Sulawesi	54	57	1.06
Bali and Nusa Tenggara	39	41	1.05
Other islands	5	4	0.80
Total	510	527	1.04

Source: Central Bureau of Statistics (1987).

Growing conditions. In the uplands, the groundnut crop is grown under rainfed conditions in rotation with rice. It is mainly grown in Regosols that have little sand and are gray to black. In east Java, it grows well on Latosols, and in Sumatra even on some acid soils with pH ranging from 4 to 5.

Cropping seasons and systems. The main season for groundnut cultivation is the rainy season that extends from mid-October to April. There are two growing periods, 1) from October to February, and 2) from February to May. However, in Java because of good rainfall the crop can be grown at anytime during the year. In irrigated lowlands (plains) it is also grown from April to June or from July to October, after harvesting the main rice crop.

The upland groundnut crop is generally grown in terraces on the flat as a monocrop or is sometimes mixed with other crops, mainly maize. In lowlands it is cultivated on the flat, on narrow or broadbeds, or in "*surjan system*". This system consists of 1-3-m wide deep flooded drains for cultivation of rice and 1-3-m wide raised broadbeds for cultivation of arable crops. Farmers have developed several intercropping systems according to their needs. Besides maize, groundnuts are grown as a base crop in orchards or intercropped with cassava, sugarcane, soybean, common beans, chillies, and even with rice under "*surjan system*".

Varietal improvement. Schwartz 21, one of the most popular groundnut varieties, and "Raja" were developed by a Dutch breeder through selection from locally adapted populations in 1909. Later hybridization between Schwartz 21 and other introductions from Japan and Israel led to the development of several varieties such as Macan, Gajah, Kidang, and Bantang in 1952. Some more introductions from Honduras and the USA were released under the following names: Pelanduk, Tupai, Tapir, Anoa, Kusa, and Landak. However, none of them became popular. Recently, a few germplasm lines were obtained from Uruguay, and from these a variety called Kelinci was released in 1983.

But all these varietal development activities had very little impact on farmers' cultivation and the old varieties such as Schwartz 21 and Gajah are still very popular. Ninety-five percent of cultivation is devoted to spanish cultivars, indicating that variability is limited to only one botanical variety, *A. hypogaea* subsp *fastigiata* var *vulgaris* and the popular cultivars have probably evolved from closely related cultivar groups.

Biotic and abiotic stresses. Late leaf spot caused by *Phaeoisariopsis personata* and the Peanut Stripe Virus (PStV) disease are the two major yield reducers, and occur almost in all groundnut-growing regions of Indonesia. PStV, in combination with certain other organisms cause yellowing symptoms, and can cause severe yield losses. Bacterial wilt caused by *Pseudomonas solanacearum* is another major biotic constraint; however, it generally appears to be a problem only in west Java. Rust caused by *Puccinia arachidis* appears late in the main cropping season with no significant economic loss.

In eastern Java, some soils are sandy and are deficient in phosphorus, potassium, sulfur, and zinc. Farmers generally apply fertilizers to such soils. Crops grown on these soils often suffer from terminal drought because of the low water holding capacity of these soils. This leads to serious aflatoxin-associated problems. Other groundnut soil areas have high rainfall and farmers there have developed effective water-management techniques. In Sumatra, soils are acidic (pH=4-5) and this could be a major yield reducing factor. The application of lime neutralizes the acidity and improves groundnut productivity.

Utilization. Most groundnut grown in Indonesia is used domestically for confectionery purposes, such as boiled nuts, salted nuts, groundnut candy, groundnut *tofu*, and *oncom* (fermented groundnut cake). In some areas, processing industries have developed. Groundnut haulms are used as cattle feed and are sold in regular markets during harvest.

Marketing. The traders grade groundnut by uniformity of pods. Generally a crop with a higher proportion of double white-seeded, mature pods fetches a higher price. In recent years, Indonesia has also emerged as an exporter of groundnuts to Singapore.

Future research needs. Research on groundnut in Indonesia has been very limited and has been confined to varietal development through introduction and selection. Bogor Research Institute for Food Crops (BORIF) and Malang Research Institute for Food Crops (MARIF) are the two major institutes now concentrating on groundnut research. The problems restricting groundnut production were identified in a recent workshop held at ICRISAT on Agroclimatology of Asian Grain Legumes growing areas (5-17 Dec 1988) and a meeting of groundnut scientists held at Malang, Indonesia (14-17 Nov 1988). Following are some research areas requiring early attention.

- An effort to increase genetic variability through germplasm enhancement, both by crossing the locally adapted genotypes with germplasm lines reported resistant to different stresses, and by the introduction of new germplasm originating from other equatorial regions of the world;
- Epidemiological studies in relation to major diseases such as late leaf spot, PStV, bacterial wilt and rust to develop better understanding on the spread of disease;
- Delineation of agroclimatic zones and the assessment of length of growing seasons (LGS);
- Breeding for genotypes that can fit in the available LGS in rice-based cropping systems; and
- Seed multiplication, storage, and distribution.

References

Rais Sri Astuti. 1988. Pelestarian dan Pemanfaatan Plasma Nutfah Kacan Tanah di Balai Penelitian Tanaman Pangan Bogor. Kursus Pemanfaatan dan Pelestarian Plasma Nutfah, 22 Pebruari - 12 Maret 1988 di Bogor, Bogor Research Institute for Food Crops, Bogor, Indonesia (Abstract).

Central Bureau of Statistics. 1987. Govt. of Indonesia, Central Bureau of Statistics, Jakarta, Indonesia.

Research Progress on Groundnut Germplasm in China

Duan Laixion and Zhou Rong (Oil Crops Research Institute, Chinese Academy of Agricultural Science, Wuchang 430 062, People's Republic of China)

China is one of the largest groundnut-producing countries in the world. Annually, groundnut is grown in over 3 million ha largely in the latitudes between 45 (°N) and 18 (°N).

The Oil Crops Research Institute, Chinese Academy of Agricultural Science, is a center of collection and conservation of groundnut germplasm in China and it coordinates research, conservation, and management. Since 1986, we have collected and conserved some 4200 groundnut germplasm accessions, including the three botanical types, spanish, valencia (Peruvian) and virginia. However, most of the collections belongs to the Peruvian type, known as "Dragon groundnut". Some 2800 accessions collected from 20 provinces in China have been described and evaluated for agronomical characters and the descriptors' list of these is being prepared for publication in 1990. Some 1400 germplasm lines have also been obtained from 20 countries, two-thirds of which were received from ICRISAT Center, USA, and India.

Several accessions were identified as resistant to rust, leaf spot, bacterial wilt, virus and root-knot diseases, and are being used in the resistance breeding program. Some accessions received from ICRISAT showed a high level of resistance to late leaf spot and rust in China. Local varieties are susceptible to late leaf spot and rust but some are highly resistant to bacterial wilt. Resistant genotypes from ICRISAT and elsewhere were crossed with local high-yielding cultivars and several promising selections have been made.

Survey of Groundnut Diseases in Guinea

F. Waliyar[1] and **N.B. Tounkara**[2] (1. ICRISAT Sahelian Center, B.P. 12404, Niamey, Niger; 2. Chef du Programme Vivrière du Centre de Recherche Agronomique de Foulaya (CRAF), B.P.156, Kindia, Republique de Guinée)

In collaboration with the Institute de Recherche Agronomique de Guinée (IRAG), we surveyed four agroclimatic zones (based on the annual rainfall) in 1989 to identify the constraints to groundnut production in major groundnut-growing areas of Guinea (Fig. 1). Guinea is located in the bimodal rainfall area of western Africa.

Groundnut is grown throughout the country and each family cultivates an average of 0.2 ha for home consumption. In Gaoual, Koundara, Dabola, and Dinguiraye states however, groundnut is grown on a large scale for commercial purposes. Groundnut is grown as a sole crop, intercrop (with maize, sorghum, cowpea, beans, etc.), or as a mixed crop.

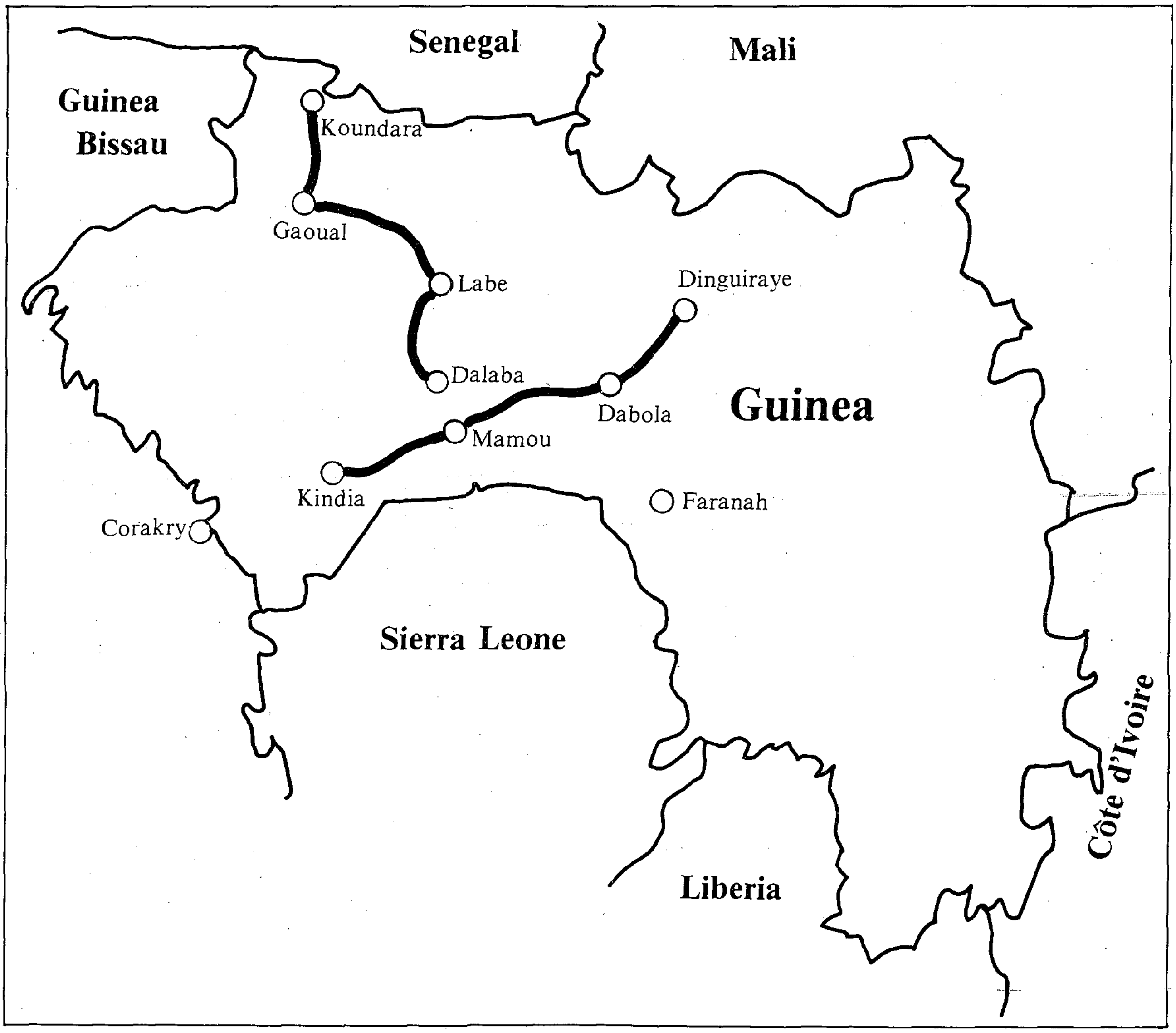


Figure 1. Route followed (marked ▬) to survey groundnut diseases in Guinea.

One of the most important diseases of groundnut in Guinea was early leaf spot (*Cercospora arachidicola* Hori.). The disease was found in all groundnut-growing areas. It was very severe in the Dabola region. In a 2-month-old crop there was up to 80% leaf damage due to early leaf spot. Late leaf spot [*Phaeoisariopsis personata* (Berk. & Curt.) v. Arx] was important only in the Kindia region (130 km from Conakry). In all other regions late leaf spot was not serious. Rust (*Puccinia arachidis* Speg.) was found in Kindia. It was severe only in a few fields. Rust was not observed in other regions.

Collar rot (*Aspergillus niger* van Tiegh) was the most common seedling disease and its incidence was very high in some regions. Insects and fungi are the major storage problems. We visited some traditional storage facilities and found a high percentage of seeds colonized by *A. flavus* Link ex Fr. and *A. niger*. These were the seeds meant for sowing in the following cropping season. In Guinea, seed dressing with fungicides is not practiced.

Among the viral diseases, groundnut rosette (both chlorotic and green) was the most important disease. We found groundnut rosette in all agroecological zones. The disease incidence, however, varies from year to year. In 1989, groundnut rosette was severe only in Dabola and Dinguiraye.

Peanut streak was found to be serious in Guinea. Peanut clump was found in some areas, but its incidence was low.

Other diseases such as pepper spot and leaf scorch [*Leptosphaerulina crassiasca* (Sechet) Jackson and Bell], web blotch [*Didymella arachidicola* (Chock) Taber, Pettit & Philley = *Phoma arachidicola*], root and pod rots (species of *Rhizoctonia* and *Fusarium*) and, stem rot (*Sclerotium rolfsii* Sacc.) were observed in a few places but they were not economically important.

Diseases of Groundnut in Vietnam

P. Subrahmanyam[1], L.J. Reddy[1], D.G. Faris[1], Ngo The Dan[2], and Nguyen Xuan Hein[3] (1. ICRISAT Center; 2. National Institute of Agricultural Sciences, Hanoi, Vietnam; 3. Institute of Agricultural Technology, Ho Chi Minh City, Vietnam)

Groundnut (*Arachis hypogaea* L.) is the second major agricultural export commodity of Vietnam. In recent years there has been a substantial increase in the area under groundnut cultivation. From 86 000 ha in 1965 it has grown to 290 000 ha in 1988, with an average yield of about 1000 kg ha^{-1}. Groundnut is grown mostly during the spring season (February to June) in northern Vietnam. However, the crop is grown throughout the year in southern Vietnam. Annual rainfall in most of the groundnut-growing areas exceeds 1500 mm. We have carried out disease surveys in 1987 (September to October), in 1988 (May to June), and in 1989 (April) to assess the relative importance of various diseases of groundnut in major groundnut-growing areas of Vietnam and the results are briefly presented in this report.

Early leaf spot (*Cercospora arachidicola* Hori.) was commonly present throughout Vietnam wherever groundnut is grown but it was most destructive in northern Vietnam. The disease onset was very early (flowering stage) in the season. Observations on disease severity on matured crops during the 1987 and 1988 crop seasons and on young crops during the 1989 crop season have lead us to speculate that early leaf spot causes substantial losses in yield in northern Vietnam. Although rust (*Puccinia arachidis* Speg.) and late leaf spot [*Phaeoisariopsis personata* (Berk. & Curt.) v. Arx] are commonly present in northern Vietnam, they occur mostly on maturing crops. Rust and late leaf spot were most severe in southern Vietnam leading to almost 100% damage to the foliage towards maturity. The cropping patterns in southern Vietnam, where groundnut is grown throughout the year, appears to provide an excellent opportunity for these pathogens to perpetuate from season to season. Fungicidal control of rust and leaf spots is not practised by Vietnamese farmers. All groundnut cultivars grown by farmers in Vietnam are susceptible to these diseases. Preliminary evaluation of ICRISAT-bred cultivars resistant to rust and late leaf spot has shown that an yield increase of over 20% in northern Vietnam and over 45% in southern Vietnam can be attained.

Preemergence seed and seedling rots (species of *Rhizopus*, *Fusarium*, *Aspergillus* and *Rhizoctonia*), damping-off (*Pythium* sp), collar rot (*Aspergillus niger* van Tiegh.) and aflaroot (*A. flavus* Link ex Fr.) were commonly observed throughout the country but the incidence was not high. Seed dressing with captan (2 to 3 g kg^{-1} seed) and treatment with hot water is practised by farmers in Vietnam.

Peanut stripe virus (PStV) disease (recognized by symptoms) was observed in three locations on crops at flowering stage in southern Vietnam but the disease incidence was very low. Since the aphids (the vectors of the virus) were also commonly present in those fields, we assume that the disease incidence may increase in those fields.

Aflatoxin contamination is not considered to be a serious problem in Vietnam. However, the produce from the second crop (April to June) in southern Vietnam usually suffers from slow drying because of frequent rains at harvest, that may predispose the produce to *A. flavus* invasion and aflatoxin contamination.

Other diseases observed on groundnut crops during our surveys include spot and veinal necrosis (*Alternaria alternata* Keissler), phyllosticta leaf spot (*Phyllosticta arachidis-hypogaea* Vasant Rao), pepper spot [*Leptosphaerulina crassiasca* (Sechet) Jackson & Bell], stem rot (*Sclerotium rolfsii* Sacc.), pod rots [*Rhizoctonia solani* Kuhn, *Macrophomina phaseolina* (Tassi.) Goid, and *Fusarium* spp], root rot (*R.* solani), botrytis blight (*Botrytis cinerea* Pers. ex Fr.), spotted wilt (TSWV), and root-knot (*Meloidogyne* sp). Bacterial wilt (*Pseudomonas solanacearum* E.F. Smith) is an important disease of groundnut in Nam Dan province.

Conclusions. Early leaf spot in the northern provinces, and late leaf spot and rust in the southern provinces are the most serious diseases of groundnut in Vietnam. Yield losses caused by these diseases in each of the major groundnut-growing areas in Vietnam need to be assessed. Developing high-yielding disease-resistant varieties should provide long-term benefits. Evaluation of cultivars resistant to rust and late leaf spot developed at ICRISAT Center should be intensified in southern Vietnam. Screening of germplasm for resistance to early leaf spot should be initiated in northern Vietnam. The levels of aflatoxin contamination in farmers' produce in different crop seasons need to be estimated and appropriate management strategies should be suggested. There is a need for a critical assessment of the distribution and importance of peanut stripe, bacterial wilt, and nematode diseases of groundnut through further surveys in Vietnam.

Groundnut Viral Diseases in Zambia

J. Kannaiyan (Msekera Regional Research Station, P.O. Box 510089, Chipata, Zambia)

Groundnut is attacked by many fungal and viral diseases in Zambia. Of these, fungal diseases (mainly leaf spots) are considered most important. However, in recent years a few viral diseases have also caused considerable yield losses. Till recently only groundnut rosette virus (chlorotic) was known to infect groundnut in Zambia. The occurrence of peanut mottle virus, groundnut streak necrosis disease, and cowpea mild mottle virus diseases on groundnut was confirmed in 1986/87. Recent studies carried out on these four viral diseases in Zambia are reported here.

Groundnut rosette virus (GRV). The incidence of GRV is erratic across seasons. In most years, low to moderate incidence in farmers' fields is possibly attributed to late sowing and a low plant density. The varieties grown at present are all susceptible to GRV. Several resistant lines (RG 1, RG 8, RG 11, RMP 12, and KIPR 11 BUS) are being utilized in our breeding program.

In 1984/85, GRV incidence was moderately high in a large plot of cv Chalimbana. GRV infected plants were classified as severely, moderately, or lightly affected, to assess yield losses caused. Twenty plants from each group and 20 healthy plants were assessed for yield and its components (Table 1). Significant reductions in yield were observed at all levels of severity. Severely affected plants produced 90% fewer pods and 90% lower seed yield; moderately affected plants 57% fewer pods and 65% lower seed yield; and lightly affected plants 32% fewer pods and 34% lower seed yield. Very severely infected plants often did not produce any pods.

Table 1. Influence of groundnut rosette disease on pod number and seed yield in groundnut variety Chalimbana Msekera, Zambia, 1984/85.

Rosette level	Pod number[1] $plant^{-1}$	Seed yield $plant^{-1}$ (g)
Severe	2.0	2.8
Moderate	8.3	9.7
Low	13.2	18.0
Healthy	19.4	27.4

1. Mean of 20 plants.

Groundnut streak necrosis disease (GSND). A low incidence of streak necrosis disease was first observed on several groundnut varieties at Msekera in 1983/84. Since then, the incidence of the disease has increased at a low rate each season. Initial symptoms were chlorotic rings, and hence the disease was suspected to be caused by tomato spotted wilt virus (TSWV). A similar disease was also recorded in Malawi by Dr Bock (ICRISAT, Malawi) who successfully transmitted sunflower yellow blotch virus (SYBV) from *Tridax procumbens* to groundnut by an aphid vector, *Aphis gossypii*. Similar transmission tests were also carried out at Msekera.

Since necrotic streaks are characteristic symptoms, the disease has been called "streak necrosis". Initial symptoms, on 2-4 week old seedlings are chlorotic with necrotic rings interspersed with yellow specks. Later symptoms consist of streak necrosis along the veins. Leaf edges show characteristic breaking and necrotic streaks. Leafs are puckered and reduced in size. Infected plants are stunted and darker green than healthy plants. Low to moderate incidence of GSND was observed on most farmers' fields during disease surveys in 1986/87 and 1987/88. SYBV is commonly observed on sunflower and *T. procumbens* during the crop season. In addition, SYBV-infected *T. procumbens* survives well during the dry season and presumably plays an important role in the epidemiology of GSND in Zambia, which is transmitted to young groundnut seedlings by *A. gossypii*. The secondary spread of the disease within groundnut is nil or minimal.

In 1986/87, a preliminary GSND-yield-loss study was carried out on cvs Chalimbana and MGS 2. In both varieties, the diseased plants produced significantly fewer pods (12-45%) and lower seed yields (20-51%) than healthy plants. The reduction in yield was greater in Chalimbana than in MGS 2.

In 1987/88, an increased incidence of GSND was recorded on many varieties. The yield loss was assessed on seven long-season and two short-season varieties. In each variety, 100 diseased and 100 healthy plants were examined for yield and its

Table 2. Yield losses caused by groundnut streak necrosis disease in nine groundnut varieties, Msekera, Zambia, 1987/88.

	Pod number[1] plant^{-1}		Seed yield plant^{-1} (g)		Shelling (%)	
Variety	Healthy	Diseased	Healthy	Diseased	Healthy	Diseased
Long season						
Chalimbana	6.2	3.4	11.3	2.3	64	48
MGS 2	14.2	9.1	12.6	7.4	67	69
MGS 3	15.5	9.4	14.0	8.3	54	50
MGS 4	23.2	11.9	17.4	7.8	56	44
MGS 5	20.6	11.0	13.0	6.3	62	56
MGS 6	17.7	10.4	12.0	6.1	57	36
Flamingo	13.1	7.3	10.8	4.8	66	38
Short season						
Comet	14.4	10.8	10.0	5.5	71	46
Tifspan	17.0	10.4	7.6	4.0	68	62
SE (treatments)	±0.3		±0.3		±0.5	
SE (varieties)	±0.6		±0.7		±1.2	
CV (%)	22		26		9	

1.Means of 10 replications (10 plants replication^{-1}).

components (Table 2). In all varieties, infected plants produced significantly fewer pods (25-49%) and lower seed yields (41-80%). The shelling percentage was also significantly lower (7-42%) in diseased plants (except MGS 2). Yield reduction was again greater in Chalimbana (80%) than in other varieties (41-56%).

Peanut mottle virus (PMV). PMV was first observed at Msekera in 1982/83, but only a low incidence has been recorded since then. In 1986/87, however, PMV incidence was moderate to high at Msekera, Eastern Province, and at Golden Valley Research Station, Central Province. PMV was recorded on many entries, and it is likely that the primary source of the inoculum came from the seed. A low incidence of PMV was also recorded in several farmers' fields in 1986/87 and 1987/88. Yield loss due to PMV was evaluated in four groundnut varieties in 1986/87. One-hundred diseased and 100 healthy plants were assessed for yield and its components (Table 3) across all varieties. Diseased plants produced significantly fewer pods (10-19%), as well as lower seed yields (9-26%). The yield reduction was higher in long-season varieties (Chalimbana and MGS 2) than in short-season varieties (Comet and Tifspan).

Cowpea mild mottle virus (CMMV). It was first recorded in Zambia in 1986/87 at Msekera on cvs MGS 2 and ICGS 90, and also in farmers' varieties (large-seeded types) in a few fields during disease surveys in 1986/87 and 1987/88 in the Eastern Province.

Table 3. Yield losses caused by peanut mottle virus in four groundnut varieties, Msekera, Zambia, 1986/87.

	Pod number plant^{-1}		Seed yield plant^{-1} (g)	
Variety	Healthy	Diseased	Healthy	Diseased
Long season				
Chalimbana	11.7[1]	9.5[1]	13.7[1]	10.1[1]
MGS 2	18.6	15.0	13.4	11.0
Short season				
Comet	13.3	12.0	5.4	4.7
Tifspan	15.6	13.6	5.4	4.9
SE (treatments)	±0.3		±0.3	
SE (varieties)	±0.5		±0.4	
CV (%)	15		22	

1.Means of 10 replications (10 plants replication^{-1}).

Survey of Groundnut Diseases in the Eastern Province, Zambia

J. Kannaiyan (Msekera Regional Research Station, P.O. Box 510089, Chipata, Zambia)

A disease survey was carried out in early Apr 1988 to assess the relative importance of various groundnut diseases in the Eastern Province, the major groundnut-producing region of Zambia. In all, 31 fields were examined in Chipata (south and north), Chadiza, Katete, Lundazi, Mambwe, and

Table 1. Severity of four important groundnut diseases in various districts of the Eastern Province, Zambia, 1987/88.

			Disease severity (Range)		
District	Number of fields surveyed	Early leaf spot[1]	Late leaf spot[2]	Rosette virus	Streak necrosis virus
Chipata (South)	9	M (3-8)	M(2-8)	L (0-5)	L (0-3)
Chipata (North)	2	M (4-6)	M(3-5)	L (0-3)	M(4)
Chadiza	5	M (3-6)	S (4-7)	L (0-3)	N
Katete	2	M (4)	S (7)	L (0-2)	L (0-2)
Lundazi	7	M (3-7)	M(2-8)	L (0-3)	L (2-4)
Mambwe	4	M (3-5)	S (3-8)	L (0-3)	L (0-2)
Petauke	2	M (3-5)	S (8)	L (0-3)	M(3-6)
Mean	31	M	S	L	L

1. *Cercospora arachidicola.*
2. *Phaeiosariopsis personata.*
N: Nil
L: Low (1-3)
M: Moderate (4-5)
S: Severe (above 6)

Petauke districts.

The disease severity was scored visually on a 1-9 rating scale. The mean disease severity in each district was calculated and classified as low (1-3), moderate (4-5), and severe (6-9). The severity of four important diseases in various districts is given in Table 1.

Most of the crops visited were at mid-pod filling stage. Both early (*Cercospora arachidicola* Hori) and late [*Phaeoisariopsis personata* (Berk. & Curt.) V. Arx] leaf spots were observed in all 31 fields. The leaf spots caused severe defoliation and would probably result in significant losses in seed yields. *P. personata* was severe in most districts and *C. arachidicola* showed only moderate severity in all the districts. This trend is different from that at the research station at Msekera, where *C. arachidicola* was most predominant throughout the crop period, and was known to cause above 50% loss in seed yield. Low severity of rust (*Puccinia arachidis* Speg.) was recorded in Chadiza and Lundazi districts only. Pepper leaf spot (*Leptosphaerulina crassiasca* Sechet) and wilt (*Fusarium oxysporum* Schlecht emend Synd & Hans.) were observed at low levels in most districts.

Among viral diseases, low incidences of groundnut rosette virus (GRV), groundnut rosette assistor virus (GRAV), and streak necrosis (SYBV) were observed in most districts. Moderate levels of streak necrosis were recorded in Chipata (North) and Petauke districts. Low incidences of cowpea mild mottle virus (CMMV) and peanut mottle virus (PMV) diseases were also recorded in one or two districts. Alectra, a root parasite, was noticed in five out of seven districts. However, the incidence was low.

This survey helped us to confirm the importance of early and late leaf spots as the two most serious diseases of groundnut in the Eastern Province of Zambia.

A World List of Plant-Parasitic Nematodes Associated with Groundnut

S.B. Sharma and **D. McDonald**
ICRISAT Center

On a global basis, very little research has been done on nematode problems of groundnut (*Arachis* *hypogaea* L.). Information available in the literature does not provide a comprehensive picture of major nematode problems, and there are only limited data on the occurrence, extent and possible economic importance of nematode problems of groundnut in different countries and regions.

Before producing an up-to-date record of on-going research on nematode problems in different countries, we collected information on the species of plant-parasitic nematodes that are known to be associated with groundnut. This information is based on personal communications with nematologists, on published reports, and on our limited surveys. It is clear that groundnuts are susceptible to a wide range of plant-parasitic nematodes (Table 1).

We hope that the information furnished in Table 1 will be useful to many nematologists as well as other scientists working on groundnut worldwide. We believe that this list will increase considerably in size as groundnut regions, particularly those in the semi-arid tropics, are surveyed and nematodes associated with the crop are identified to species.

Table 1. A world list of plant-parasitic nematodes associated with groundnut (*Arachis hypogaea* L.).

S.no.	Nematode	Distribution
1.	*Aphasmatylenchus straturatus* Germani[1]	Burkina Faso
2.	*Aphasmatylenchus variabilis* Germani & Luc	Mali, Sénégal
3.	*Aphelenchoides arachidis* Bos[1]	Nigeria
4.	*Aphelenchoides* sp	Egypt, India, Côte d'Ivoire, Burkina Faso, Benin, Niger, Nigeria
5.	*Aphelenchus* sp	Burkina Faso, Egypt, India, Côte d'Ivoire, Israel, Nigeria, the Philippines
6.	*Belonolaimus gracilis* Steiner[1]	USA
7.	*B. longicaudatus* Rau[1]	USA
8.	*Criconemoides xiamensis* Tang & Chongti	China
9.	*Criconemoides* sp	Benin, Burkina Faso, Egypt, Gambia, India, Nigeria, Sénégal, USA, Venezuela
10.	*Ditylenchus destructor* Thorne[1]	South Africa (Transvaal Province)
11.	*Ditylenchus* sp	Burkina Faso, Benin, India, Mali, Niger, Nigeria
12.	*Gracilacus* sp	Mali, Sénégal
13.	*Helicotylenchus arachisi* Mulk & Jairajpuri	India
14.	*H. dihystera* (Cobb) Sher	Burkina Faso, Benin, Gambia, India, Sénégal, USA

Continued.

Table 1. *Continued.*

S.no.	Nematode	Distribution
15.	*H. egyptiensis* Tarjan	India
16.	*H. nigeriensis* Sher	Malawi
17.	*H. retusus* Siddiqi & Brown	India
18.	*Helicotylenchus* sp	Benin, Burkina Faso, Gambia, Egypt, India, Côte d'Ivoire, Mali, Malawi, Niger, the Philippines, Sénégal, USA, Venezuela
19.	*Hemicaloosia paradoxa* Luc	Burkina Faso
20.	*Hemicriconemoides* sp	Egypt
21.	*Hemicycliophora* spp	Egypt, Gambia, Sénégal, Burkina Faso
22.	*Heterodera* sp	Egypt, India
23.	*Hirschmaniella* sp	Egypt, India
24.	*Histotylenchus* sp	Niger
25.	*Hoplolaimus arachidis* Maharaju & Das	India
26.	*H. clarissimus* Fortuner	Gambia
27.	*H. coronatus* Cobb	USA
28.	*H. galeatus* (Cobb) Filipjev & Sch. Stekh.	USA
29.	*H. indicus* Sher	India
30.	*H. pararobustus* (Sch. Stekh. & Teunissen) Sher	Gambia, Niger, Benin, Burkina Faso, Sénégal
31.	*H. seinhorsti* Luc	India
32.	*H. seshadrii* Mulk & Jairajpuri	India
33.	*Hoplolaimus* spp	Gambia, India, the Philippines, Sénégal, USA
34.	*Longidorus africanus* Merny	Sudan
35.	*L. siddiqii* Aboul-Eid	Sénégal

Continued.

Table 1. *Continued.*

S.no.	Nematode	Distribution
36.	*Longidorus* sp	Egypt
37.	*Macroposthonia curvata* (Raski) de Grisse & Loof	USA, India, Niger
38.	*M. ornata* (Raski) de Grisse & Loof	USA
39.	*Macroposthonia xenoplax* (Raski) de Grisse & Loof	USA
40.	*Meloidogyne arenaria* (Neal) Chitwood[1]	India, Israel, Egypt, Malawi, Sénégal, Taiwan, USA, Zimbabwe
41.	*M. hapla* Chitwood[1]	Australia, China, India, Israel, Japan, Zimbabwe, S. Korea, USA, South Africa
42.	*M. incognita* (Kofoid & White)	Egypt, India, Nigeria, Chitwood Sénégal
43.	*M. javanica* (Treub) Chitwood[1]	Brazil, Egypt, India, Malawi, Nigeria, Sénégal, USA, Zimbabwe
44.	*Meloidogyne* spp	Egypt, Gambia, Sénégal
45.	*Paralongidorus* sp[1]	Niger
46.	*Paratrichodorus christiei* (Allen) Siddiqi	USA
47.	*P. minor* (Colbran) Siddiqi	USA
48.	*Paratrophurus* sp	Sudan
49.	*Paratylenchus* sp	Mali, Sénégal
50.	*Peltamigratus* spp	Sénégal
51.	*Pratylenchus brachyurus* (Godfrey) Filipjev & Sch. Stekh.[1]	Australia, Benin, Egypt, Gambia, India, Sénégal Nigeria, USA, Zimbabwe
52.	*P. coffeae* (Zimmermann) Filipjev & Sch. Stekh.	India
53.	*P. delattrei* Luc	India, Nigeria
54.	*P. indicus* Das	India

Continued.

Table 1. *Continued.*

S.no.	Nematode	Distribution
55.	*P. loosi* Loof	Sénégal
56.	*P. nizamabadensis* Maharaju & Das	India
57.	*P. penetrans* (Cobb) Filipjev & Sch. Stekh.	USA
58.	*P. sefaensis* Fortuner	Sénégal
59.	*Pratylenchus sudanensis* Loof & Yassin	Sudan
60.	*P. thornei* Sher & Allen	Australia
61.	*P. zeae* Graham	India
62.	*Pratylenchus* spp	Gambia, India, Malawi, Mali, Niger, Philippines Sénégal, USA
63.	*Radopholus similis* (Cobb) Thorne	India, Malawi, USA
64.	*Rotylenchulus parvus* (Williams) Sher	Burkina Faso
65.	*R. reniformis* Linford & Oliveira	India, Philippines, Puerto Rico, Sénégal, Venezuela
66.	*Rotylenchulus* sp	Egypt, Mali, Senegal, Nigeria
67.	*Rotylenchus* sp	Israel
68.	*Senegalonema sorghi* Germani, Luc & Baldwin	Sénégal
69.	*Scutellonema cavenessi* Germani[1]	Gambia, Sénégal
70.	*S. clathricaudatum* Whitehead	Benin, Burkina Faso, Mali, Niger, Nigeria
71.	*Scutellonema* sp	Benin, Burkina Faso, Nigeria, Niger, Sudan
72.	*Siddiqia citri* (Siddiqi) Khan, Chawla & Saha	India
73.	*Telotylenchus indicus* Siddiqi	Niger
74.	*Telotylenchus* sp	Senegal
75.	*Trichodorus* sp	Burkina Faso, Egypt, Gambia, Israel, Côte d'Ivoire, Niger, Sénégal, USA

Continued.

Table 1. *Continued.*

S.no.	Nematode	Distribution
76.	*Trichotylenchus* sp	Gambia, Sénégal
77.	*Triversus annulatus* (Merny) Sher	Burkina Faso
78.	*Tylenchorhynchus brevilineatus* Williams[1]	India
79.	*T. claytoni* Steiner	USA
80.	*T. gladiolatus* Fortuner & Amougou	Gambia, Sénégal
81.	*Tylenchorhynchus mashhoodi* Siddiqi & Basir	India
82.	*T. phaseoli* Sethi & Swarup	India
83.	*T. vulgaris* Upadhyay, Swarup & Sethi	India
84.	*T. zeae* Sethi & Swarup	India
85.	*Tylenchorhynchus* sp	Burkina Faso, Egypt, Gambia, India, Israel, Mali, the Philippines, Niger, Sénégal, Sudan Nigeria, USA, Venezuela
86.	*Xiphinema americanum* Cobb	USA
87.	*X. diversicaudatum* (Micoletzky) Thorne	USA
88.	*X. insigne* Loos	India
89.	*X. italiae* Meyl	Niger
90.	*X. parasetariae* Lucl	Benin, Burkina Faso, Niger
91.	*Xiphinema* spp	Egypt, Gambia, Malawi, Nigeria, Sénégal, USA

1. These have been responsible for disease situations in fields.

Research Reports

Efficacy of Herbicides in the Control of Weeds in Groundnut

A. Ramakrishna, C.K. Ong, and **S.L.N. Reddy** (ICRISAT Center)

Groundnut (*Arachis hypogaea* L.) is one of the most important oilseed crops in India. Several studies have investigated weed competition in groundnut and reported heavy yield reduction (Dalal et al. 1967; Sandhu and Gill 1973). Low seedling vigor and slow early growth of groundnut makes weed control essential during the first 30-35 days after sowing the crop. Traditional methods such as hand-weeding and hoeing are tedious, costly and time consuming. Chemical weed control is therefore gaining wide acceptability. A field trial was conducted during rainy season 1987 at ICRISAT Center, Patancheru, to assess the efficacy of different herbicides in controlling weeds under limited irrigation conditions in Kadiri 3 cultivar.

The soil of the experimental plot was an Alfisol of sandy clay loam texture with low nitrogen,

Table 1. Weed biomass and pod yield of groundnut as influenced by different treatments, ICRISAT Center, rainy season 1987.[1]

Treatment	Herbicide dose (kg a.i.ha^{-1})	Application time	Dry matter of weeds (kg ha^{-1})		Pod yield (t ha^{-1})
			60 DAE	At harvest	
Alachlor	1.5	Pre[2]	160	244	0.88
Alachlor	2.0	Pre	110	201	1.03
Fluchloralin	1.0	Pre	154	236	0.69
Fluchloralin	1.5	Pre	130	189	0.84
Oxyflourfen	0.25	Pre	125	185	0.99
Oxyflourfen	0.50	Pre	89	170	1.06
Gesapax-H-500	0.75	Pre	214	208	0.71
Gesapax-H-500	1.25	Pre	132	206	0.76
Pronamide	1.0	Pre	149	268	0.53
Pronamide	1.5	Pre	166	240	0.35
Metribuzin	0.75	Pre	167	236	0
Metribuzin	1.25	Pre	102	203	0
Flauzifopbutyl +Bentazon	0.25 + 1.0	Post[2]	177	291	0.43
Flauzifopbutyl +Bentazon	0.25 + 1.5	Post	157	275	0.70
Hand-weeding(1)	-	20 DAE[2]	149	248	1.36
Hand-weeding(2)	-	20+40 DAE	24	69	1.82
Weedfree	-	-	7	7	1.96
Weedy control	-	-	220	288	0.24
SE			±29	±21	±0.084

1. Original weed dry matter data were transformed to $\sqrt{X + 0.5}$
2. Pre = Preemergence; Post = Postemergence; and DAE = Days after emergence.

phosphorus, and medium organic carbon and potassium content. Diammonium phosphate was applied @100 kg ha^{-1} at the time of final plowing. The experiment was laid out in a randomized-block design with three replications. Measurements of dry matter production of weeds and pod yield are presented in Table 1.

Weed density was high during the season because of good moisture conditions. *Digitaria sanguinalis* was the dominant grass weed followed by *Echinocloa colona, Dactyloctenium aegyptium, Brachiaria eruciformis,* and *Eragrostis* sp. Among dicots *Celosia argentea* was prevalent. The other dicot weeds were *Amaranthus viridis, Digera arvensis, Eclipta alba, Lagascea mollis, Portulaca oleracea, Euphorbia hirta, Phyllanthus* spp and *Tridax procumbens. Cyperus rotundus* was present at varying intensity.

Two hand-weedings at 20 and 40 days after emergence (DAE) effectively controlled the weeds and resulted in 90% weed control. Good weed control was also achieved with oxyflourfen (0.5 kg) 60%, alachlor (2.0 kg) 50%, oxyflourfen (0.25 kg) 41%, and fluchloralin (2.0 kg a.i. ha^{-1}) 40% in comparison to weedy control at 60 DAE. However, at harvest increased weed biomass was recorded in all the herbicide treated plots and least in weedfree control that was on par with two hand-weedings given at 20 and 40 DAE.

The pod yield was highest in weedfree treatment followed by two hand-weedings given at 20 and 40 DAE. There was no significant difference in yield between these treatments. The decrease in pod yield in the nonweeded control was 87% when compared to either weedfree control or two hand weedings. Oxyflourfen at 0.5 kg a.i ha^{-1}, alachlor at 2.0 kg a.i ha^{-1} and oxyflourfen at 0.25 kg a.i ha^{-1} were found better than other herbicides in controlling the weeds. The reduction in pod yield in the first oxyflourfen treatment was 46%, in the alchlor treatment 48%, and in the second oxyflourfen treatment 49% in comparison to the weedfree treatment. Metribuzin proved toxic to groundnut plants and poor weed control and low yield was recorded with pronamide at both concentrations.

All the preemergent herbicides were found to be effective in controlling the weeds during early stages of the crop. However, subsequent rains encouraged the fresh emergence of weeds. Hence, applications of herbicides alone are not adequate to control the weeds but a combination of one hand-weeding and hoeing at 30-35 DAE with preemergent herbicides will help to keep the crop relatively free of weeds and result in high yields.

References

Dalai, J.L., Gill, G.S., and **Saini, J.S.** 1967. Effect of hoeing weeding cum manuring on the yield of rainfed groundnut in Punjab. Indian Journal of Agronomy 12:309-313.

Sandhu, K.S., and **Gill, G.S.** 1973. Studies on critical period of weed competition in maize. Indian Journal of Weed Science 5:15.

Effect of Plant Products on the Incidence of Major Diseases of Groundnut

T. Ganapathy[1] and **P. Narayanasamy**[2]
(1. Agricultural Research Station, Aliyarnagar, Tamil Nadu, India; 2. Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India)

Out of 20 plant products screened to control ring mosaic caused by tomato spotted wilt virus (TSWV) and of 54 plant products screened to control late leaf spot [*Phaeoisariopsis personata* (Berk. & Curt.) v.Arx.] and rust (*Puccinia arachidis* Speg.) diseases of groundnut (*Arachis hypogaea* L.) under laboratory conditions, the water extracts of neem (*Azadirachta indica* A. Juss.) leaf, neem cake and neem oil (1%) inhibited all the three diseases. Neem oil caused deformation of rust spores while conidia of *P. personata* exhibited klinokinesis response. Neem seed extract and neem oil reduced the lesion of *P. personata* and pustule development of *P. arachidis*, on detatched leaves.

When tested on primary leaves of cowpea (*Vigna sinensis* L.) cv C 152 against TSWV, leaf extract of nerium (*Nerium odorum* Sol.) and neem oil completely inhibited the lesion development. Leaf extract of coconut (*Cocos nucifera* L.) and sorghum (*Sorghum vulgare* Pers.) also controlled the lesion development.

Field experiments conducted during 1985 at Agricultural College and Research Institute, Madurai, and at Thirumangalam, Madurai district, Tamil Nadu, India, revealed that neem oil (1%) and neerium leaf extract (10%) reduced the incidence of all the three diseases and neem oil increased pod yield by 62.3% of groundnut over control (Table 1). Application of neem oil also reduced the incidence of thrips *Frankliniella schultzei* Trybam. and *Scritothrips dorsalis* Hood. Antiviral property of neem products was earlier reported by Narayanasamy and Ramaiah (1983) and the antifungal property of neem oil was reported by Singh and Singh (1982).

Table 1. Effect of neem oil and nerium leaf extract on the incidence of three diseases and pod yield of groundnut at Agricultural College and Research Institute (Madurai), and Thirumangalam, Tamil Nadu, India, 1985.

	Ring mosaic		Leaf spot		Rust		Pod yield	
Treatment	Percentage of incidence	Decrease over control (%)	PDI[2]	Decrease over control (%)	PDI[2]	Decrease over control (%)	(kg ha^{-1})	Increase over control
Neem oil %	3.5 (10.73)[3]	67.4	18.85 (25.67)	48.2	17.02 (24.25)	51.9	1416.5	62.3
Nerium 10%	4.69 (12.52)	56.3	21.15 (27.38)	41.9	19.84 (26.45)	43.9	1012.8	16.05
Control	10.74 (19.1)		36.43 (37.08)		35.35 (36.5)		872.75	-
SE	±1.83		±2.94		±1.77		±89.55	

1. Values represent mean of two locations.
2. PDI = Percentage of Disease Incidence based on 1-9 scale, where 1 = no visible symptom, and 9 = more than 50% defoliation (leaf spot) or withering (rust).
3. Data in parentheses are arcsine transformed values.

References

Narayanasamy, P., and **Ramaiah, M.** 1983. Characterisation of Antiviral principle from Sorghum leaves. Pages 15-17 *in* Proceedings of National Seminar on Management of Diseases of Oilseed Crops, Department of Plant Pathology, Agricultural College and Research Institute, TNAU, Madurai 625 104, 21-22 Jan 1983.

Singh, H.B., and **Singh, O.P.** 1982. Effect of volatiles of some plant extracts and their oils on conidia of *Erysiphe polygoni* De. Australian Plant Pathology 10:66-67.

Comparative Efficacy of Four Fungicides Against Rust and Late Leaf Spot of Groundnut

P. Subrahmanyam, P.V. Subba Rao, and **D. McDonald** (ICRISAT Center)

Rust (*Puccinia arachidis* Speg.), early leaf spot (*Cercospora arachidicola* Hori) and late leaf spot [*Phaeoisariopsis personata* (Berk. & Curt.) v. Arx] are the most important fungal diseases of groundnut (*Arachis hypogaea* L.) on a worldwide scale. Yield losses range from 10 to over 50% but vary considerably from place to place and between seasons. At ICRISAT Center, rust and late leaf spot normally occur together causing severe damage to foliage and occasioning yield losses up to 70% (Subrahmanyam et al. 1984). In recent years various fungicide formulations have been reported to be effective against rust and leaf spot (Smith and Littrell 1980).

The present study was conducted to examine the efficacy of four fungicides against rust and late leaf spot at ICRISAT Center during the 1989 rainy season.

Seeds of a groundnut cultivar ICGV 87123 (formerly ICGS 11) were treated with thiram (3 g kg^{-1} seed) and sown in field plots (12 m^2) with a spacing of 75 cm from row to row and 10 cm between plants. A basal dose of 60 kg P_2O_5 ha^{-1} was given at land preparation. Gypsum (400 kg ha^{-1}) was applied as top dressing at pegging stage. The fungicide treatments included were hexaconazole (50 mL ha^{-1}), chlorothalonil (1.28 kg ha^{-1}), myclobutanil (96 mL ha^{-1}), and wettable sulfur (800 g ha^{-1}) in 500 L of water ha^{-1}. Fungicide sprays were given at 10-day intervals starting from 30 days until 90 days after sowing. Plots sprayed with tap water (500 L ha^{-1}) served as controls. There were four replications of each treatment and the plots were arranged in a randomized-block design.

At 100 days after sowing, five plants were randomly selected from each plot and their main stems were assessed for percentage defoliation, and leaf area damage because of rust and late leaf spot by comparison with schematic diagrams depicting leaves with known percentages of their areas affected. From these data, the percentage of remaining green leaf area (RGL) was calculated as described by Subrahmanyam et al. (1984). Plots were harvested at optimal maturity and the yields of pods and haulms, shelling percentages, and 100-seed masses were determined.

Rust and late leaf spot were very severe in water-sprayed plots causing considerable reduction in the RGL. Hexaconazole and chlorothalonil were most effective in controlling both rust and late leaf spot, and in increasing the RGL (Fig. 1). Myclobutanil and wettable sulfur were not very effective (Table 1). There was a highly significant (P = 0.01) correlation between the RGL and yields of pods (r = 0.91) and haulms (r = 0.84). Pod yields were highest in hexaconazole-sprayed plots followed by chlorothalonil and yields from the wettable sulfur-treated plots did not significantly differ from water-sprayed plots. Haulm yields were higher in chlorothalonil- and hexaconazole-treated plots than in other treatments. The percentage loss in pod and haulm yields because of combined attack of rust was 66% and of late leaf spot 52%. Shelling percentages were significantly higher in water-sprayed plots than in fungicide-sprayed plots

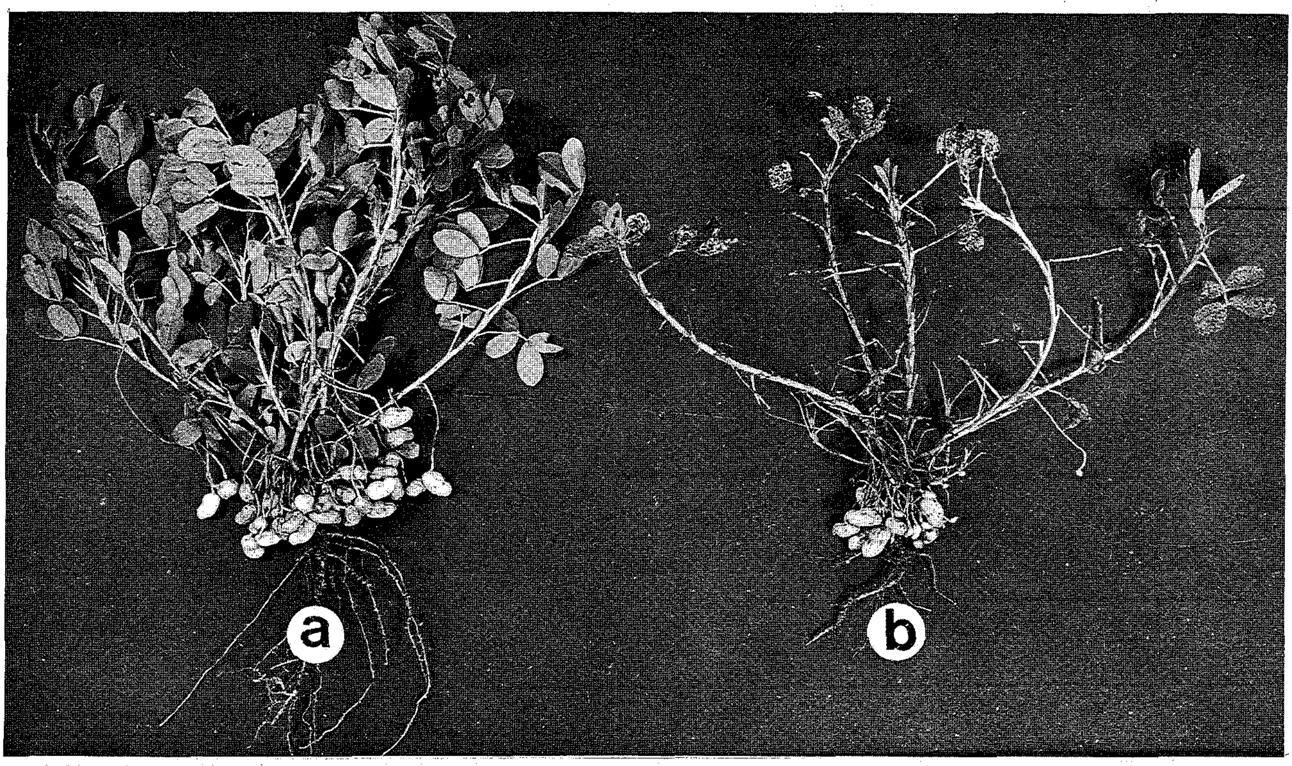


Figure 1. Groundnut plants sprayed with hexaconazole (a) and water (b). Note excellent foliage retention and pod yield in hexaconazole treatment.

Table I. Efficacy of four fungicides against rust and late leaf spot, and on yields of groundnut, ICRISAT Center, rainy season 1989.

Spray treatment	Defoliation (%)	Leaf area damage: Rust (%)	Leaf area damage: Late leaf spot (%)	Remaining green leaf (%)	Yield (t ha^{-1}): Pods	Yield (t ha^{-1}): Haulms	Shelling (%)	100-seed mass (g)
Hexaconazole	0	0.3	0.2	99.5	2.75	2.22	69	28.4
Chlorothalonil	0	1.5	0.4	98.1	2.41	2.43	68	28.8
Myclobutanil	22	4.5	5.2	70.8	1.59	1.83	69	27.2
Wettable sulfur	31	6.9	7.4	58.8	1.07	1.42	70	26.4
Control (Water)	62	7.0	12.6	30.8	0.93	1.15	72	27.0
SE	±1.9	±0.43	±0.82	±1.8	±0.1	±0.14	±0.8	±1.0
CV (%)	16	21	32	5.1	13	16	2	6.9

probably because of the difference in maturity periods between treatments. There were no marked differences in the 100-seed masses between treatments.

The results of the present investigation clearly indicate the potential use of hexaconazole and chlorothalonil in controlling both rust and late leaf spot of groundnut. Further trials are required to assess the optimum dose of the chemical, spray regimes, and the cost : benefit ratio.

References

Smith, D.H., and **Littrell, R.H.** 1980. Management of peanut foliar diseases with fungicides. Plant Disease 64:356-361.

Subrahmanyam, P., **Williams, J.H.**, **McDonald, D.**, and **Gibbons, R.W.** 1984. The influence of foliar diseases and their control by selective fungicides on a range of groundnut (*Arachis hypogaea* L.) genotypes. Annals of Applied Biology 104:467-476.

Screening Groundnut for Resistance to Early Leaf Spot in India

F. Waliyar[1], S.J. Kolte[2], D. McDonald[3], P.V. Subba Rao[3], and **P.M. Reddy[3]** (1. ICRISAT Sahelian Center, Niamey, Niger; 2. G.B. Pant University of Agriculture and Technology, Pantnagar, Uttar Pradesh, India; 3. ICRISAT Center)

Early leaf spot (ELS) caused by *Cercospora arachidicola* Hori. is an important foliar disease of groundnut worldwide. Usually early and late leaf spot [*Phaeoisariopsis personata* (Berk. & Curt.) v. Arx] are together referred to as "Cercospora leaf spots" or 'tikka leaf spots' causing yield losses of up to 50%. Losses can be more serious (up to 70%) particularly if leaf spots are associated with rust (*Puccinia arachidis* Speg.) disease. Early leaf spot usually occurs early in the growing season and its severity depends highly on the climatic conditions (humidity, temperature, rainfall, etc.). Although no major differential reaction of genotypes to early leaf spot were observed within India, differences do occur between Malawi and India. For example, PI 476176 (ICG 10946), which is resistant in India, is completely susceptible in Malawi. Furthermore, most of the genotypes identified to be resistant in the USA were susceptible in India and Malawi. In addition, benonmyl-resistant pathogenic strains have also been identified in the USA. This information may suggest the existance of pathotypes in *C. arachidicola.*

At ICRISAT Center, India, where severe rust and late leaf spot epidemics occur regularly, development of early leaf spot epidemics are rare. However, screening for early leaf spot resistance was possible in 1987, when the disease was severe on the ICRISAT farm. At the same time, we tried to identify "hot spot" locations for early leaf spot elsewhere in India to facilitate regular screening of groundnut germplasm for resistance to early leaf spot. As a result, G.B. Pant University of Agriculture and Technology, Pantnagar, U.P., in northern India was identified as a suitable location to screen groundnut genotypes for early leaf spot.

Table 1. Reaction of some groundnut genotypes against early leaf spot at two locations in India, 1987-88.

		Reaction to early leaf spot[1]	
ICG No.	Identity	ICRISAT Center 1987	Pantnagar 1988
1703	NC Ac 17127	4.6	5.0
1710	NC Ac 17135	6.0	4.0
2711	NC 5	6.0	6.3
4995	NC Ac 17506	6.0	5.0
6284[2]	NC Ac 17500	5.0	-
6330	PI 270806	6.3	4.3
6709	NC Ac 16163	3.6	4.3
6902	NC Ac 17894	5.6	5.0
7878[2]	NC Ac 10811 A	5.0	-
9294	58-295	5.3	4.6
10040	PI 476176 SPZ 484 Gasp	5.0	5.0
10756	TGR 997	6.0	4.6
10920	PI 476152	6.0	4.6
10946	PI 476176	5.0	5.2
11099	ZFA 3525	5.3	4.0
221[3]	TMV 2	8.0	8.6
SE		±0.28	±0.41
CV (%)		9.4	11.2

1. Evaluation on a 1-9 scale, where 1 = no disease, and 9 = 50-100% of foliage destroyed.
2. Found to be promising in Malawi (1987/88 and 1988/89) and in Burkina Faso (1989).
3. Susceptible control cultivar.

On the G.B. Pant University farm, ELS occurs on both rainy season and postrainy season groundnuts every year, and is particularly severe on rainy-season groundnuts. Groundnut genotypes were screened successfully at this location and at ICRISAT Center during 1987 and 1988.

During 1987, 33 out of 618 germplasm lines, 3 out of 641 breeding lines, and 5 out 1665 interspecific hybrid derivatives showed satisfactory levels of resistance to early leaf spot at ICRISAT Center.

During 1988 rainy season, 100 genotypes were tested at Pantnagar and at ICRISAT Center. These lines included new germplasm lines, in addition to the promising lines identified during 1987 at ICRISAT Center. Unfortunately early leaf spot development was not satisfactory enough for a meaningful evaluation during the 1988 rainy season at ICRISAT Center. On the other hand, screening was successful at Pantnagar; 13 genotypes identified to be resistant at ICRISAT Center during 1987 were also found to be resistant at Pantnagar in 1988 (Table 1). Further tests are required to confirm the stability of their resistance.

New Information on the Thrips Vectors of Tomato Spotted Wilt Virus in Groundnut Crops in India

J.M. Palmer[1], D.V.R. Reddy[2], J.A. Wightman[2], and G.V. Ranga Rao[2] (1. British Museum of Natural History, Cromwell Road, London SW7 5BD; 2. ICRISAT Center)

Reddy and Wightman (1988) published a comprehensive review of the vector thrips and transmission of tomato spotted wilt virus (TSWV) which is the causal agent of bud necrosis disease (BND) in groundnut crops. The documentation quoted in the review pointed to *Frankliniella schultzei* Trybam. as the main vector of TSWV isolates from groundnut in India. Since then it has been discovered that the situation may be more complex than originally perceived. This came about following the discovery by R.J. Beshear (University of Georgia) that specimens from ICRISAT Center labeled as *F. schultzei* were in fact *Thrips palmi* Karny. This discovery was considered to be significant because *T. palmi* had recently been identified as one of the vectors of TSWV in Japan (Kameya-Iwaki et al. 1988).

The obvious need to clarify the situation led to an examination of the thrips in the ICRISAT slide collection and on local crops. The former consisted of *Scirtothrips dorsalis* Hood, *S. oligochaetus* (Hood), *F. schultzei* (pale form sometimes called '*sulphurea*'), and *T. palmi*. The record afforded from this collection indicated that all species were present on the ICRISAT farm since 1980.

Visits to groundnut fields near Hyderabad, Andhra Pradesh, and Raichur, Karnataka, in February 1989 revealed that *S. dorsalis* and *S. oligochaetus* were in the leaf terminals, on old leaflets and in the flowers, although the larvae were concentrated between the folded terminal leaflets. *F. schultzei* was present in the flowers and *T. palmi* in the terminal leaf buds. *S. dorsalis* was the most abundant and consistently present. *S. oligochaetus* was comparatively rare, and *F. schultzei* and *T. palmi* were irregular in distribution.

These collections provided fresh specimens of these species, as well as of the easily recognized flower thrips *Megalurothrips usitatus* (Bagnall), to test individual insects for the presence of TSWV by dot immunobinding assay. There was a positive result for *T. palmi* although we need further confirmation. Viral antigens could not be detected in *M. usitatus* and *S. oligochaetus*. The results with *S. dorsalis* and *F. schultzei* were inconclusive because of nonspecific reaction. This information is communicated through this newsletter to indicate to our colleagues that there is a need to reexamine the vector relationships of BND in Asia.

References

Kameya-Iwaki, M., Hanada, K., Honda, Y., and **Tochihara, H.** 1988. A watermelon strain of tomato spotted wilt virus (TSWV-W) and some properties of its nucleocapsid (Abstract). Page 65 *in* Proceedings of the 5th International Congress of Plant Pathology, 20-27 Aug 1988, Kyoto, Japan, (Abstract).

Reddy, D.V.R., and **Wightman, J.A.** 1988. Tomato spotted wilt virus: thrips transmission and control. Advances in Disease Vector Research 5: 203-220.

Report of Sex Pheromone in Groundnut Leaf Miner

V. Nandagopal and **P.S. Reddy** (National Research Centre for Groundnut (ICAR), Junagadh, Gujarat 362 015, India)

Groundnut leaf miner *Aproerema modicella* Deventer is an oligophagus pest. It is reported to cause 67 to 100% economic damage in groundnut (Sadalathula et al. 1976) and 75% of leaflets damage in soybean (Gujarati et al. 1973). It also occurs in Indonesia, Laos, Malaysia, Myanmar, Pakistan, the Philippines, Sri Lanka, and Thailand (Mohammad 1981). Though many strategies are employed in the management of this pest, no information is available about mass trapping of male moths using sex pheromone. This was expressed by Dr S. Jayaraj, the Vice Chancellor of Tamil Nadu Agricultural University, Coimbatore, India, during the 35th Rabi/Summer Oilseeds Workshop. This prompted us to initiate a field study during rainy season 1989. We report for the first time the presence of strong pheromone in the freshly emerged virgin female moths.

The three different types of traps used in this study were:

1. Water trap: (Plastic tray of 40 x 30 x 7.5 cm in which 4 cm water-kerosene (20 mL) mixture was maintained),
2. All weather trap: (Polythene trap which is usually used in cotton and groundnut ecosystem to monitor/mass trapping of *Helicoverpa* sp/*Spodoptera* sp male moths), and
3. Glue trap: (Transparent plastic tumbler (7 cm height x 6 cm diameter 4 cm diameter of bottom). To the opening a strip of polysterine sheet (175 μm of 10 cm long and 2 cm width was stapled both ends. A round sheet of the same sheet of 13 cm dia was stapled at the top to protect the bait from rain).

The freshly emerged virgin female was introduced into a plastic tube (vial) (2 cm length x 0.5 cm dia) covered with muslin cloth at both the ends and secured with cellotape. The vial was tied to a cross frame from a height of 30 cm at the center of water trap with a 2 cm gap between vial and water level. The vial was tied in the all weather trap and the glue trap. Castor oil was smeared inside the tumbler (Glue trap). Each trap was replicated three times. Traps were placed in a completely randomized-block design. Traps were placed or tied in 5 ha of cv GG 2/GAUG 10 groundnut crop during the pod-filling stage. A radius of 10 m. was allowed on all sides of the trap. Virgin females were replaced every evening. The moths trapped during the nights were collected separately next day morning and sex was verified. Moth trapping was recorded for 10 days continuously. Simultaneously in place of virgin female, freshly emerged 1 day or 2 days old males were confined to the vials and observed for attractancy.

Male moths were trapped in all the traps baited with freshly emerged virgin female while no moths of either sexes were trapped in traps baited with male moths indicating the presence of sex pheromone in virgin female only. A mean of 6.2 moths day^{-1} $trap^{-1}$ were collected in water trap follwed by 4.5 and 4.4 in all weather and glue traps. The mean intensity of leaf miner incidence was 4.5% during the study period. Under such meager intensity of leaf miner, a maximum of 30 moths in water trap, for 2 moths in all weather trap, and 23 moths in glue trap were collected in a single night. This indicates the presence of sex pheromone in the leaf miner. Under laboratory conditions 1-day old males could mate readily with freshly emerged female while freshly emerged males failed in an artificial light source (40 W). Duration of mating was recorded for 10 pairs. The mean duration under coitus was 8.3 min (range 5.2 to 17.8 min).

Acknowledgment: The first author is grateful to Dr S. Jayaraj, the Vice Chancellor, Tamil Nadu Agricultural University, Coimbatore, with whose inspiration and encouragement the work was initiated.

References

Gujarati, J.P., Kapoor, K.N., and **Gangaade, G.A.** 1973. Biology of soyabean leaf miner *Stomopteryx subsecivella* (Lepidoptera : Gelechiidae) Entomologist 106(1323):187-191.

Mohammad, A. 1981. The groundnut leaf miner *Aproaerema modicella* Deventer (=*Stomopteryx subsecivella* Zeller) (Lepidoptera : Gelechiidae). A review of world literature. Occasional paper no.3, Patancheru, India: Groundnut Improvement Program, International Crops Research Institute for the Semi-Arid Tropics. (Mimeo) pp. 33.

Sadalathulla, S., Abdul-Kareem, A., Sirnivasan, P.M., and **Jayaraj, S.** 1976. Chemical control of groundnut leaf webber Stomopteryx subsecivella zell. (*Gelechiidae : Lepidoptera*) in Tamil Nadu. Pesticides 10(5):30-31.

Recent ICRISAT Publication

The publishing address for each publication is: ICRISAT, Patancheru, Andhra Pradesh 502 324, India.

ICRISAT. 1989. Summary Proceedings of the Second Coordinators' Meeting on Peanut Stripe Virus, 1-4 Aug 1989. Patancheru, A.P. 502 324, India:ICRISAT.

Book Review

Ruth H. Mathews (ed.). 1989. Legumes: Chemistry, Technology and Human Nutrition. Marcel Dekker, Inc. 270 Madison Avenue, New York, New York 10016, USA. 389 pp. (ISBN 0-8247-8042-6).

Legumes constitute the world's most important sources of food supply, in terms of food energy as well as nutrients. This book provides comprehensive information on the chemistry and technology of the production, processing, and properties of various legumes and legume products. It has 10 chapters written by sixteen authors, mostly from the USA, famous in their fields of research. The first chapter provides information on culture and genetics of six major grain legumes, including groundnut and chickpea. The second chapter deals with harvesting, threshing, drying and storage methods for legumes. Chapter three describes the physicochemistry, processing, and various products of refined oils. In chapters four to six, chemistry and technology of isolated soy proteins, protein flour and concentrates, and fermented products such as Miso (bean paste), Shoyu (soy sauce), Sufu (Chinese cheese), Ontjom (made from groundnut press cake), Humanatto (black beans), Idli, Natto and Tempeh are described. Chapters seven and eight provide nutrient composition of raw, cooked, canned, sprouted legumes and other legume products including those of soybean and groundnut. Biological efficiency of not only soybean and groundnut meal but also of lupins, field peas, faba beans, guar, winged bean in the monogastric animals is given in chapter nine. The last chapter deals with the biochemical properties and nutritional significance of various antinutritional factors including protease inhibitors, lectins, goitrogens, cyanogens, antivitamin factors, estrogens, toxic amino acids, and favism.

Although this book is primarily intended for nutritionists, food technologists, and food scientists, it is also useful as a reference book for all scientists working on legumes improvement.

The cost of the book (US$ 119.50) may look reasonable for those in the developed countries, but is prohibitive for individual buyers in developing countries. Nevertheless, it is a useful addition to the libraries in the developing countries.

L.J. Reddy
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When both English and original titles are available

Rosolem, C. A., Nakagwa, J., and **Machado, J. R., Jr.** 1980. [Effect of top dressing fertilizing for grain sorghum on two oxisols.] Adubacao em cobertura para sorgo-granifero em dois latossolos. (In Pt. Summary in En.) Revista Brasileira de Ciencia do Solo 4(1):44-49. 12 refs.

Books

Entry with editors and edition

Lyons, J. M., Graham, D., and **Raison, J. K.** (eds.) 1979. Low temperature stress in crop plants: the role of the membrane. 2nd edn. New York, USA: Academic Press. 565 pp.

Entry with series

Binswanger, H. P., Virmani, S. M., and **Kampen, J.** 1980. Farming systems components for selected areas in India: evidence from ICRISAT. Research Bulletin no. 2. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics. 40 pp.

Entry with same author and publisher, and series

Commonwealth Bureau of Soils. 1977. Sorghum composition and quality as affected by fertilizing, 1958-1967. Annotated Bibliography no. S1217R. Harpenden, Herts, UK: Commonwealth Bureau of Soils. 8 pp. 35 refs.

Government publication

Botswana: Ministry of Agriculture, Animal Production Unit. 1979. Livestock and range research in Botswana, 1978. Gaborone, Botswana: Ministry of Agriculture, Animal Production Unit. 172 pp.

Chapter in a book

Bagnall, D. J. 1979. Low temperature responses of three *Sorghum* species. Pages 67-80 *in* Low temperature stress in crop plants: the role of the membrane (Lyons, J.M., Graham, D., and Raison, J.K., eds.). 2nd edn. New York, USA: Academic Press.

Book or serial with limited distribution

Walker, T. S., Singh, R. P., and **Jodha, N. S.** 1983. Dimensions of farm-level diversification in the semi-arid tropics of rural South India. Economics Program Progress Report no. 51. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics. 30 pp. (Limited distribution.)

Proceedings

Complete proceedings

Ahmadu Bello University. 1980. Proceedings of the 4th NAFPP Workshop on Sorghum, Millet and Wheat, 14-16 Apr 1980, Samaru, Nigeria. Samaru, Zaria, Nigeria: Ahmadu Bello University. 318 pp.

Spiertz, J. H. J., and **Kramer, T.** (eds.) 1979. Crop physiology and cereal breeding: proceedings of a Eucarpia Workshop, 14-16 Nov 1978, Wageningen, Netherlands. Wageningen, Netherlands: PUDOC (Centre for Agricultural Publishing and Documentation). 300 pp.

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Paper or abstract in proceedings

Rao, N. G. P. 1982. Transforming traditional sorghum in India. Pages 39-59 *in* Sorghum in the eighties: proceedings of the International Symposium on Sorghum, 2-7 Nov 1981, ICRISAT Center, India. Vol. 1. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics.

Kanwar, J.S., Kampen, J., and **Virmani, S.M.** 1982. Management of Vertisols for maximising crop production—ICRISAT experience. Pages 94-118 *in* Vertisols and rice soils of the tropics. Symposium papers 2. Transactions of the 12th International Congress of Soil Science, 8-16 Feb 1982, New Delhi, India. New Delhi 110 012, India: Indian Agricultural Research Institute.

Singh, R. B., and **Tyagi, B. R.** 1974. Translocation stocks in *Pennisetum typhoides*. Page 367 *in* Advancing frontiers in cytogenetics in evolution and improvement of plants: proceedings of National Seminar, 14-19 Oct 1972, Kashmir, India (Kachroo, P., ed.). New Delhi, India: Hindustan Publishing Corp. (Abstract.)

Renfro, B. L. 1976. The downy mildew disease of pearl millet. Pages 77-83 *in* Proceedings of the Consultants' Group Meetings on Downy Mildew and Ergot of Pearl Millet, 1-3 Oct 1975, ICRISAT, Hyderabad, India. Patancheru, A.P. 502324, India: International Crops Research Institute for the Semi-Arid Tropics.

Paper presented at a symposium but not formally published

Seshu Reddy, K. V., and **Davies, J. C.** 1978. The role of the Entomology Program with reference to the breeding of pest-resistant cultivars of sorghum at ICRISAT. Presented at the Symposium on Strategies for Insect Pest Control through Integrated Methods, 16-17 Aug 1978, Indian Agricultural Research Institute, New Delhi, India. Patancheru, A.P. 502324, India: International Crops Research Institute for the Semi-Arid Tropics. (Limited distribution.)

Theses

Ph.D.

Huffman, K. W., III. 1978. The effect of environment on seed development in sorghum. Ph.D. thesis, Texas A & M University, College Station, Texas, USA. 89 pp.

M.Sc.

Patil, S. S. 1977. Studies on induced mutations and selection response for yield in sorghum. M.Sc. thesis, University of Agricultural Sciences, Bangalore, Karnataka, India. 217 pp.

Others

Ramadan, G. A. 1980. Heterosis and combining ability in forage sorghum. (Summary in Ar.) Thesis, Tanta University, Kafr El-Sheikh, Egypt. 123 pp.

Annual reports

Complete report

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1983. Annual report 1982. Patancheru, A.P. 502324, India: ICRISAT. 440 pp.

Section of complete report

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1983. Chickpea. Pages 100-128 *in* Annual report 1982. Patancheru, A.P. 502 324, India: ICRISAT.

Publications "in press"

A journal article accepted by the journal's editor

Soman, P., and **Peacock, J. M.** (In press.) A laboratory technique to screen seedling emergence of sorghum and pearl millet at high temperature. Experimental Agriculture.

A book chapter, similarly accepted for publication but not yet published. (The same rule applies for a book.)

Vasudeva Rao, M. J. (In press.) Techniques for screening sorghums for resistance to *Striga*. *In* Biology and control of parasitic weeds. 1. *Striga* (Musselman, L. J., ed.). Boca Raton, FL 33431, USA: CRC Press.

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2. Surname
3. Given name(s)
4. Designation (e.g. Department Head/Librarian/Breeder SII)
5. Professional Qualifications(Highest Degree/other) PhD [ ] MA/MS [ ] BA/BS [ ]
   High School/Diploma [ ] Other .....
6. Institute/Organization
7. Street Address
8. City
9. State/Province
10. Postal/Zip code
11. Country
12. Telex No.
13. Cable Address
14. Telephone Number (Office)
15. Telephone Number (Residence)
16. If you are a member of a Computer-Based Messaging System or
    Electronic-Mail System please give your CBMS address.
17. Nationality
18. First Language

Relationship with ICRISAT: If you have contacts with ICRISAT, please give name(s) of contact person(s)

19. Contact 1
20. Contact 2
21. Contact 3

and indicate if you are or were

22. ICRISAT Staff (give details and dates)
23. Collaborator with Legumes Program (give details and dates)
24. Collaborator with ICRISAT (give details and dates)
25. Consultant to ICRISAT (give details and dates)
26. Visitor (give details and dates)
27. Trainee (give details and dates)
28. Member of AGLN

Please indicate a maximum of three of the major interests listed overleaf (enter letters selected from A to I) [ ] [ ] [ ] and a maximum of five specific interests (enter numbers selected from 11 to 95). Your specific interests need not be confined to the major interest groups you have selected. [ ] [ ] [ ] [ ] [ ]

Which ICRISAT Publication do you find most useful?
Which ICRISAT Service do you find most useful?
What activity occupies most of your time?
Administration ( ) Research ( ) Teaching/Training ( ) Extension ( ) Other ....
What percentage of your time do you spend working with Arachis? ( )
List a maximum of three of your publications relevant to Arachis (You may send a complete list of your publications, if you wish)

A. *Breeding*

11. Confectionery breeding
12. Disease-resistance breeding
13. Pest-resistance breeding
14. Adaptation breeding
15. Nutrition and food quality
16. Genetic studies
17. Mutation breeding
18. Breeding methodology

B. *Cytogenetics*

21. Cytology
22. Haploids
23. Aneuploids
24. Wild species
25. Wide crosses
26. Tissue culture
27. Transformation
28. Protoplasts

C. *Physiology/Microbiology*

31. Water stress
32. Drought screening
33. Nitrogen fixation
34. Mineral nutrition
35. Photoperiod studies
36. Climate and environment
37. Temperature tolerance

D. *Pathology*

41. Fungal diseases
42. Aflatoxin
43. Bacterial diseases
44. Nematodes
45. Deficiency and toxicity diseases
46. Foliar diseases
47. Pod and soilborne diseases
48. Disease control
49. Surveys

E. *Virology*

51. Characterization
52. Identification
53. Detection
54. Classification
55. Transmission
56. Cultural control
57. Sources of resistance
58. Integrated management
59. Surveys

F. *Entomology*

61. Taxonomy
62. Bionomics
63. Ecology
64. Varietal resistance
65. Chemical control
66. Cultural control
67. Cropping systems
68. Integrated pest management
69. Insect vectors

G. *Genetic resources*

71. Collection and assembly
72. Evaluation
73. Maintenance and conservation
74. Documentation

H. *Agronomy*

81. Soil and crop management
82. Fertilizer response
83. Interculture
84. Plant population
85. Rotations
86. Harvesting, seed technology, postharvest management
87. Irrigation and water management
88. Tolerance for adverse soils
89. Machinery

I. *Other*

91. Training
92. Extension
93. Library science/information technology
94. Sociology or anthropology
95. Other