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International Arachis Newsletter

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

Prepared by

LEGUMES PROGRAM

Patancheru, Andhra Pradesh 502 324, India

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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
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INDIA

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

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News and Views

Editorial

The editorial team of IAN has suddenly shrunk, with two of its editors, P. Subrahmanyam and B.B. Sahni, leaving ICRISAT. Dr Subrahmanyam left ICRISAT Center to take up his new assignment as Principal Plant Pathologist with the ICRISAT Regional Groundnut Project for Southern Africa, Malawi. Mr Sahni has resigned to persue his academic career. We wish to thank both of them for their help in bringing out the past issue (IAN 7) and extend our best wishes in their new endeavors.

The eighth newsletter contains reports on factors contributing to higher groundnut productivity (dried pod yields as high as 11.2 t ha^{-1}) in China and higher groundnut production in Argentina, in addition to various research articles.

The strength of a newsletter mainly depends on the newsworthiness of the articles published in it. So we request our readers to contribute articles with more news value. We also request our contributors to strictly adhere to the 'Style and Form for Contributions' given on the cover verso to expedite the review process.

L.J. Reddy

News from ICRISAT Center

Indian Oilseed Cooperatives Meet at ICRISAT Center to Discuss Transfer of Groundnut Technology

Nineteen senior officials of the National Dairy Development Board and its subsidiary State Cooperative Oilseeds Growers' Federations met at ICRISAT Center on 23 May to discuss a joint action plan. Their objective is to transfer improved groundnut technology to farmers in six states in India. The officials shared their conviction that Legumes On-Farm Testing and Nursery Unit (LEGOFTEN) has already been able to introduce valuable new technology to groundnut farmers, and they have therefore adopted a similar approach to technology transfer in their own organizations. Their target is to have the new technology operational on at least 100 000 ha within the next 3 years. During the meeting, they asked ICRISAT to continue providing technical backstopping, monitoring, and training to support their effort.

New ICRISAT Groundnut Varieties Released in India

The Central Sub-Committee on Crop Standards, Notification, and Release of Varieties, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India has released and notified three more ICRISAT groundnut varieties, ICGS 1 (ICGV 87119), ICG(FDRS) 10 (ICGV 87160), and ICGS 37 (ICGV 87187) for cultivation in India. With these releases, the total of ICRISAT groundnut varieties released in India increases to six.

ICGV 87119: Variety ICGV 87119 is suitable for rainy-season cultivation in Haryana, Punjab, Uttar Pradesh, Bihar, and Rajasthan states in India. It has also been found suitable for spring-season cultivation in Uttar Pradesh. In All India Coordinated Research Project on Oilseeds (AICORPO) trials in the rainy season in zone I, comprising above-mentioned states, ICGV 87119 showed an average pod-yield advantage of 17.2% over JL 24, 10.9% over J 11, and 36.3% over Ak 12-24.

ICGV 87119 is a spanish variety with decumbent 2 to decumbent 3 growth habit and medium to small elliptic dark-green leaves. It has two-seeded pods with tan seeds.

It's oil content ranges from 49.7% to 53.3%. It matures in 110 to 115 days and has a shelling percentage of 70%.

ICGV 87160: Variety, ICGV 87160 is the first rust-resistant and late leaf spot tolerant variety of ICRISAT released in India. It is recommended for rainy-season cultivation in Andhra Pradesh, Karnataka, and parts of Maharashtra in India. In AICORPO trials, ICGV 87160 has shown an average pod-yield advantage of 18.7% over JL 24, 36.1% over TMV 2, 17.7% over J 11, and 8.0% over Kadiri 3.

ICGV 87160 has an erect growth habit and medium elliptical dark-green leaves. It belongs to the Natal group and has mainly two-seeded pods with tan seeds. It's oil content ranges from 44.1% to 51.1%. It matures in 105-124 days and has a shelling percentage of 67%. Being a foliar diseases resistant variety, ICGV 87160 produces a better quality fodder.

ICGV 87187: Variety ICGV 87187 is suitable for summer cultivation in Gujarat, north Maharashtra, and Madhya Pradesh. ICGV 87187 has shown an average pod-yield superiority of 41.5% over national control J 11, 27% over ICGS 44, and 53% over JL 24 in various trials conducted by the All India Coordinated Research Project on Oilseeds.

ICGV 87187 is a spanish variety with decumbent 2 to decumbent 3 growth habit. It has mainly two-seeded medium sized pods. Its seeds are tan and contain 48% oil and 23% protein. It matures in 110-120 days.

News About ICRISAT Groundnut Scientists and Research Fellows

Dr P.W. Amin, Senior Entomologist, Legumes Program, left ICRISAT on his appointment as Vice Chancellor of Punjabrao Agricultural University, Akola, Maharashtra, India on 4 May 1990.

Dr S.N. Nigam, Principal Groundnut Breeder, returned to ICRISAT Center following a year's study leave at the North Carolina State University, Raleigh, USA, on 6 Jun 1990.

Dr R.C. Nageswara Rao, Crop Physiologist II, Legumes (Groundnut) Program, proceeded on 9 months sabbatic leave on 26 Sep 1990 to work with the Department of Primary Industries, Kingaroy, and the Australian National University, Canberra.

Dr P. Subrahmanyam, Senior Plant Pathologist (Groundnut), separated from ICRISAT Center on 26 Sep 1990 to accept the position of Principal Plant Pathologist with the ICRISAT Regional Groundnut Project for Southern Africa, Malawi.

Dr D.H. Smith joined ICRISAT as Principal Plant Pathologist (Legumes) on 13 Oct 1990.

Dr S.R. Boye-Goni, Senior Groundnut Breeder, Institute of Agricultural Research, Kano, Nigeria, joined as a Research Fellow for 3 months from Aug 1990 in the Groundnut Breeding Unit, ICRISAT Center.

Fellowships at ICRISAT

ICRISAT has a limited number of fellowships available for scientists interested in research related to groundnut, chickpea, or pigeonpea. These fellowships allow successful candidates to work with ICRISAT scientists in research projects of mutual interest.

- **Postdoctoral Fellowships** are awarded to scientists who have received their Ph.D. degree within the past 3 years. The Postdoctoral Fellowship can last for up to 2 years.
- **Research Fellowships** are for those with an M.Sc., or a Ph.D., and
- **Senior Research Fellowships** for those with a Ph.D. and experience of more than 5 years.

Research Fellowships are for up to 1 year. Successful candidates are provided with travel costs and a stipend. If you wish to be considered for one of these fellowships, please send your request for an application form to:

Principal Training Officer
Training Program
ICRISAT, Patancheru
Andhra Pradesh 502 324
INDIA

Recent ICRISAT Publications

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1990. Legumes entomology. (Public Awareness Series). Patancheru, Andhra Pradesh 502 324, India: ICRISAT.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1990. Groundnut variety ICGV 87141 (ICGS 76). Plant Material Description no. 24. (ISBN 92-9066-190-9) (Supplied gratis).

Nigam, S.N., Vasudeva Rao, M.J., and **Gibbons, R.W.** 1990. Artificial hybridization in groundnut. Information Bulletin no. 29. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics. (ISBN 92-9066-177-1).

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1990. Summary proceedings of the First ICRISAT Regional Groundnut Meeting for West Africa, 13-16 Sep 1988, Niamey, Niger. Patancheru, A.P. 502 324, India: ICRISAT. (Published bilingually in English and French) (ISBN 92-9066-178-X).

Nambiar, P.T.C. 1990. Nitrogen nutrition of groundnut in Alfisols. Information Bulletin no. 30. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics. (ISBN 92-9066-179-8).

ICRISAT. 1990. Annual Report 1989. Patancheru, A.P. 502 324, India: ICRISAT. (ISSN 0257-2478).

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1990. Summary proceedings of the First Consultative Group Meeting on the Host Selection Behavior of *Helicoverpa armigera*, 5-7 Mar 1990, ICRISAT Center, India. Patancheru, A.P. 502 324, India: ICRISAT.

Abstract

Helicoverpa (Heliothis) armigera Hübner (Lepidoptera: Noctuidae) is a major pest of several food and cash crops in the Old World semi-arid tropics. In this publication, scientists review research on the host selection behavior of *H. armigera* and on the mechanisms of host-plant resistance to this pest in pigeonpea (*Cajanus cajan* (L.) Millsp.) and chickpea (*Cicer arietinum* L.). Five technical papers cover host selection by lepidopteran insects, behavioral and electrophysiological studies of *H. armigera*, the identification of host-plant resistance in pigeonpea and chickpea, and the chemical basis of pest resistance in these pulse crops. Recommendations are made for further action to control *H. armigera* through a better understanding of its host selection behavior and the factors that interfere with this behavior.

News from Eastern and Southern Africa

Ethiopia: A. Wakjira of Lowland Oilseeds Improvement Program, Institute of Agricultural Research, Melka Werer Research Center, Ethiopia, writes that ICRISAT germplasm line ICG 7794 has been released provisionally this year for cultivation in high rainfall and irrigated areas of his country. Other ICRISAT developed promising material that are likely to be released include ICGSs 11, 30, 44, 49, 66, and 77. He expresses appreciation and gratitude to ICRISAT and looks forward to receiving more groundnut material, particularly of confectionery types.

Malawi: G.L. Hildebrand from SADCC/ICRISAT Groundnut Project, Malawi, informs that ICGMS 42 has been approved recently for prerelease multiplication and on-farm trials in Malawi by the Ministry of Agriculture. Earlier in 1987, this variety was also identified for prerelease multiplication in Zambia and is currently undergoing farmers' tests. ICGMS 42 was selected at the SADCC/ICRISAT Project from the breeding material supplied from ICRISAT Center in 1982.

Some commercial farmers in Zimbabwe have also evinced interest in this variety. As this variety is acceptable to importers in the U.K., it is likely to give a boost to the dwindling groundnut export from this region.

News from the ICRISAT Sahelian Center

Second Regional Groundnut Meeting for West Africa

The Second Regional Groundnut Meeting for West Africa was held at ICRISAT Sahelian Center, Sadore, Niger, from 11-14 Sep 1990. The meeting was officially inaugurated by H.E. Adamou Aboubacar, Minister for Higher Education, Science and Technology, Niger. It was attended by 54 participants from Benin, Burkina Faso, Cameroon, Central Africa Republic, Côte d'Ivoire, Gambia, Ghana, Guinea, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo, and Chad. Institut français de recherche scientifique pour le développement en coopération (ORSTOM), Institut de recherches pour les huiles et oléagineux (IRHO), Centre de Coopération internationale en recherche agronomique pour le développement (CIRAD) and Conférence des responsables africains et français de la recherche agronomique or African and French Officials Conference for Agricultural Research (CORAF),

Participants of the Second Regional Groundnut Meeting with H.E. Adamou Aboubacar, Minister for Higher Education, Science and Technology, Niger (front row 3rd from left).

Peanut CRSP, ICRISAT Center, and SADCC/ICRISAT were also represented. The participants also visited ICRISAT at Bengou and Tara in southern Niger.

News from Peanut CRSP (Collaborative Research Support Program)

Second Regional Groundnut Meeting for West Africa. The Second Regional Groundnut Meeting for West Africa organized by ICRISAT in collaboration with Peanut CRSP was held at the ICRISAT Sahelian Center from 11 to 14 Sep 1990. Peanut CRSP participants included: Drs A. Traore and I. Dicko, Burkina Faso; Mr D. Soumano, Mali; Mr A. Mounkaila, Niger; Drs S. Misari and P. Olorunju, Nigeria; Dr A. Ba, Mr J.C. Mortreuil, and Mr O. Ndoye, Senegal; Dr B. Singh, Alabama A&M University; Dr C. Simpson, Texas A&M University; and Dr D. Cummins, Program Director, University of Georgia.

Cooperators' Meeting. A West Africa CRSP Cooperators' Meeting was held at the Grand Hotel, Niamey, Niger, on 14 Sep 1990. All Peanut CRSP Cooperators attending the Second Regional Groundnut Conference participated.

Rosette Virus Coordinators' Meeting. Dr J. Demski, Peanut CRSP Virus Project Principal Investigator, University of Georgia, and Dr S. Misari, Institute for Agricultural Research, Ahmadu Bello University, Nigeria, and Peanut CRSP Virus Project Cooperator were among the participants in the Peanut Rosette Virus Coordinators' Meeting coordinated by ICRISAT and held in Montpellier, France, between 18 and 19 Sep 1990.

Training Course on Food Legumes and Course Grains (FLCG). A Training Course on Quality Evaluation and Utilization of Food Legumes and Course Grains was held by the Department of Product Development, Kasetsart University, Thailand, from 1 to 27 Oct 1990.

The Course was sponsored by UNDP/FAO in cooperation with Kasetsart University and Peanut CRSP and coordinated by Dr P. Chompreeda, also Peanut CRSP Principal Investigator at Kasetsart. Peanut CRSP lecturers on the Course included: Dr Chompreeda, V. Haruthaithanasan, Dr C. Oupadissakoon, S. Khotaveewattana, and P. Thamratwasik, (Kasetsart); Dr R.R. del Rosario, (University of the Philippines at Los Baños); Drs L. Beuchat (Principal Investigator for the Utilization Project in the Philippines and Thailand); and R. Brackett, (University of Georgia). CRSP support of the Department of Product Development in the Faculty of Agroindustry has assisted them in becoming leaders in utilization research in the region.

Texas A&M University. Mrs R.A. Taber, Department of Plant Science and Peanut CRSP Principal Investigator for the Mycorrhizae Project, is retiring from the Texas A&M University on 31 Dec 1990.

Dr R. E. Pettit, Department of Plant Science and Peanut CRSP Principal Investigator for the Mycotoxin Project, retired from Texas A&M University on 30 Sep 1990. He will continue to work on the Peanut CRSP on a half-time basis.

Dr D.H. Smith, Plant Pathologist at the Research and Extension Center in Yoakum and Peanut CRSP Cooperator has assumed duties at ICRISAT as Principal Pathologist, Legumes.

Investigators' and Technical Committee Meeting. The Annual Meeting of the Peanut CRSP Investigators was held at the Evergreen Conference Center at Stone Mountain, Georgia, on 13 Jul 1990 following the Annual Meeting of the American Peanut Research and Education Society. Approximately 33 scientists attended with 9 representatives from the host countries. The Technical Committee Meeting followed on 13 and 14 Jul.

Board of Directors' Meeting. The Peanut CRSP Board of Directors met in Washington, DC, on 31 Oct 1990 during the CGIAR International Centers' Week.

CRSP Council. The eight Collaborative Research Support Programs supported by USAID have organized into a Council. The CRSP Council is an integrated CRSP initiative that addresses the global concerns of agricultural production and sustainability, natural resource conservation, and environmental quality. The Council unites the resources and capabilities of the eight CRSPs, effectively creating a powerful international research network to service and support USAID missions and regional offices. The CRSPs provide access to cutting-edge technology through over 700 experienced international scientists form 32 U.S. universities and over 80 international research institutions representing over 70 disciplines. These resources can be used to plan and implement USAID and other donor projects in agricultural and aquacultural research, natural resource conservation, and nutrition. The CRSPs can be accessed by USAID missions and other donor organizations as a whole or in part through grants, contracts, and basic ordering agreements. The eight CRSPs are Bean/Cowpea, Sorghum/Millet, Nutrition, Peanut (Groundnut), Pond Dynamics/Aquaculture, Small Ruminant, Fisheries Stock Assessment, and Tropical Soils.

University of Georgia. Dr C. Kuhn, Department of Plant Pathology, Athens, and Peanut CRSP Co-Principal Investigator for the Virus Project, will retire from the University of Georgia on 31 Dec 1990.

North Carolina State University (NCSU). Dr R.L. Brandenburg, entomologist at NCSU, has assumed duties as Principal Investigator for the Peanut CRSP Insect Management Project for Thailand and the Philippines. Dr J. Harper, Head of the Entomology Department at NCSU, will be a Cooperator on the Project.

Alabama A&M University (AAMU). Dr Umaid Singh, Biochemist, returned to ICRISAT following a sabbatical leave with Dr Bharat Singh in the Department of Food Science and Animal Industry at AAMU from 1 Jan to 30 Jun 1990. While at AAMU, he studied functional properties of groundnut flour and sorghum-groundnut composite flour and the effect of processing method on the digestibility of protein and phytic acid in groundnut.

In-country Training Course on Legumes Production in Sri Lanka

The AGLN Coordination Unit in collaboration with the Department of Agriculture, Sri Lanka, organized an In-country training course on legumes production from 9 to 17 Jul 1990, at Peradeniya, Kandy, Sri Lanka. The objective of the course was to educate staff from the Department of Agriculture, Sri Lanka, about the latest legume production technologies so that this information could be utilized to enhance legumes production in that country. The course broadly covered the following topics:

- Problems, constraints, and importance of legume production in Sri Lanka. (The crops covered were pigeonpea, groundnut, mung bean, black gram, and cowpea.)

- Agronomic and physiological aspects of legumes production.
- Disease and insect problems in these crops.
- Seed production and certification.
- Postharvest technology, including *dhal*-making and storage.
- Field visits and demonstrations.

There were 24 trainees including research scientists, extension officers of the Department of Agriculture, and teaching assistants from the Peradeniya University, Sri Lanka. The resource personnel were from the Sri Lanka Department of Agriculture and Peradeniya University (16), ICRISAT (6), and Asian Vegetable Research and Development Research Center, Taiwan (1). During the course, 31 lectures, 2 video shows, and 3 days of field demonstrations were arranged including pre- and post-training course evaluations. The evaluations indicated that this course enhanced the knowledge of the trainees.

Recommendations of theRegional Collaborative Meeting on 'Breeding Peanuts for Acid-Soil Tolerance, Shade Tolerance, and Peanut Entomology', 3–6 Apr 1990, Los Baños, Philippines

1. Recommendations from the working group on shade and acid-soil tolerance
   - The initial step in screening for shade tolerance or acid-soil tolerance should be to characterize the target environment and also where screening and testing is to occur. This will allow researchers at other institutions to determine if the germplasm identified as tolerant is appropriate for local conditions.
   - Scientists at the Institute of Plant Breeding, University of the Philippines, Los Baños, have identified groundnut germplasm that have relatively high yields in shade environments and in acid soils. It is recommended that this work be continued to identify groundnut genotypes adapted to shade and to acid soils; and additional research be conducted to identify the specific components of the shade environment or the acid-soil environment, for which tolerance is being identified so that potential use of the developed germplasm in the region can be ascertained. When appropriate, the expertise of TROP-Soils and Peanut CRSP scientists be utilized to characterize the acid-soil environment.
   - For shade: Scientists from the Philippines will report results of the shade-tolerant screening to other scientists through the International Arachis Newsletter and the ACIAR Food Legume Newsletter. Seeds of tolerant germplasm be increased and made available to other interested countries in south and southeast Asia.
   - For acid soils: Activities on screening for acid-soil tolerance be encouraged in southeast Asia. It was recommended that the ACIAR Food Legume Newsletter and the International Arachis Newsletter solicit reports from scientists working on screening for acid-soil tolerance. The articles should indicate resistant germplasm identified and how seeds of the germplasm can be obtained. It is also recommended that breeding for acid-soil tolerance be discussed as part of a regional workshop on groundnut in southeast Asia to be held in 1993-94.
   - ICRISAT should be involved with acid-soil tolerance screening programs and make additional tolerant germplasm available to national programs in south and southeast Asia.
2. Recommendations from the working group on peanut (groundnut) entomology
   - Prepare a proposal to conduct a survey of insect pests of groundnut in Asia. The survey would take place over a 5-year period in any one country. The proposal is to be submitted to international agencies for funding initially for 2 years as an internationally coordinated project, to be continued with external funding for an additional 3 years by scientists of participating countries. The project as a whole should last for 10 years to cover as many Asian countries as possible.
   - The proposal should include a stipend for a Project Coordinator and support for data collection and interpretation.
   - Prepare a handbook and videotape to be used as a guide to conduct uniform insect surveys on groundnut.
   - Organize and train survey teams comprised of national scientists from participating countries, scientists from international agencies, and local agricultural agents from each country.

The First International Crop Science Congress

The Congress to be held 14-22 Jul 1992, Iowa State Center, Ames, Iowa, USA, is Sponsored by the Crop Science Society of America and Iowa State University.

Congress Mission

- Presentation and discussion of recent research results.
- Integrate and apply knowledge from crop science to such issues as biodiversity, sustainable agriculture, cropping systems, global climate change, and the physiology and genetics of crop adaptation and productivity.
- Proposals for future thrusts in research and development.
- Examine future scientific and education needs and directions of crop-based agriculture.
- Initiate and nurture scientific and educational partnerships.
- Contribute a comprehensive, written proceedings from the Congress.

Program Organization

The program will consist of plenary sessions, symposia, and voluntary poster papers and professional tours organized so as (a) to present knowledge pertinent to crop scientists from all regions of the world, (b) to emphasize integration of knowledge from crop science to solve global and regional problems and issues, and (c) to focus on global research needs. Entertainment, meal functions, recreational and agricultural tours, and opportunities for work group sessions will be provided in the congress program.

Congress Information

Further information about the first International Crop Science Congress will be issued during spring 1991. To obtain the second brochure write to: K. Frey, Chair, International Crop Science Congress, c/o Agronomy Department, Iowa State University, Ames, IA 50011, USA, by providing following information:

Name, Address, City/State Zip, Country.

Reports

Factors Contributing to High Yields of Groundnut in Shandong, China

Sun Yanhao and **Wang Caibin** (The Peanut Research Institute of Shandong Province, Laixi, Shandong, China)

Shandong lies in the east of China, between latitudes 34° and 38°N and longitudes 115° and 122°E. It is the main groundnut-production area, with 660000 ha which makes up to 18% of the total area in China. During the groundnut-growing season (April-September), the mean temperatures range between 21 and 23°C, rainfall is between 675 to 700 mm; relative humidity is between 70 and 75%, and solar radiation between 9213.6 and 9492.8 W m^{-2} $month^{-1}$; and evaporation between 200 to 210 mm $month^{-1}$.

We began a research program on increasing groundnut yields in 1979 which was a great success. Pod (dry) yields more than 7.5 t ha^{-1} were obtained from 120 plots with a total area of more than 600 ha between 1980-87 in Shandong. Among those, the highest pod (dried) yield of 11.2 t ha^{-1} was obtained in 0.1 ha in 1983, which was the world record. Yields of 9.58 t ha^{-1} in a 14-ha plot, 8.29 t ha^{-1} in a 67-ha plot, and 7.58 t ha^{-1} in a 720-ha plot were obtained. The factors contributing to such high yields are presented below:

Varieties. Four high-yielding varieties (Haihua No.1, Hua No.37, Xuzhou 68-4, and Hua No.17), developed by crossing different *A. hypogaea* varieties, were used. Hua No.17 has more branches with big pods and is of long duration (140-145 days). The other three have sparse branches with big pods and are of long duration (145-150 days).

Physiological parameters. The maximum leaf area indices (LAI) were 5.2 to 5.5 and Hua No.17 had slightly higher LAI than the other three varieties (with sparse branches). The total dry matter (TDM) ranged from 13.8 to 18.9 t ha^{-1} with harvest index (HI) of 0.48-0.55 (Table 1).

Yield parameters. The actual numbers of harvested plants (ANHP) were 195 to 235.5 thousand ha^{-1} with 17.9-20 pods $plant^{-1}$ which yielded 3375-4710 thousand pod ha^{-1}. The pod numbers kg^{-1} were 410-512 (Table 2).

Table 1. Physiological parameters of high-yielding groundnut varieties, Shandong, China.

Variety type	Leaf-area index			Net assimilation ratio[3] ($g\ m^2\ day^{-1}$)		Harvest index	Total dry matter ($t\ ha^{-1}$)	Pod yield ($t\ ha^{-1}$)
	Mean	Max.	Min.	Max.	Min.			
VSB[1]	2.81	5.20	0.71	8.90	1.5	0.5 -0.55	13.8-18.9	7.59-11.21
VMB[2]	3.00	5.52	0.55	10.5	0.9	0.48-0.52	14.8-16.8	7.71- 8.78

1. VSB = Varieties with sparse branches.
2. VMB = Varieties with more branches.
3. $$NSR = \frac{\text{Increase in plant dry mass}}{\text{Mean leaf area} \times \text{days}} \quad \frac{\text{Plant dry mass at } t_2 - \text{mass at } t_1}{\frac{(\text{Leaf area at } t_1 + \text{area at } t_2)}{2} \times (t_2 - t_1)}$$

where t_1 = 10 days after emergence; t_2 = time at which maximum mass was attained (Note: Sampling was carried out once every 10 days after the seed emergence until harvest)

Table 2. Yield-parameters of high-yielding groundnut varieties, Shandong, China.

Variety type	ANHP[1] 1000 ha^{-1}	MSH[2] (cm)	FBL[3] (cm)	BN/P[4]	PN/P[5]	TPR[6] (%)	MPR[7] (%)	PNK[8]	TPN/H[9] (1000 ha^{-1})
VSB[10]	195-235.5	45-48	50-54	8-9	17.9-20.0	57.3-78.8	51.2-68.9	410-490	3375-4710
VMB[11]	210-235.3	42-44	46-50	12-15	18.5-19.9	62.9-65.0	45.0-50.0	500-512	4185-4350

1. ANHP = Actual number of harvested plants.
2. MSH = Main stem height.
3. FBL = First branch length.
4. BN/P = Branch number $plant^{-1}$.
5. PN/P = Pod number $plant^{-1}$.
6. TPR = Two-seeded pod ratio (two-seeded pod number/total pod number).
7. MPR = Mature pod ratio (mature pod number/total pod number).
8. PNK = Pod number kg^{-1}.
9. TPN/H = Total pod number ha^{-1}.
10. VSB = Varieties with sparse branches.
11. VMB = Varieties with more branches.

Key cultivation practices.

1. Crop rotation. Winter: wheat, summer: maize, winter: wheat, vegetable-groundnut (five crops within 3 years).
2. Deep plowing (30 cm deep) for the first crop (winter wheat) of rotation cycle in autumn and shallow plowing (16.5 cm) was practised for the succeeding four crops.
3. Fertilizers were applied to the preceding crop (vegetable) at a rate of 75 t ha^{-1} farm yard manure (FYM), 450 kg ha^{-1} ammonium bicarbonate, 900 kg ha^{-1} calcium superphosphate, and 188 kg ha^{-1} muriate of potash. No fertilizers were applied to the groundnut crop.
4. Changing small bed sowing (60 cm bed spacing, one row bed^{-1}, 16 cm spacing within plant rows) to big bed sowing (86-90 cm bed spacing, two rows of 38-40 cm width bed^{-1}, and within row spacing of 16.5-18.15 cm). This results in a rational population structure of 121.2-138.45 thousand plants ha^{-1}.
5. Soil was irrigated during flowering and pod-filling

stages, if the water content in soil was less than half of the maximum water-holding capacity of soil.

Groundnut Production in Argentina

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The genus *Arachis* is a native of South America. There is evidence that the cultivated groundnut *Arachis hypogaea* L. originated in northwestern Argentina and Bolivia. Today, 98% of groundnut production in Argentina is from the Province of Cordoba, in a region between 30° 30' S and 32° S. The average land sown to groundnut during the last 50 years was 225,100 ha (Fig. 1) with an important annual variation because of unpredictable profit of the crop compared with other alternative crops and the adverse weather conditions, for a totally rainfed crop, in some years. The largest area sown to groundnut was in 1977/78 with 449,000 ha. Since that crop season, the area decreased averaging 179,500 ha during the last decade. Groundnut yields were 752 kg of seed ha^{-1} during 35 years since 1940 until 1974 with a rate of increase of 1.8 kg ha^{-1} (Fig. 1). In 1975, Argentina began to export some edible groundnut. As a result, groundnut farmers increased their net income and were able to introduce technological changes that resulted in yield improvement of 49.9 kg ha^{-1} (Table 1). The average yield during the last 15 years was 1131 kg ha^{-1}. In spite of the importance of each innovation cited in Table 1, the technology which produced the main change in the yield trend was the introduction of the virginia type varieties in 1982. While the average yield of the older Valencia and Spanish groundnut varieties under improved technology cropping system was 1.3 t ha^{-1}, the introduced Florunner and the local Florman Instituto Nacional de Technologia Agropecuaria (INTA) varieties were able to produce about 2 t ha^{-1}.

Argentinian groundnut growers use grass crops such as maize and sorghum preceding groundnuts in the crop rotation. Fertilizer is applied neither to groundnut nor to preceding crops, because soil nutrient levels are medium to high and the chances of a yield response are minimal. Land preparation begins by managing plant residue from the previous crops. Litter is shredded and harrowed into the soil surface during fall, well in advance of deep turning with the moldboard plow. Groundnut growers aim to

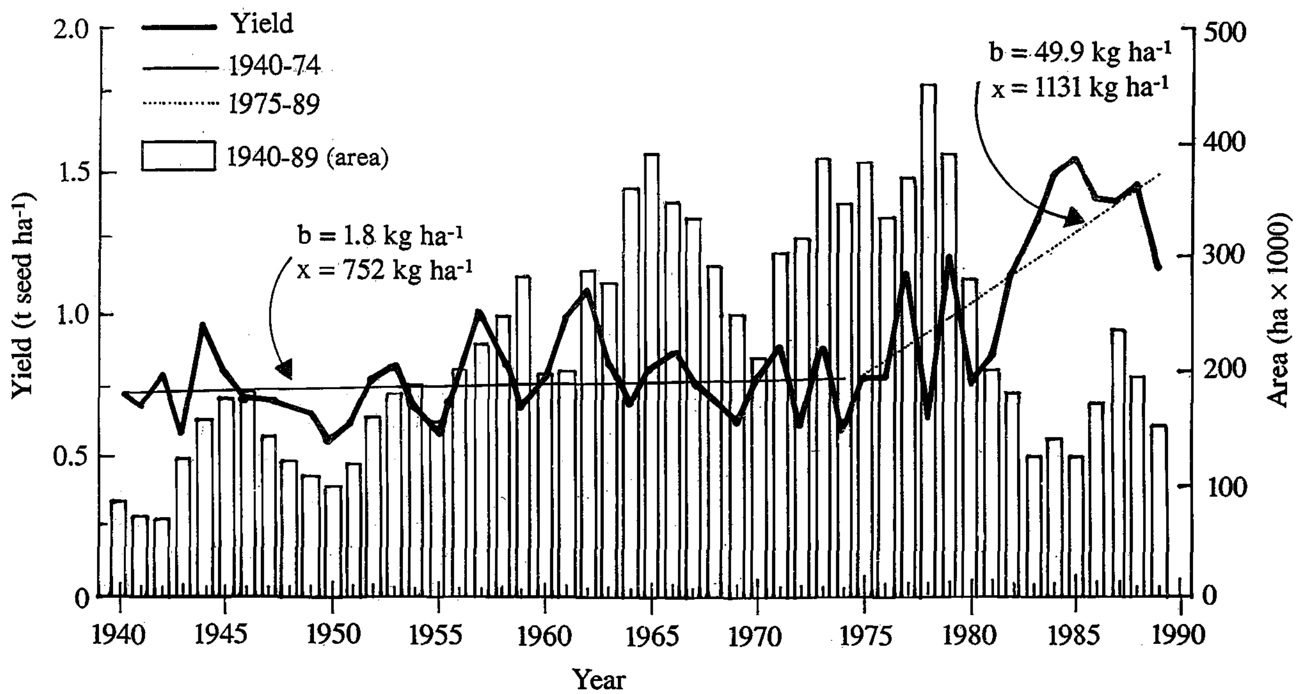

Figure 1. Yield, trend, and area sown to groundnuts in Argentina since 1940.

prepare a smooth and uniform seedbed for sowing. Seeds treated with recommended fungicides, are sown with planters provided with force-feed plates. Most of the groundnuts are sown with a row spacing of 70 cm and 10-12 cm of spacing within the row during November. Virginia type varieties require from 150 to 160 days to fully mature, and hence, they are ready to harvest during late April or early May. All groundnuts produced in Argentina are harvested by a combine harvester directly from the windrows. Whole groundnuts are brought into a combine harvester where pods are removed, cleaned, and bagged or conveyed into a trailer. Artificial drying is minimal, therefore bagged groundnuts are left in the field until the moisture reaches the maximum level allowed for safe storage. In recent years, it has become very popular to store groundnuts in bins with air flow for adequate drying.

Ecological characteristics of the Argentinian groundnut area. The Argentinian groundnut area has light textured soils, loamy sand, and sandy loam, well drained, with good chemical fertility for groundnut production. The average rainfall during the growing season is between 550 and 650 mm while the winter is dry. The average temperature in summer is about 21°C with daily maximum up to 40°C and minimum is 12°C. About 235 days are free from killing frost.

Economic characterization. In Argentina, groundnut is grown by 2000 to 2300 farmers. The production was only about 1.5% of the world production during the last decade, but because of the export market, the Argentinian participation now is 15% of the world trade of groundnut products. Today, Argentina is the third largest exporter of edible groundnuts after USA and China with an average of 100,000 t annum^{-1}.

Current research activities. Research is conducted by agricultural universities and mainly by Instituto Nacional de Technologia Agropecuaria at Manfredi Experimental Station, where each year one of the largest groundnut germplasm collection of the world is sown. Highly trained INTA extension agronomists have helped some groundnut farmers to reach the highest yield and quality through development of modern groundnut production models. Stronger extension teams should now extend that knowledge to most groundnut farmers.

Table 1. Chronological list of the leading technology adopted by groundnut farmers during the last 20 years in Argentina.

Technology	Year of diffusion
Broadleafed weed control with postemergence herbicides	1970
Preplanting soil incorporated with preemergence herbicides	1975
Grass control with postemergence herbicides	1979
Foliar disease control with organic fungicides	1979
Virginia type varieties (Florunner and Florman INTA)	1982
Digging with digger-shaker-inverter	1988

Improved Confectionery Groundnut Varieties for Cyprus

A. Hadjichristodoulous

(Abstract of the Technical Bulletin 116 (ISSN 9970-2315), Agricultural Research Institute, Ministry of Agriculture and Natural Resources, Nicosia, Cyprus)

Confectionery type of groundnuts were evaluated at Akhelia, Paphos, during 1985-89. The best variety, HYQ 25 [HYQ(CG) S 25 (M 13 × NC Ac 17352] outyielded the local variety by 2.3% in pod yield and by 6.2% in seed yield. The 1000-seed mass of this variety was 910 g compared to 804 g of local variety. Oil content was 54% and crude protein content 22%, similar to local variety. Other promising varieties were Hazera 234/73 and GK 3. Application of iron chiline A 12 to cure calcium-induced iron chlorosis verified earlier results and increased seed yield, dry matter yield of forage, and number of pods plant^{-1}. The effect of iron varied with variety; it was negligible in the local variety and maximum in HYQ 49 [HYQ(CG) S 49 (Ah 114 × NC Ac 1107)]. The dry matter yield of forage was positively correlated with seed yield, and maturity: 1000-seed mass and crude protein content. Seed yield was positively correlated with shelling percentage and pod yield with seed yield. The 1000-seed mass was positively correlated with crude protein content.

Research Reports

Chromosome Number and Karyomorphology of Some New Accessions of Genus *Arachis*

A.K. Singh, A. Venkateshwar, J.P. Moss, and **T.P.S. Rau** (ICRISAT Center)

Karyomorphology has been a conventional tool to ascertain phylogenetic relationships. In genus *Arachis*, such studies led to the identification of marker chromosomes in the genome of *A. hypogaea* (Husted 1936) and later to the characterization of A and B genomes in diploid species of section *Arachis* which contributed to evolution of *A. hypogaea* through amphidiploidization (Smartt et al. 1978; Singh and Moss 1982). In the last two decades, there have been several expeditions to South America leading to collection of many accessions. However, there has been little effort on characterization of genomes of these accessions and verification of their identity.

Karyomorphology of 15 accessions, belonging to sections *Arachis* and *Erectoides*, has been studied in present investigations. Chromosomes have been classified on the basis of size of chromosomes and position of centromeres as described in Table 1. The karyotypic formulae, total chromatin length, and the place of chromosome pair with secondary constriction within the ranking, when chromosomes are arranged by decreasing length were utilized to describe karyomorphology. These features help in tracing specific identity and relationships with accessions characterized earlier.

Table 1. Characters used in classification of chromosomes.

Criteria	Definition/ abbreviation
(a) Length of chromosome:	
1.5 µm or less	A
1.5 µm - 2.5 m	B
2.5 µm - 3.5 m	C
3.5 µm or more	D
(b) Position of centromere:	
Arm ratio	
1.0 - 1.09	Medium (M)
1.1 - 2.0	Submedian(Sm)
2.0 or more	Subtelocentric(St)
(c) Position of secondary constrictions:	
Distal to centromere	Satellite small [Sat(S)]
Proximal to centromere	Satellite large [Sat (L)]

Of the 15 accessions, 10 belong to section *Arachis* and 5 to *Erectoides* (Table 2). All the accessions studied had 20 chromosomes and were diploid (2n=20). Among section *Arachis* accessions, the pair of longest chromosomes in accession 30081 has the secondary constriction proximal to centromere and a large satellite. This pair is morphologically similar to the marker chromosomes of the B genome of section *Arachis* represented by *A. batizocoi*. Further, this accession lacks the distinct pair of small chromosomes as found in the A genome species, thus suggesting this as another accession of *A. batizocoi*. The other annual accessions, 30074 and 30075, have the 3rd and 4th pair of chromosomes with nucleolar organizer region and a distinct pair of small chromosomes similar to that of *A. duranensis* representing A genome of section *Arachis* (Singh 1985). Among perennial accessions, 30008, 35001, 30035, 30036, and 30017 have a distinct pair of small marker chromosomes, also similar to that of A genome of section *Arachis*. They also have a distinct pair of chromosomes with secondary constriction and a large satellite, on VII pair in 30035 and 30036, on VIII pair in 30008 and 35001, and on II pair in 30017 (Table 2). Morphologically these pairs of chromosomes are very similar to that of the corresponding secondary constriction chromosomes of *A. cardenasii* (Singh and Moss 1982). But total karyomorphology is a little distinct.

The other two perennial accessions, 30085 and 30007, also have a distinct pair of small marker chromosomes similar to that of the A genome species. They also have a pair of chromosomes with secondary constriction distal to the centromere and a small satellite, which is not discernible in all the mitotic plates. These features suggest their closer affinity to species such as *A. chacoense* or *A. villosa*.

Among accessions of section *Erectoides*, 30003, 30009, 30126, and 30134, the chromosome pair I or II has secondary constriction distal to centromere (Table 2), whereas the chromosome pair VIII of 30092 has second-

Table 2. Karyomorphological details of some wild *Arachis* accessions[1] studied.

ICG no.	Collector no.	Section	Series	Karyotypic formulae[2]	Total chromatin length (µm)	Place of nucleolar organizer	Constituent genome
8201	30081	*Arachis*	Annuae	1BSmSat(L)+1BSm+1BSt+1BM+5ASm+1ASmSt	14.25	I	B
8957	30074	*Arachis*	Annuae	1DSm+2CM+4CSm+1CMSat(L)+1BSm+1BM	28.62	III	A'
8205	30075	*Arachis*	Annuae	1CSm+5BSm+1BSmSat(L)+2ASm+1AM	17.72	IV	A'
8194	30017	*Arachis*	Perennes	1CSm+1BSmSat(L)+6BSm+1BSm+1Asm	19.25	II	A
8959	30085[3]	*Arachis*	Perennes	2CSm+1CSm+1BSmSat(S)+4BSm+1BSm+1ASm	22.68	IV	A
8191	30007	*Arachis*	Perennes	3CSm+2CM+3BSm+1BSmSat(S)+1BM	24.95	IX	A
8192	30008	*Arachis*	Perennes	1CSm+1CSm+6BSm+1BSmSat(L)+1AM	21.29	VIII	A
8954	30035	*Arachis*	Perennes	2CSm+3CM+1CSm+1BSmSat(L)+2BSm+1BM	25.85	VII	A
8955	30036	*Arachis*	Perennes	4CM+2CSm+1CSmSat(L)+3BSm	27.48	VII	A
8164	35001	*Arachis*	Perennes	2DM+1DSt+2CM+2CSm+1CSmSat(L)+2BSm	30.57	VIII	A
8945	30003	*Erectoides*	Procumbensae	2CSm+1CSmSat(S)+4BM+2BSm+1BSt	23.75	II	E
8946	30009	*Erectoides*	Procumbensae	1DSmSat(S)+3DSm+2DM+1DSt+1CSm+1CM+1CSt	39.55	I	E
8960	30092	*Erectoides*	Procumbensae	1CSm+7BSm+1BSmSat(L)+1BM	21.63	VIII	E
8215	30126	*Erectoides*	Tetrafoliatae	1CSmSat(S)+3CSm+5BSm+1Bst	23.99	I	E_1
8973	30134	*Erectoides*	Tetrafoliatae	3CSm+1CMSat(S)+6BSm	24.27	II	E_1

1. All accessions have 2n=20.
2. For definition of abbreviations see Table 1.
3. Narrow leaf.

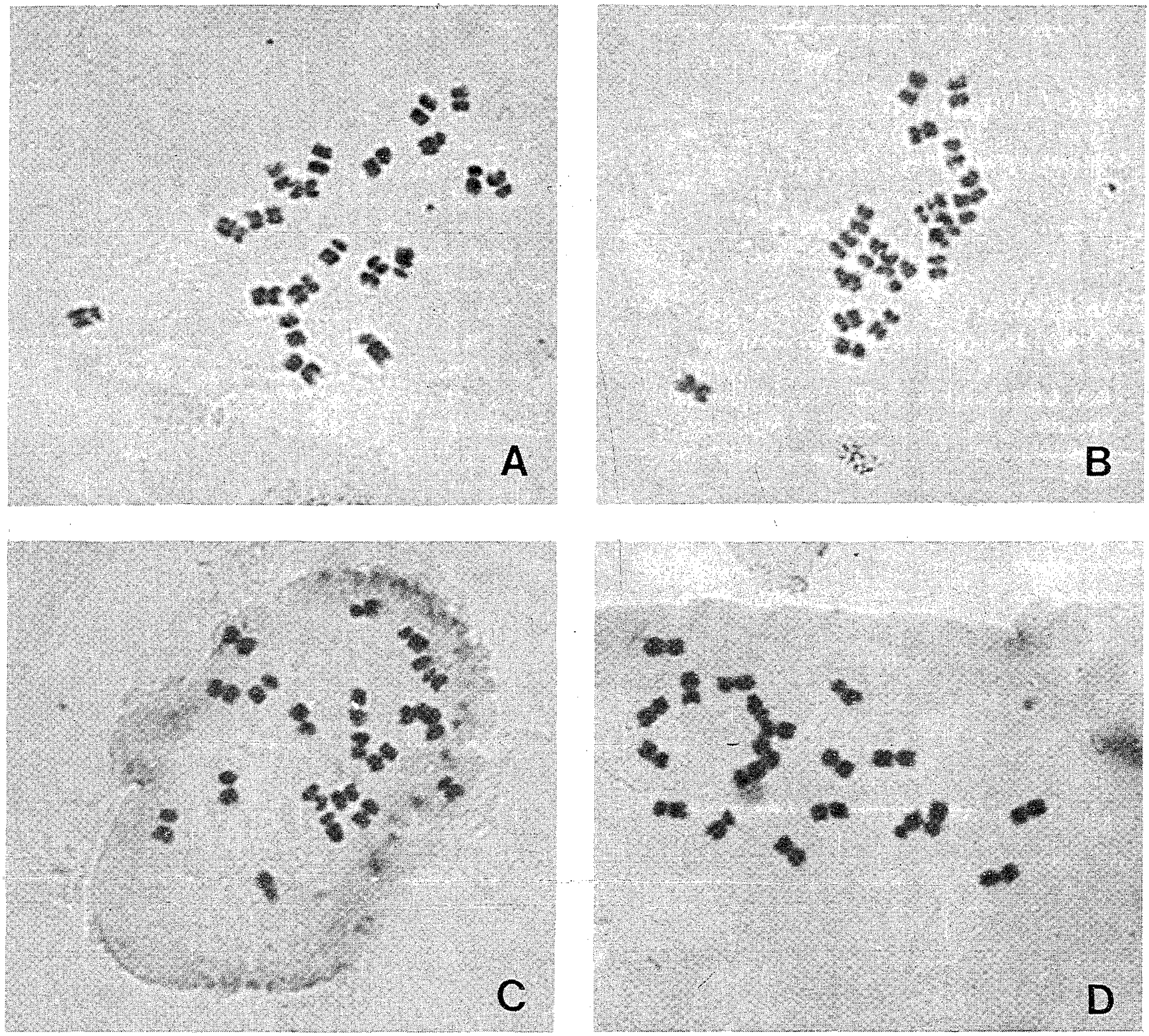

Figure 1. Somatic cells at metaphase. (A) *A*. sp 30003; (B) *A*. sp 30092; (C) *A*. sp 30126; (D) *A*. sp 30124 all from section *Erectoides*.

ary constriction and a large satellite (Fig. 1). Accessions 30126 and 30134 comparatively have a symmetrical karyotype with nearly uniform chromosome size and nearly similar pair of chromosomes with secondary constriction.

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Manipulation of Early Vegetative Growth for Yield Improvement in Groundnut

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Groundnut (*Arachis hypogaea* L.), like most other grain legumes, has indeterminate growth habit and many flowers formed in the later stages of plant growth fail to reach the soil in appropriate time. Work of McCloud et al. (1980), based on the results obtained from three runner and one bunch type of groundnut, shows that there are four aspects that promote high yield: (1) a rapid expansion phenophase, (2) a short podding phenophase, (3) a long seed-filling phenophase, and (4) a high partitioning of assimilates to the pods. In sandy loam soil, a basal dose of 20 kg N ha^{-1} is not sufficient to augment the early vegetative growth. Nodule development takes place 25 to 30 days after sowing (DAS) for symbiotic fixation of atmospheric nitrogen. Therefore, during the early stage of plant growth, nitrogen is very much in demand.

A field experiment was conducted to find out the effect of manipulating on the early vegetative growth through N-topdressing and subsequent foliar spray of a growth retardant 2-chloropthyl trimethyl ammonium chloride (CCC) on yield of groundnut. The experiment was laid out in a randomized-block design with three replications and eight treatments of N-topdressing, CCC spray, and nipping of apical buds using two erect varieties, i.e., AK 12-24 (V_1) and JL 24 (V_2) as the test varieties. The experiment was conducted during rainy

Table 1. Effects of N-topdressing, CCC[1] spray and nipping on two groundnut varieties on sandy loam soil, Bhubaneswar, Orissa, India, rainy season 1986.

	No. of matured pods $plant^{-1}$		Dry matter $plant^{-1}$ (g)		Pod yield (g m^{-2})	
Treatment	V_1[2]	V_2[3]	V_1	V_2	V_1	V_2
T_1 Control (nontreated)	7.4	5.4	29.1	31.4	184	168
T_2 N-topdressing	8.2	6.9	38.3	38.2	225	200
T_3 CCC 1000 ppm spray	11.7	9.4	33.6	33.8	265	278
T_4 N-topdressing + CCC 1000 ppm spray	13.7	10.8	42.1	43.8	308	304
T_5 CCC 2000 ppm spray	12.2	9.6	35.7	38.4	287	280
T_6 N-topdressing + CCC 2000 ppm spray	15.8	11.2	39.2	40.3	316	306
T_7 Nipping	6.2	4.1	32.4	28.4	186	138
T_8 N-topdressing + nipping	8.6	6.3	38.8	37.2	203	166
SE						
Varieties	±0.26		-		-	
Treatments	±0.53		±0.39		±4.80	
Varieties × treatments	±0.75		±1.60		±7.70	

1. CCC = 2-chloroethyl trimethyl ammonium chloride.
2. V_1 = Variety AK 12-24.
3. V_2 = Variety JL 24.

season (July to November) of 1986 at the Central Research Station, Bhubaneswar, India. The soil was sandy loam (haplaquept) with 400 kg N ha^{-1}, 29 kg P ha^{-1}, and 210 kg K ha^{-1}. Seeds were sown in plots of 2.5 m × 4 m with 30 cm × 10 cm spacing maintaining a plant population of 34 plants m^{-2}. A basal dose of fertilizers at the rate of 20 kg N ha^{-1}, 40 kg P_2O_5 ha^{-1}, and 40 kg K_2O ha^{-1} were incorporated in to the soil just before sowing of seeds. Another 10 kg of N ha^{-1} was topdressed to four of the treatments 20 DAS. CCC was sprayed 35 DAS in the concentrations of 1000 and 2000 ppm. Nipping of apical buds was done five times at 15-day intervals from the 35th day after sowing. Data on yield and yield attributes are presented in Table 1.

The results showed that N-topdressing together with CCC foliar spray improved the pod yield. N-topdressing increased the total dry matter production and the pod yield. CCC foliar spray enhanced the number of mature pods, total dry matter $plant^{-1}$ and yield. Topdressing of N along with CCC spray further improved pod number, total dry matter, and yield. Spraying of 2000 ppm CCC along with N-topdressing increased the number of matured pods $plant^{-1}$ and pod yield m^{-2}. Nipping treatment alone or with N-topdressing proved less effective or ineffective. Both the varieties responded to the treatments of N-topdressing and CCC spray. The variety AK 12-24 proved superior to JL 24 in yield and yield-attributing characters.

The results of the study showed that it is possible to improve yield of erect groundnuts grown on a sandy loam soil, by enhancing the early vegetative growth by N-topdressing and arresting the vegetative growth later.

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A New Record of *Alternaria tenuissima* on Groundnut in Tamil Nadu, India

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A new leaf disease "leaf margin blight" was recorded on groundnut (*Arachis hypogaea* L.) at the Agricultural Research Station, Aliyarnagar, Tamil Nadu, India, during the 1989 rainy season in cultivars ALR 1, Co 2, and JL 24. The typical symptoms of the disease include drying up of the margins and tips. The blighted area is light brown to dark brown and the disease progresses towards the middle of the leaflets. Blighted leaves folded inwards and later became brittle. Initial symptoms appeared on young leaves of 25-30 days old crop. At severity, premature drying of the leaflets was noticed. During the season, we noticed that for the variety ALR 1 more than 15-30% of leaflets $plot^{-1}$ were dried and defoliated.

Alternaria tenuissima (Kunze Ex pers.) Wilts was isolated consistently from the infected leaves. After 8-10 days of inoculation of conidial suspension of the fungus on 25-30-days-old groundnut plants of ALR 1, similar symptoms could be reproduced. The fungus was reisolated from infected leaves of inoculated plants. The symptoms of the disease and the morphological characteristics of the fungus are similar to that of the characters described by Ghewande et al. (1982) from Gujarat. This is the first record of *A. tenuissima* on groundnut from Tamil Nadu, India.

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Control of Foliar Diseases of Groundnut by Seed Treatment with Nonconventional Chemicals

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Chowdhury and Sinha (1989) reported that when 2-week old pot-grown groundnut plants (cv J 11) raised from seeds wet-treated with different concentrations of indoleacetic acid (IAA), 2,4-dichlorophenoxyacetic acid (2,4-D), 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), cycocel (chlorocholine chloride), and cycloheximide were placed in the field at random between rows of early leaf spot (*Cercospora arachidicola* Hori.) affected plants, they soon developed disease symptoms like the nontreated plants, but after 7 weeks showed 62-67% less symptoms at their most effective concentration, than the latter. Results of further studies with these and some other chemicals are briefly reported here.

In a preliminary experiment, three new chemicals, i.e., cysteine (10^{-4} M), sodium azide (10^{-4} M), and chitosan (0.1%, 0.3%, and 1%) were tested against early leaf spot as described earlier (Chowdhury and Sinha 1989). While presowing treatment with most chemicals involved soaking seeds in their solution for 24 h, chitosan solution was applied to the seeds as drops [2 mL $(100\ g)^{-1}$] followed by vigorous shaking to spread it on seed surface, followed by air drying. Severity of disease was assessed 9 weeks after the pots had been placed in the field on a 0-5 scale (0 = leaf without damage, 5 = leaf severely affected or dead). Plants treated with cysteine recorded 31%, with sodium azide 25%, and with chitosan recorded 50-55% reduced disease indices as compared to the plants in the nontreated control.

Table 1. Effects of seed treatment with select group of chemicals on early leaf spot and rust of groundnut and pod yields in field trials at Kalyani and Mohanpur, West Bengal, India, postrainy season 1989.

		Disease index [1]		
Location	Treatment	Early leaf spot[2]	Rust[3]	Pod yield $plant^{-1}$ (g)[4]
Kalyani	Water (control)	3.9	-	14.5
	Indoleacetic acid (10^{-4} M)	1.9	-	27.6
	2,4-dichlorophenoxy acetic acid (10^{-6} M)	2.1	-	22.0
	2,4,5-trichlorophenoxy acetic acid (10^{-6} M)	2.4	-	20.6
	Cycloheximide (10^{-6} M)	2.0	-	26.0
	Cycocel (500 ppm)	2.0	-	26.0
	SE	±0.136	-	±0.446
Mohanpur	Water (control)	2.6	2.7	17.3
	Cysteine (10^{-3} M)	0.5	1.7	24.2
	Cysteine (10^{-4} M)	0.8	1.5	23.7
	Sodium azide (10^{-3} M)	1.3	1.5	20.1
	Sodium azide (10^{-4} M)	1.1	1.7	18.7
	p-chloromercuribenzoic acid (10^{-4} M)	1.2	1.4	18.3
	p-chloromercuribenzoic acid (10^{-5} M)	0.7	2.0	21.8
	Chitosan (0.3%)	0.6	1.1	28.4
	Chitosan (1.0%)	0.8	1.3	25.7
	SE	±0.0453	±0.108	±0.913

1. Based on 0-5 scale (0 = no leaf damage, 5 = leaf severely damaged).
2. Mean of 12 plants, assessed at Kalyani after 9 weeks, and at Mohanpur after 13 weeks.
3. Mean of 12 plants, assessed at Mohanpur after 17 weeks.
4. Mean of 120-125 plants.

Subsequently, effective compounds were tested further in two field trials in the 1989 summer at Kalyani and Mohanpur. Seeds were sown in field plots in a randomized-block design with four replications. Each row had 30-35 plants. Results are presented in Table 1.

At Kalyani, leaf spot infection occurred early, and disease severity was assessed after 9 weeks. The test compounds, i.e., IAA; 2,4-D; 2,4,5-T; cycocel and cycloheximide, reduced disease index significantly, by 38-51%. Pod yields also recorded significant increase with these treatments (42-90%) over the control. Best effects were recorded with IAA (10^{-4} M). Cycocel (500 ppm) and cycloheximide (10^{-6} M) were slightly less effective.

At Mohanpur, besides cysteine, sodium azide, and chitosan, a new compound, *p*-chloromercuribenzoic acid, was also tested, at two concentrations each. Early leaf spot infection occurred late. Disease assessment was made after 13 weeks when all four compounds were found to have reduced disease index substantially (62-83%) at their more effective concentration. Cysteine (10^{-3} M) had the best effect. At this stage, rust (*Puccinia arachidis* Speg.) infection was first noticed. Disease severity was assessed on a 0-5 scale, 4 weeks later. With different compounds, 44-59% reductions in disease index were recorded at their more effective concentration. Chitosan (0.3%) had the best effect against rust. Except sodium azide, all compounds increased pod yield very significantly ($P = 0.01$), but it was substantial only with chitosan, which alone strongly inhibited both early leaf spot and rust.

It is significant that most of the test compounds could provide good protection to groundnut plants from early leaf spot and some also from rust by simple seed treatment, that too at low concentrations, and also cause significant increase in pod yield. Such compounds merit further exploration.

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Performance of Foliar Diseases Resistant ICRISAT Groundnut Lines (ICGV) in East Java, Indonesia

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Late leaf spot [*Phaeoisariopsis personata* Berk. & Curt. v. Arx = *Cercosporidium personatum* (Berk. & Curt.) Deighton] and rust (*Puccinia arachidis* Speg.) are chronic leaf diseases of groundnut (*Arachis hypogaea* L.) in Indonesia. Though actual yield losses in different areas are not well documented, the two diseases together are considered as a serious yield reducing factor throughout the groundnut-growing areas.

The local groundnut genotypes mainly grown by the farmers and the presently recommended improved varieties are susceptible to both late leaf spot and rust. Since development of resistant varieties is the most effective way to avoid losses, 81 promising disease-resistant genotypes from the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) were evaluated for their reaction to late leaf spot and rust, and agronomic characteristics including yield at Muneng, Genteng, and Mojosari experimental stations of Malang Research Institute for Food Crops (MARIF) in East Java, Indonesia, in different growing seasons since 1988.

The observations for 2 years (1988-89) have shown that at Muneng and Genteng, natural incidence of late leaf spot is uniformly high during April-July sowings, but incidence of rust is low. However, rust is severe at Muneng alone during August-December sowings, while the severity of late leaf spot incidence is a score or two lower at both the locations in this season than the one observed during April-July sowings. Mojosari has high incidence of late leaf spot during April-July sowings, but during September-December sowings neither late leaf spot nor rust could be observed in the trials sown.

Because of high and uniform natural incidence of late leaf spot and rust at Muneng, preliminary evaluation of the disease-resistant ICGV lines was done at Muneng, followed by a second-stage evaluation of selected genotypes at other two locations in addition to Muneng in three or four plots with three replications in a 6 × 6 triple lattice or randomized-block designs. For the second stage testing, genotypes were selected by their resistance reaction to late leaf spot, and pod yield higher than the control cultivar Kelinci. Initially (Apr-Jul 1988) each genotype was scored for the disease severity on a 9-point scale

(Subrahmanyam et al. 1982), first at 45-50 days and then at 90-95 days after sowing (DAS).

However, soon it was realized that consideration of final disease score for late leaf spot at 90 DAS or thereafter just before harvest only, allows identification of highly resistant genotypes, such as ICGV 87165, with a final

Table 1. Promising late leaf spot and rust resistant ICGV lines observed in East Java, Indonesia, in different growing seasons after 1988.

		Disease score over season[1]						
		Late leaf spot			Rust			Yield (%) compared to
Genotype	Pedigree	40-45 DAS[2]	70-75 DAS	90-95 DAS	40-45 DAS	70-75 DAS	90-95 DAS2	Kelinci[3]
Highly resistant group								
ICGV 87165	*A. hypogaea* × *A. cardenasii* (CS 9)	1.0	2.3	3.0	1	1	2.0	103.0 98.8
ICGV 88252	(Robut 33-1 × CS 9)	1.0	2.0	2/3	1	1	1.0	133.9
ICGV 88255	(Robut 33-1 × CS 16)	2.0	3.0	4.0	1	4	6.0	123.7
ICGV 88262	(Robut 33-1 × PI 298115) × (Robut 33-1 × NC Ac 2214)	1.0	2.0	3.0	1	1	1.0	-
Moderately resistant group								
ICGV 86644	(HG 1 × NC Ac 17090)	3.0	4.3	7.6	1	4	6.0	119.0
ICGV 86654	(RS 114 × PI 259747)	2.6	5.0	8.0	1	5	7.0	145.5
ICGV 86630	[FSB 7-2 × EC 76446(292)]	3.0	5.3	6.6.	1	4	8.0	117.0
ICGV 86663	(Ah 65 × NC Ac 17090)	3.0	5.0	6.3	1	4	8.0	131.4
ICGV 86972	[NC Ac 1107 × EC 76446(292)]	3.0	5.3	6.6	1	4	6.0	143.8
ICGV 87255	(JH 60 × PI 259747) × NC Ac 17133(RF)S_1	3.0	4.3	6.6	1	5	9.0	127.5
ICGV 87260	(JH 60 × PI 259747) × NC Ac 17133(RF)S_2	2.3	5.3	6.6	1	6	8.0	97.7
ICGV 88246	2024 Cyto (*A. hypogaea* × *A. stenosperma*)	2.3	4.6	7.3	1	1	1.0	133.3
ICGV 88271	(Robut 33-1 × CS 9) × NC Ac 2232	2.0	4.0	5.0	1	1	1.0	-
ICGV 88276	(Robut 33-1 × CS 9) × (Robut 33-1 × NC Ac 2214)	3.0	4.6	9.0	1	2	2.0	155.6
ICGV 88251	(Robut 33-1 × CS 9)	2.6	4.0	4.3	1	1	1.0	102.2
ICGV 88277	(Robut 33-1 × CS 9) × LJRS 2	2.3	5.0	8.6	1	1	1.0	118.5
ICGV 88278	(JH 335 × PI 259747)S_1 × (JH 335 × PI 259747)S_2	2.3	5.0	9.0	1	5	6.0	125.8
ICGV 88260	(PI 259639 × PI 259747)	3.3	5.3	9.0	1	5	8.0	-
Control (Kelinci)	-	2.6	6.3	8.6	1	5	7.0	100
Susceptible group								
Pasuran Local	-	3.3	7.3	8.3	1	5	8.5	-
Gajah	-	3.5	7.6	8.3	1	6	9.0	-
J 11	-	4.5	7.5	9.0	-	-	-	-

1. Scored on a 9-point disease scale, where 1 = No disease, and 9 = Plants severely affected, 50 to 100% leaves withering (Subrahmanyam et al. 1982).
2. Days after sowing.
3. Since the yield estimates are from different trials they are not comparable. Therefore, yield has been represented as percentage of the control cultivar Kelinci. Yield of Kelinci ranged from 854 to 922 kg ha^{-1} in the trials.

score of 2-3. All others, which had the score of 8 or 9 were considered susceptible, similar to the local cultivars such as Gajah or Pasuruan Local. Though a substantial number of ICGV lines had varying degrees of reduced rate of disease development as compared to the susceptible local genotypes, they could not be detected by just two-point disease observations, relying mostly on the final disease score. Therefore, subsequently, disease scores were recorded at 4-5 points during the entire crop-growing period beginning at 40 DAS. This allowed detection of variation among genotypes for delayed disease severity development. With this procedure, genotypes were conveniently grouped into three categories: highly resistant, moderately resistant, and highly susceptible. Genotypes with high disease incidence but giving high yield could probably be considered as tolerant, but this can be ascertained only by multilocational tests conducted over 2 to 3 years.

Highly susceptible genotypes such as Pelanduk, Pasuruan Local, and Gajah had an initial score of 3 or 4 at 40-45 DAS and reached a score of 7-8 by 70-75 DAS. Moderately resistant types such as Kelinci had an initial score of 2-3 at 40 DAS, and reached a 6-7 score around 70-75 DAS, and a 8-9 score at 90-95 DAS. Many ICGV lines reached a score of 5 or less by 70-75 DAS and the final disease score recorded was 6-7 as compared to 8-9 in the susceptible genotypes at 90-95 DAS.

The highly resistant ICGV lines had a score of 2 at 70-75 DAS and ended with the final score of 3 at 90-95 DAS. These observations indicated that, considering the labor input, a three point scoring at 40-45, 70-75, and 90-95 DAS is sufficient for characterizing the genotypes effectively.

Table 1 presents the promising late leaf spot resistant ICGV lines. In general, past experience with different sources of resistance to late leaf spot in groundnut has shown that resistant genotypes are low yielding and late maturing (Higgins 1956; Norden et al. 1982; Jogloy et al. 1987). However, in recent years it has been possible to develop many late leaf spot and rust resistant genotypes with high yield potential (McDonald et al. 1985; Coffelt and Porter 1986; Gorbet et al. 1986, 1988). Most of the ICGV lines, both in the highly resistant and moderately resistant groups, (Table 1) have yielded higher than the recommended cultivar Kelinci. Six of these lines having resistance to late leaf spot are also highly resistant to rust. These lines provide excellent sources of resistance to late leaf spot and rust and need to be carefully evaluated for the stability of resistance and their agronomic adaptation and yield potential. As such they reach maturity a week or 10 days later and have lower shelling percentage and nonacceptable seed color and shape.

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Chlaenius sp (Col. : Carabidae): A Predator of Groundnut Leaf Miner Larvae

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The groundnut leaf miner (GLM), *Aproaerema modicella* Deventer (Lep. : Gelechiidae), is a serious pest of groundnut and soybean throughout south and east Asia. The biology, ecology, and control of GLM has been reviewed by Mohammad (1981). He listed more than 25 hymenopterous parasitoids that attack GLM eggs, larvae, and pupae worldwide. In addition, three disease agents, a nematode, a virus, and a fungus, infect GLM larvae in India (Srinivasan and Siva Rao 1987; Godse and Patil 1981; Oblisami et al. 1969). Very few references to predators attacking GLM are available in the literature. The only reference to a specific predator is that of Maxwell-Lefroy and Howlett (1909), who reported *Odynerus punetum* Fabr. (Hym.: Eumenidae) attacking GLM larvae on groundnut in India. Predation by spiders and robber flies (Dip. : Asilidae) has been reported by Srinivasan and Siva Rao (1987) but no further details were given.

The genus *Chlaenius* (Col. : Carabidae) is widely distributed in Europe, North America, and Asia. The larvae commonly feed on lepidopterous larvae. Barrion and Litsinger (1985) found several species of *Chlaenius* attacking rice leaf folder, *Cnaphalocrocis medinalis* Gn. (Lep. : Pyralidae) in the Philippines. In India, *Chlaenius rayotes* Bates has been reported as a predator of *Hyblaea puera* Cramer (Lep. : Hyblaeidae), a pest of teak in Kerala (Choudhuri and Misra 1981). Another species, *C. bioculatus* Chd., is a predator of *Marasmia suspicalis* Wlk. (Lep. : Pyralidae), a minor-leaf rolling pest of sorghum and pearl millet in India (Seshu Reddy and Davies 1979).

During the 1988 rainy season (June-September), *Chlaenius* sp larvae were found inside GLM mines in both groundnut and soybean leaves grown at the research farm at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) at Patancheru, near Hyderabad, Andhra Pradesh, in peninsular India. These larvae moved rapidly along stems and petioles, as well as across the leaf surface. *Chlaenius* larvae readily attacked and ate GLM larvae when confined together in glass vials. The impact of this predator on field populations of *A. modicella* has not been quantified, but as one of the guild of generalist predators, it undoubtedly contributes to the natural control of the groundnut leaf miner.

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Leaf Area Damage by *Aproaerema modicella* Deventer — A Pest of Groundnut

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Aproaerema modicella (*Strompteryx subceivella*) Deventer was listed as a potential pest of groundnut causing webbing of leaves at the apex of plants with stunted plant growth, resulting in considerable yield loss. The young larva penetrates a leaflet and makes a blotch-type mine. It emerges from the mine when it is too large to remain in the mesophyll, webs two halves of a leaflet or two or more leaflets, and continues to feed on leaf tissue (Wightman and Amin 1988).

Studies were made to measure relative leaf area damage by *A. modicella* during its larval period on different groundnut varieties in the greenhouse during 1989/90 at S.V. Agricultural College, Tirupati, India. Five eggs from mass culture were transferred on to different top leaflets on each variety of groundnut that were 3 weeks old. Five groundnut varieties, JL 24, Kadiri 3, TCG 1518, Tirupati 1, and TMV 2 were chosen for this study. Four replications were maintained. The damaged leaflets were stipped off to measure the leaf area after completion of the instar. To know the time of larval moult, separate set of larvae were simultaneously reared in petridishes by providing groundnut leaves once in 24 h.

Total leaf area was measured on leaf-area meter, Model L 3000. The leaf area mined by the pest was carefully removed with a blade and the remaining area was measured. The difference gave the damaged area. Cumulative damage was envisaged for successive instars to facilitate the caterpillar to feed inside the mine continuously without any disturbance. At the end of fifth instar, the estimated damaged leaf area was the result of totality of the entire larval period.

Leaf area damaged on different varieties during larval period by *A. modicella* is presented in Table 1. There was significant reduction in leaf area of all the varieties. The percentage reduction of leaf area was considerably large in TCG 1518 (9.42%). The minimum leaf area reduction was for TMV 2 (6.31%) and it was on par with the leaf area reduction of JL 24 (7.69%).

It was observed that there were significant varietal differences in the extent of leaf damage. The minimum was with TMV 2 (300.23 mm^2) and maximum was with TCG 1518 (405.70 mm^2). As expected, the leaf damage increased as the insect passed from one instar to another. Interaction between varieties and instars indicated no difference in damage to leaf because of varieties during first and second instars. Later instars caused significant damage to leaf. The groundnut variety, TMV 2, was less susceptible to damage especially during later instars.

The studies on damage potentiality by the pest reckon to be important to develop economic threshold levels. Since the total duration of life cycle is short, i.e., 13-15 days, the build up of pest population would be faster and correspondingly denude leaf area. The relationship of leaf area loss to yield loss, once established, can be used in pest management.

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Wightman, J.A., and **Amin, P.W.** 1988. Groundnut pests and their control in the semi-arid tropics. Tropical Pest Management 34(2):218-226.

Table 1. Comparison of groundnut leaf area damage potential by different instars of *A. modicella*, S.V. Agriculture College, Tirupati, Andhra Pradesh, India, 1989/90.

Groundnut variety	Instar damage (cumulative) (mm^2) by 5 caterpillars						Leaf area damaged by 5 caterpillars (%)
	I	II	III	IV	V	Mean	
JL 24	20.50	68.25	266.00	550.50	926.50	366.35	7.685
Kadiri 3	19.75	71.25	268.25	511.00	827.00	339.45	8.060
TCG 1518	15.75	68.50	298.75	612.50	1033.00	405.70	9.415
Tirupati 1	14.75	67.75	278.00	552.25	1015.75	385.70	8.965
TMV 2	17.75	67.00	238.62	439.50	738.25	300.22	6.317
Mean	17.70	68.55	269.93	533.15	908.10		
	Variety/instar			Variety × instar			
SE	±7.08			±15.82			±0.444

Neem Products: Possible Insecticides on the Groundnut Jassid *Balclutha hortensis* Lindb.

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The jassid, *Balclutha hortensis* Lindb., is an important sucking pest recorded first on groundnut after an outbreak during the 1986 rainy season (Nandagopal and Reddy 1987) and since then it has continued to be a major pest in the Saurashtra area of Gujarat, India. Its damage is akin to *Empoasca kerri* Pruthi. A density of 35 jassids per 5 m-row at the vegetative stage reduced the seed yield by 487 kg ha^{-1}. Similarly a density of 125 jassids per 5 m-row at the pod filling stage reduced the seed yield by 487 kg ha^{-1} and a density of 180 jassids per 5 m-row at the maturity stage reduced the seed yield by 584 kg ha^{-1} (NRCG 1988). The complexities and cost involved desisted farmers from using insecticides on groundnut (Mariappan and Saxena 1983). The insecticidal properties of neem (*Azadirachta indica* Aajuss) are well known.

In this study, neem oil (in 1.66% aqueous 'Teepol' solution), neem leaf extract (500 g leaves extracted in 500 mL of distilled water) and neem decoction (500 g of leaves boiled in 500 mL of distilled water for 0.5 h at 55-60°C and filtered through muslin cloth) were used with three concentrations, i.e., 5%, 10%, and 25%, and 1.66% aqueous 'Teepol', is used as control. Treatments were replicated 12 times. A simple cage was fabricated from a plastic container, a vial (5 cm height) and a petridish (10-cm diameter). Shoots of 1-month old cv GAUG 10 were dipped in the respective concentrations and dried under room conditions for 0.5 h. The vial with 0.2% sugar solution and shoots inserted, wrapped with cotton was fixed on the inverted petridish with a drop of Fevicol®. The plastic container was placed over the vial so that shoots did not touch the bottom of the container. Ten field-collected jassids were released inside the container using an aspirator. Mortality was recorded after 24 h and 48 h. This experiment was conducted during the 1988 rainy season. The observations on mortality of jassids because of various neem products are given in Table 1. Maximum mortality of jassids resulted within 24 h after treatment. The mean mortality of jassids because of neem oil and extract ranged between 66-97%. The mortality of jassids decreased with increase in concentration of neem decoction, i.e., there was 66.7% mortality at 25% concentration of decoction while mortality was 87.5% with 5% concentration of decoction. Neem oil and neem leaf extract recorded increased mortality (%) with increase in concentration. The highest mortality was 97.5% when 25% neem oil was used.

Neem oil at 5% concentration was as effective as neem oil at higher concentrations against the jassid, *B. hortensis*. As there was involvement of cost in neem oil, neem leaf extract at 5% concentration may be a better choice to control the jassids. A question yet to be answered is the residual effect of these neem products on the survival and fecundity of these insects.

Table 1. Mortality of *B. hortensis* on groundnut because of neem derivatives at Junagadh, India, rainy season 1988.

Treatments	Mortality[1] after		Cumulative
	24 h	48 h	
Neem oil (5%)	80.8[cd1]	10.8[b]	91.6[efc]
(10%)	93.3[d]	3.3[d]	96.6[f]
(25%)	95.0[d]	2.5[a]	97.5[g]
Neem leaf extract (5%)	61.7[b]	21.7[b]	83.4[cd]
(10%)	71.7[bc]	21.7[b]	93.4[def]
(25%)	69.2[bc]	20.0[b]	89.2[def]
Neem decoction (5%)	62.5[b]	25.0[b]	87.5[de]
(10%)	65.0[b]	14.2[ab]	79.2[c]
(25%)	42.5[a]	24.2[c]	66.7[b]
Control (Teepol) (1.66%)	27.5[a]	6.7[a]	34.2[a]

1. Means within the column followed by same letters are not significantly different at 5% level by Duncan's Multiple Range Test.

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Overhead Irrigation and the Integrated Management of Spider Mites in a Groundnut Crop

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Red spider mites *Tetranychus* sp occasionally appear late in the rainy and postrainy seasons on groundnut at ICRISAT Center. The most recent outbreak was in a single 2-ha field (A) during the 1989-90 postrainy season. It was first noticed in early April and it rapidly increased thereafter. By the 2nd week of April, the mite population was so dense that laborers refused to harvest the crop because of the skin irritation caused by the mites. As the crop was mature, rapid action was needed. We did not want to apply a pesticide because of the risk of exacerbating the pest situation and because such an activity would create a health hazard for the harvesters.

However, the question of how such an isolated outbreak appeared was a key issue. Local (Wightman and Amin 1988) and general (Campbell 1978; Penman and Chapman 1983) knowledge pointed to a flare-up induced by the overuse of insecticides or fungicides. We, therefore, compared the mite population density in a neighboring field (B) that had been treated with insecticides with that of another, that had remained insecticide-free (C) (Table 1). A comparison of the data from A and B indicated that the pesticide applied (one application of dimethoate at the rate of 300 mL a.i. ha^{-1} early in the season followed by quinalphos at the rate of 500 mL a.i. ha^{-1} in midseason with no fungicide) during that season may have been the cause of the outbreak. However, this hypothesis was rejected because field B had statistically the same mite population density as field C.

Fields A and B had received the same pesticide schedule which was however, much lighter than the one reported by Wightman and Amin (1988) to have induced an outbreak.

There was a major difference in the way that the fields had been managed. The plants in fields A and C received irrigation along the furrows that had been made between the 1-m wide beds. Field B, which was also in broadbed and furrows, received overhead irrigation throughout the crop period. After the mite outbreak in field A, there was a thorough debate on the situation, and overhead irrigation was applied to all the three fields instead of a miticide. The data in the Table 1 indicate that there was an immediate response to this treatment and that the mite population density quickly fell by 80%. Although there were still many mites in field A, the intensity of the problem had been reduced to a level that permitted the field to be harvested.

This is an example of integrated pest management in action. We demonstrated how a crop management pattern can influence the population density of a potential pest. In this case, we assume that physical factors related to water falling on the leaflets (wetting and impact) were the prime movers. This information parallels the well known phenomenon of aphid populations being decimated by rain storms and the subsequent endemics of aphidiphilous fungi. It is also noteworthy that the results of Wheatley et al. (1990) pointed to the benefits of overhead irrigation to manage other groundnut insects.

The practical implications are clear but may only be relevant to research farms and to irrigated farms owned by such rich farmers who are willing and able to use suitable pumps and irrigation lines. However, this elite sector can benefit from the knowledge gained from the discomfort of ICRISAT's irritated harvesters.

Table 1. Spider mite population density on groundnut plants as influenced by irrigation and pesticide regimes and the application of overhead irrigation, ICRISAT Center, 1990.

			Mites per 50 leaflets[1]	
Field	Insecticides	Nature of normal irrigation system	Before overhead irrigation 18 Apr 1990	After overhead irrigation 23 Apr 1990
A	Yes	Furrow	6323	1282
B	Yes	Overhead	110	18
C	No	Furrow	64	13
SE			±43	±69

1. Samples of 50 leaflets were removed at random from plants growing in five parts of each field. Data are the means of the five samples.

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Reactions of Groundnut Varieties to *Meloidogyne javanica*

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Ten groundnut varieties were screened against *Meloidogyne javanica* (Treub 1885) Chitwood 1949 in 15-cm diameter pots filled with sterilized soil + farmyard manure (FYM) (9:1). Three seeds of groundnut were sown in each pot and after germination, the seedlings were thinned down to 1 plant pot^{-1}. Ten pots were maintained for each variety; 5 were inoculated (1 day after germination) with 2000 second-stage juveniles plant^{-1} and the remaining 5 plants were treated as control. Pots were irrigated regularly. Plants were removed carefully 60 days after nematode inoculation, and roots were washed with water to assess the root galling (%) on a 0-5 scale; where 0 = No root galls (highly resistant); 1 = 1 to 20 (resistant); 2 = 21 to 40 (moderately resistant); 3 = 41 to 60 (moderately susceptible); 4 = 61 to 80 (susceptible); and 5 = more than 80% roots galled (highly susceptible) (Jones and Nirula 1963). Representative roots as well as soil samples were analyzed for final population of the nematode (Chawla and Prasad 1974). Plant-growth parameters were also recorded.

The nematode infection reduced the plant growth of GAUG 1, GG 2, ICGS 44, J 11, JL 24, and NRCG 1 (Table 1). Plant growth of GAUG 10, GG 11, Punjab 1, and Robut 33-1 was more in nematode-inoculated pots than in the control pots. On the basis of root-knot indices, Punjab 1 and NRCG 1 showed moderately susceptible reaction. J 11 was found highly susceptible while other varieties were susceptible. GUAG 10, GG 11, Punjab 1, and Robut 33-1 were susceptible but plant growth in these varieties was better than the control. Effect on pod and seed yield was not measured. However, it seems reasonable that yield of these varieties may not be adversely affected by the nematode infection and these varieties may be considered as tolerant of *M. javanica*. Varieties GAUG 1 and JL 24 were considered as suscept-

Table 1. Screening of groundnut varieties against *M. javanica*: effect on plant growth and host infestation (mean of 5 repetitions), Department of Nematology, B.A. College of Agriculture, Gujarat Agricultural University, Anand, Gujarat, India.

	Shoot				Root						
	Length (cm)		Dry mass (g)		Length (cm)		Dry mass (g)				
Variety	I[1]	CK[2]	I	CK	I	CK	I	CK	Number of galls plant^{-1}	Final population pot^{-1} kg^{-1} of soil	Reaction
GAUG 1	13.2	14.6	2.95	3.43	9.6	10.4	1.76	1.40	617	18,320	S
GAUG 10	17.9	15.8	3.80	3.10	10.0	9.1	1.65	1.15	378	18,720	S
GG 2	12.9	17.0	2.70	4.95	8.4	10.1	1.45	1.20	760	19,020	S
GG 11	18.7	12.1	2.85	2.15	9.0	8.5	1.05	0.90	344	17,980	S
ICGS 44	13.3	17.6	2.78	4.74	9.0	10.2	1.50	1.04	388	17,985	S
J 11	16.3	18.1	4.65	5.00	12.5	13.0	1.95	1.50	780	18,065	HS
JL 24	17.3	19.8	4.60	6.00	11.7	13.2	1.65	1.50	568	18,005	S
NRCG 1	14.8	17.0	2.85	4.90	8.7	10.6	1.55	1.40	441	13,650	MS
Punjab 1	16.3	13.5	2.92	2.75	9.7	8.1	1.60	1.35	327	17,990	MS
Robut 33-1	23.6	19.5	5.35	5.10	14.0	11.3	1.75	1.54	792	20,040	S

1. Inoculated.
2. Control.

ible because of high root-knot index and reduced plant growth in nematode infested pots than in the control pots. Darekar and Jagdale (1988) found movwa runner and Robut 33-1 groundnut as resistant of *M. arenaria* in Maharashtra and our results indicate them as tolerant to *M. javanica*. Sakhuja and Sethi (1985) reported GUAG 1 and Punjab 1 as moderately susceptible and GUAG 10 and JL 24 as highly susceptible to *M. javanica* on the basis of gall index.

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Allelopathic Interaction of *Cyperus rotundus* on Groundnut Seed Germination

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Allelopathy is related to production and release of some phytochemicals into the environment by one plant species and exerting harmful effects, directly or indirectly, on other crop plants. These harmful effects may be indicated in the form of inhibition of seed germination, reduced seed growth and metabolic activities, etc. At Agricultural Research Station, Durgapura, Jaipur, India, one weed plant, *Cyperus rotundus*, is commonly found in the rainy season and is the dominant weed crop. Because of its deep rooted nature, its eradication with manual weeding does not seem to be possible. Presuming the weed crop might be constantly producing some leachable chemicals into the soil, the laboratory studies were conducted to find out the effect of leachable chemicals, from different tissues of weed plant, on seed germination of groundnut.

The seed germination study was undertaken in July 1988 using petridishes and filter papers. In each treatment, 50 seeds for each groundnut variety, replicated four times, were used in a split-plot design where main treatments were varieties: M 13, MA 10, and AK 12-24 and subtreatments were distilled water (T1); aqueous extracts of root of weed plant (T2); aqueous extracts of shoot of weed plant (T3); aqueous extracts of leaves of weed plant (T4), and aqueous extracts of whole plant (T5). Germination was recorded after 10 days.

The data, along with statistical analysis, are presented in Table 1. While the varietal differences were not significant, the treatments and their interaction with varieties gave significant differences. There was significant reduction in seed germination in all the three varieties when seeds were treated with aqueous extracts of either roots (T2) or whole plant (T5). A reduction of 24% to 30%, in seed germination in respect of three varieties in T2 and T5, shows significant varietal interaction with treatments. However, there was no significant difference within treatments T5 and T2 in all the three varieties. Therefore, it cannot be ascertained whether roots or whole plant, in-

Table 1. Effect of aqueous extracts of different tissues of *Cyperus rotundus* on seed germination of three groundnut varieties, Agricultural Research Station, Durgapura, Jaipur, Rajasthan, India, rainy season 1988.

	Seed germination (%)					
Variety	T1[1]	T2	T3	T4	T5	Mean
M 13	96.0	75.0	84.0	80.0	76.0	82.2
MA 10	94.0	75.0	85.0	80.0	74.0	81.6
AK 12-24	98.0	74.0	84.0	76.0	70.0	80.4
Mean	96.0	74.6	84.3	78.6	73.3	
SE (Treatments)	±0.86					
SE (Variety × Treatments)	±1.01					

1. Treatments include distilled water (T1) aqueous extracts of weed roots (T2), shoots (T3), leaves (T4), and whole plant (T5).

cluding roots, exert the maximum leachable chemicals into the soil. All other treatment effects were significant when compared with T1 and markedly reduced seed germination.

The nonsignificant varietal differences as such indicate that seed mass, which is different in the three varieties, does not play any role in allelopathic interaction with weed plants. The study, therefore, reveals that there are possibilities of release of some harmful chemicals from different tissues of weed plant which might adversely effect groundnut seed germination under field conditions as well.

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