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International Arachis Newsletter

Prepared by
Legumes Program
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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.

CONTENTS

News and Views

Editorial

The mailing list of the newsletter is growing rapidly and the last issue, IAN 8 was dispatched to 204 institutional heads in 52 countries, 678 libraries in 79 countries, and 901 individual scientists in 73 countries. This is an index of the growing popularity of this newsletter.

With the rapid increase in global population and the subsequent pressure on the land use, there is a growing need for the development of early-maturing groundnut cultivars which can suit the multiple-cropping systems, and for the expansion of the groundnut crop into areas with short monsoon. The appearance of three reports in the current issue, on the identification of new early-maturing genotypes is an indication of increased research efforts in this direction.

Most of our readers know that ICRISAT acts as a world repository for the genetic resources of groundnut. I request the authors who contribute articles on new genetic material in the newsletter to send seed samples (about 250 g) of these new genotypes to our Genetic Resources Unit.

We appreciate the efforts of Mr K. Ramana Rao, Office Assistant, Legumes Program, in compilation of this newsletter, computer entry of the manuscripts, and editorial assistance.

L.J. Reddy

News from ICRISAT Center

News About ICRISAT Groundnut Scientists, Postdoctoral Fellows, and Research Fellows

Dr B.R. N'tare, Cowpea Breeder, International Institute of Tropical Agriculture, Niamey, joined as Principal Groundnut Breeder at ICRISAT Sahelian Center, Niamey, on 1 Jan 1991.

Dr J.P. Moss, Principal Cell Biologist, ICRISAT Center, proceeded on 6 months sabbatical leave on 1 Feb 1991 to work on a collaborative project at the Scottish Crops Research Institute, Dundee, UK.

Dr H.D. Upadhyaya joined ICRISAT Center as Groundnut Breeder on 7 Feb 1991.

Dr Nalini Mallikarjuna formerly Research Associate in the Cell Biology Unit, Legumes Program, ICRISAT Center was selected as Cell Biologist on 18 Apr 1991.

Dr R.V. Satyanarayana Rao joined Legumes Entomology Unit, ICRISAT Center as Postdoctoral Fellow on 18 Jan 1991. He will be working on a major insect pest, groundnut leaf miner, under the leadership of Dr J.A. Wightman, Principal Groundnut Entomologist, ICRISAT Center.

Ms Siti Zainab Ramawas, Groundnut Breeder, Malaysian Agricultural Research and Development Institute, Malaysia, spent about 40 days as a Research Fellow in the Groundnut Breeding Unit, ICRISAT Center, during March-April 1991.

Notice to All Scientists Taking Part in Internationally Coordinated Research on Peanut Stripe and Other Groundnut Viruses in Asia

Following the Coordinators' Meeting held at ICRISAT Center, Hyderabad, India, from 1 to 4 Aug 1989, Dr D.V.R. Reddy has not received from some of the coordinators the various progress reports on surveys, on epidemiology research, and on screening for disease resistance. Coordinators from the People's Republic of

China and Indonesia have submitted reports containing many interesting results. After the other reports have been received, Dr Reddy will prepare a comprehensive report to circulate to all the coordinators.

We are contemplating holding the next Coordinators' Meeting in Thailand in August or September 1992, if funds are available. If the reports sent by the coordinators are interesting and comprehensive, it will be easy for us to procure funds to support this Meeting.

Dr Reddy, when on sabbatical leave from July 1991 to March 1992, will be at Dr R.J. Shepherds' Laboratory, University of Kentucky, Lexington, USA, and can be contacted at this address. However, you can send routine reports or queries concerning the virus group activities to Principal Plant Virologist, ICRISAT, Patancheru, Andhra Pradesh 502 324, India.

Recent ICRISAT Publications

Reddy, D.V.R., Wightman, J.A., Beshear, R.J., Highland, B., Black, M., Sreenivasulu, P., Dwivedi, S.L., Demski, J.W., McDonald, D., Smith, J.W. Jr., and **Smith, D.H.** 1990. Bud necrosis: a disease of groundnut caused by tomato spotted wilt virus. Information Bulletin no. 31. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1990. Proceedings of the Fourth Regional Groundnut Workshop for Southern Africa, 19-23 Mar 1990, Arusha, Tanzania. Patancheru, A.P. 502 324, India: ICRISAT.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1990. Groundnut variety ICGS 1 (ICGV 87119). Plant Material Description no. 25. (Supplied gratis).

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1990. Groundnut variety ICGV 87187 (ICGS 37). Plant Material Description no. 27. (Supplied gratis).

News from Peanut CRSP (Collaborative Research Support Program)

J. Chalkley, University of Georgia, technician for the Peanut Collaborative Research Support Program (CRSP) Virus project, spent 3 weeks in January at ICRISAT to study a new ELISA technique used to detect viruses in plant material and seed. He worked with Dr D.V.R. Reddy to learn the new process that will be used for the presence of tomato spotted wilt virus in germplasm screening for resistance in Georgia.

The Peanut CRSP Technical Committee met in Georgia, 18-19 Feb 1991, to review Work Plans and Budgets for 1991-92.

The University of Georgia held a Title XII Symposium on 20 Feb 1991 to review progress made on the recently completed USAID Strengthening Grant. Dr D.G. Cummins presented an exhibit on Peanut CRSP accomplishments. Dr C.R. Jackson, Director of RUR/USAID and former Director of International Cooperation at ICRISAT and Director of the ICRISAT Sahelian Center, delivered the keynote address.

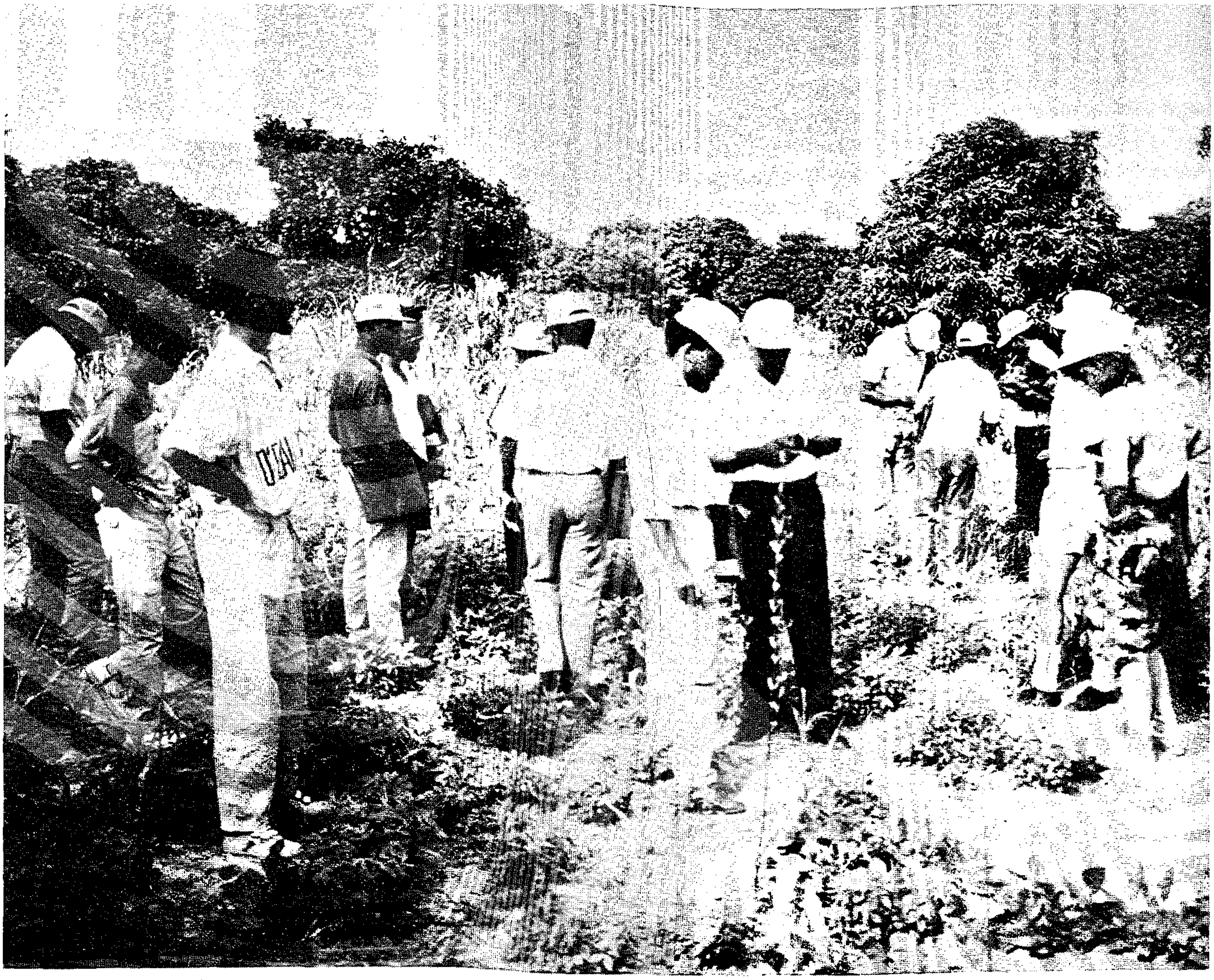
The Caribbean Agricultural Research and Development Center (CARDI) held its Annual Review, from 11 to 15 March. Dr M. Chinnan, of the University of Georgia, and Peanut CRSP Principal Investigator for the CARDI Postharvest Project attended. A major item on the agenda was Peanut CRSP accomplishments, including the present postharvest program and the earlier varietal selection program that led to the release of the CARDI/Payne variety that is being adopted rapidly by farmers.

Dr M. Chinnan was part of a six member inter-CRSP team that visited the Honduras in January 1991. The team identified southern Honduras as a potential site for an inter-CRSP research program that could involve all eight CRSPs focused on constraints pertaining to the deterioration of the natural resource base, inadequate development of human capital, and malnutrition and food security. The Southern Zone as encompasses hillside subsistence farming and fruits and vegetable farming on the coastal plain, and aquaculture on the plains and in the Gulf of Fonseca. A cooperative program could lead to technology that would support a productive agriculture that can become a permanent part of the Honduran economy and society.

News from the SADCC/ICRISAT Groundnut Project, Malawi

Second Regional Groundnut Plant Protection Group Tour

The Second Regional Groundnut Plant Protection Group Tour was conducted in Zimbabwe, Mozambique, and Swaziland during 25 Feb-1 Mar 1991. Eighteen scientists



Participants of the Groundnut Protection Group Tour, SADCC/ICRISAT Groundnut Project, examining the groundnut fields near Maputo, Mozambique.

actively engaged in research on groundnut plant protection in seven SADCC member countries, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia, and Zimbabwe participated in the group tour. Four scientists from ICRISAT Center and one scientist from the SADCC/ICRISAT Sorghum and Millet Improvement Program, Zimbabwe, also participated.

The tour was inaugurated by Dr G. Schmidt, Team Leader, SADCC/ICRISAT Groundnut Project on 25 Feb at the University of Zimbabwe, Harare.

During the group tour, the participants visited various field trials related to plant protection research in Harare (Zimbabwe), Maputo (Mozambique), and Luyengo and Malkerns (Swaziland). Eight review papers covering various aspects of pathology, entomology, nematology, epidemiology, and aflatoxin management in groundnut were presented. Eight reports reviewing the situation of diseases and insect pests of groundnut in various SADCC countries were also presented.

This meeting provided an excellent opportunity for the participating scientists to sustain their professional contacts with their counterparts from other SADCC countries and interact with them on aspects related to groundnut plant protection research in the SADCC region.

The group tour concluded at Manzini, Swaziland, on 1 March after a plenary session where several issues related to regional cooperation were discussed.

Announcements

Information on Groundnut Cultivars in Various Parts of the World

The Groundnut Breeding Unit at ICRISAT Center wishes to compile a latest list of all groundnut varieties released in various parts of the world and intends to publish this list in due course as an ICRISAT Information Bulletin. We shall be most obliged if you could provide necessary information in the proforma enclosed at the end of this newsletter to the following address:

Principal Groundnut Breeder
ICRISAT Center
Patancheru
Andhra Pradesh 502 324
India

Information on *Hypochthonella caeca*

It was interesting to read about *H. caeca* in Dr J.A. Wightman's book: Insect Pests of Food Legumes. This species is rarely found, since its original description. It is actually not a tettigometrid plant hopper but the only species in the family *Hypochthonellidae*. The adults are flightless and so it would be interesting to see the extent of variation between populations and since it is found underground it may be more common and widespread than was hitherto known. Anyone who might be able to supply fresh specimens or is likely to find the species occasionally is requested to write to Dr M.R. Wilson, at the following address:

Dr M.R. Wilson
International Institute of Entomology
56 Queen's Gate, London SW7 5JR
UK

Reports

Asian Grain Legumes On-farm Research (AGLOR) Project

C.L.L. Gowda and **D.G. Faris** (ICRISAT Center)

Introduction

A Planning Meeting for Asian Grain Legumes On-farm Research (AGLOR) was organized by the Asian Grain Legumes Network (AGLN)/ICRISAT during 20-24 Nov 1989, to prepare plans for adaptive on-farm research andtransfer of technology in Asian countries for ICRISAT's mandate legumes: groundnut, chickpea, and pigeonpea. The representatives of Indonesia, Myanmar, Nepal, Sri Lanka, and Vietnam along with consultants and ICRISAT staff prepared draft proposals for adaptive on-farm-research for each country. Based on these draft proposals, ICRISAT submitted a proposal for funding to the United Nations Development Program (UNDP). Based on the recommendations of the fact-finding mission, the UNDP approved the on-farm research activities for four countries (Indonesia, Nepal, Sri Lanka, and Vietnam) as a component of the UNDP/FAO Regional Project for Improvement of Food Legumes and Coarse Grains in Asia (RAS/89/040).

The ICRISAT component of the RAS/89/040 is titled "Testing and adaptation of technology for increased and stabilized groundnut, pigeonpea, and chickpea production in South and Southeast Asia". The objectives of the project are:

- to assist NARSs to assemble available information from research and extension sources within the project countries and the region that could be used in generating production technologies.
- to generate and test, crop production technology under research station and farmers' field situations.
- to modify the most effective production technologies to suit real-farm situations.
- to enhance the adaptive research capabilities and interest of NARSs in legumes production.

Planning meetings

In the beginning we are undertaking on-farm research on groundnut. As a first step to initiate the project, AGLOR Planning Meetings were held in each country. These meetings were conducted to review the existing information and to document the available technology, and decide on the target areas for undertaking on-farm research. In some countries (Nepal and Sri Lanka), the Planning

Meetings were held after the rapid rural appraisals or diagnostic surveys, while in other countries (Indonesia and Vietnam) the meeting was held earlier. The following meetings were organized:

Agency for Agricultural Research Development (AARD)-ICRISAT AGLOR Planning Meeting, Malang, Indonesia, 29-31 Nov 1990.

Ministry of Agriculture, Food and Cooperatives (MAFC)-ICRISAT AGLOR Planning Meeting, Hambantota, Sri Lanka, 26 Jan 1991

Ministry of Agriculture and Food Industry (MAFI)-ICRISAT AGLOR Planning Meeting, Hanoi, Vietnam, 4-6 Feb 1991

National Agricultural Research Center (NARC)-ICRISAT AGLOR Planning Meeting, Kathmandu, Nepal, 11-2 Apr 1991.

Diagnostic survey/rapid rural appraisal

The diagnostic surveys, or rapid rural appraisals were undertaken to assist in planning the on-farm experiments. A multidisciplinary team of scientists from the national programs, ICRISAT, and the International Rice Research Institute (IRRI) visited the target area in Indonesia and interviewed farmers to understand the local agrosystems, agronomic and crop management practices followed, to identify the causes for low yield in groundnut, and to prepare plans for on-farm and supportive backup experiments to address and solve the identified constraints. The details follow:

- **Indonesia:** Diagnostic surveys were conducted in two target areas, Tuban in East Java (rainfed area), during 10-14 Dec 1990 and Subang in West Java (irrigated area, postrice crop), during 25-29 Dec 1990.

  Most groundnut in Tuban is grown on undulating uplands (red latosols) during the second part of the rainy season from March to June. Insect pests, and soil nutrient disorders were major problems, and diseases, and drought were second priority problems.

  In Subang area, most groundnut is grown as an irrigated crop mostly as a third crop after two rice crops. Poor seed quality (low germinability) and low-plant populations were the major problems. Insect pests, diseases, and drainage were identified as second priority problems.

  Based on the identified constraints in the two target areas, plans for on-farm research and backup research were formulated. The three different packages of practices for the farmers: Low-, medium-, and high-input technology that were formulated at the planning Meeting were modified based on the survey findings.

- **Sri Lanka:** Rapid rural appraisal was conducted mostly in the central and southern parts of Sri Lanka during 14-25 Jan 1991. It was obvious from the survey that the farmers considered groundnut as a low-input crop, and the present area and production levels appear to balance the present demand. Seedling mortality, high seed rate, diseases (leaf spot and rust), and lack of high-yielding variety were the major problems. Simple, single-factor diagnostic trials have been planned for on-farm research. Plans also include a marketing survey to evaluate the effects of increased production on price situation.
- **Nepal:** A diagnostic survey in the major groundnut production areas of Nepal was undertaken during 6-11 Apr 1991. Lack of an integrated market infrastructure was considered as the major constraint that is acting as a disincentive to many potential groundnut growers. Other constraints identified were: insect pests, diseases (late and early leaf spots, rust), reduced plant population, lack of fertilizer management, and high-yielding varieties. On-farm experiments include simple diagnostic trials of components to compare with farmer's normal practice. Also included are the plans for backup research to support the on-farm trials.
- **Vietnam:** Diagnostic surveys were conducted in both north Vietnam (Nghe Tinh province, 7-13 Feb 1991) and south Vietnam (Long An and Tay Ninh provinces, 19-24 Feb 1991).

  In Nghe Tinh province, groundnut is the main crop grown during spring (Feb-June) in the coastal sandy area, river beds, and midland and sloping areas as a rainfed crop. Lack of cash to purchase inputs, and low price of groundnut at harvest were major socio-economic problems. Drought at flowering and waterlogging at harvest were important abiotic constraints. Among the biotic constraints, bacterial wilt (?) and damping-off diseases, leaf-eaters and white grub were considered major problems.

  In Long An and Tay Ninh provinces, groundnut is grown mostly as a second crop after rice in the winter-spring (Nov-Feb), and as a third crop in summer (March-June). Most groundnut is irrigated. Leaf eaters, and lack of coconut ash (as manure) were priority problems. Inadequate irrigation water, weeds, and damping-off disease were the other problems considered as important by farmers.

  On-farm experiments to address identified problems in both regions have been planned, along with supportive backup research. Considering that the level of crop management by farmers and yields obtained are high in south Vietnam, many backup research studies were suggested for this region to enable scientists to refine the existing technology with reduced or reallocated resources.

Progress to date

The experiments in Tuban (Indonesia) and Nghe Tinh and Ha Bac (Vietnam) have been sown. The experimentation in other areas will start in the next crop season.

An In-country Training Course for "The Detection of Groundnut Viruses with Special Emphasis on Seedborne Viruses"

D.V.R. Reddy (ICRISAT Center)

A training course on "The Detection of Groundnut Viruses with Special Emphasis on Seedborne Viruses" was held from 15-26 Oct 1990 at the Oil Crops Research Institute of the Chinese Academy of Agricultural Sciences (CAAS) in Wuhan in the People's Republic of China. The course was funded by ICRISAT and the Asian Development Bank (ADB) with the CAAS providing travel expenses for the participants. One instructor was sponsored by the University of Georgia Foundation, the others being provided by ICRISAT and the CAAS. The ten participants were drawn from agricultural research, extension, and plant quarantine departments within China.

Participants were given "hands on" experience in use of the direct antigen coating and protein A coating forms of enzyme-linked immunosorbent assay, in utilizing alkaline phosphatase and penicillinase systems, the extraction and conjugation of gama globulins with penicillinase, in mechanical sap inoculations, in local lesion assays, and in processing of seed samples for virus detection. In addition, dot immunoblotting assay, agar gel double diffusion and precipitin ring interphase tests were demonstrated. Lectures were given on identification, epidemiology, and management practices for economically important groundnut viruses. All participants performed extremely well and their keen interest to learn was sustained throughout, making this one of the most successful courses organized by ICRISAT. A diagnostic kit containing antisera and reagents was provided to each participant so that they could perform limited ELISA tests after returning to their laboratories.

Genetic Evaluation of Groundnut Germplasm for Nitrogen Fixation in the People's Republic of China

Jiang Rongwen, Duan Laixiong, and **Liao Boshou** (Oil Crops Research Institute of CAAS, Wuhan, Hubei 430062, the People's Republic of China)

Under the low-input agriculture conditions for groundnut production in most developing countries in the world, inadequate supply of nitrogen has been well recognized as a common constraint. Hence, genetic manipulation of improving the symbiotic nitrogen fixation ability of groundnut cultivars with *Rhizobium* spp might be a potential help to resolve the problem. Since 1987, a project has been implemented by a group consisting of microbiologists and plant breeders, financially supported by the Chinese National Foundation for Science and the International Foundation for Science (Sweden) on evaluation of groundnut germplasm for nitrogen-fixing characters. The main research activities and results are as follows:

- About 1000 combinations of groundnut cultivars or germplasm lines with *Rhizobium* strains have been tested through artificial inoculation under greenhouse conditions for the nodulation ability, nitrogenase activity, nitrogen percentage of inoculated plant, and shoot plant dry mass.
- Considerable genetic diversity in all the characters involved has been found among different botanical types of cultivated groundnut. Genetic analysis was also conducted for N-fixing characters by using segregating generations in breeding program.
- The interaction between groundnut cultivars and *Rhizobium* strains has been observed in field experiments. Yield increase of groundnut ranging from 2.5% to 15% has been found in most of the field experiments involving inoculation of *Rhizobium* strains to groundnut. Some superior combinations of cultivars and *Rhizobium* strains have been selected.
- The coefficient effects of *Rhizobium* inoculation and some agronomic measures like plastic film covering on increasing yield in groundnut cultivars adapted to different regions have been studied in various locations in the People's Republic of China.

Further research activities in the project are underway on evaluating and screening germplasm lines for more desirable characters in nitrogen fixation and on selecting for superior combinations. Genetics of the N-fixing characters should be further studied to integrate them with other desirable agronomic characters.

Analysis of Karyotypes and Evolution of Wild Species in Genus *Arachis*

Tan Ronghua Zhou Hanqun and **Cai Jiye** (Institute of Economic Crops, Guangxi Academy of Agricultural Sciences, the People's Republic of China)

[Abstract of the paper published in Oil Crops of China (1) 1990:43]

Mitotic chromosomes of nine species of six sections of the genus *Arachis* were karyotyped. *A. correntina* and *A. rigonii* both do not have satellite chromosomes while the other diploid species possess one or two chromosome pairs. All species have only one chromosome pair which is distinctly smaller than the others, with the exception of *A. batizocoi* and *A. villosulicarpa.* The three species of section *Arachis* have "A" chromosome and one species of section *Ambinervosae* has a median chromosome, but lack the submedian chromosome while other species carry one or three submedian chromosome pairs. The somatic chromosome number of *A. glabrata* is 2n=40 with an asymmetric karyotype in comparison with *A. hypogaea.* It has three submedian chromosome pairs and no "B" chromosome is observed. *A. batizocoi* is different from the other diploid species of the section *Arachis*, with greater genetic distance from the other diploid species of *Arachis*; it indicated that *A. batizocoi* has an unique karyotype which is the most advanced species within the section *Arachis.* According to the degree of genetic distance, all diploid species of the five sections could be arranged in the following evolution order. Section *Arachis* (the diploid species with "A" chromosomes - *A. batizocoi*) - Section Ambinervosae - Section Triseminalae - Section Erectoides - Section Extranervosae.

Research Reports

Early-maturing Groundnut Varieties for the Rainfed Lowlands of Intermediate Zone of Sri Lanka

R. Pathirana (Department of Agronomy, University of Ruhuna, Kamburupitiya, Sri Lanka)

As a result of irregular rainfall in the Intermediate Zone of Sri Lanka, large extents of paddy lands are not cultivated each year. This is particularly so during the South West Monsoon, which brings only 1/3rd of the annual rainfall. Even the early-maturing rice varieties released recently do not perform well during most of the seasons due to water deficit. A large proportion of the paddy lands in the southern low country intermediate zone is sandy resulting in higher water requirements for the paddy crop. As an alternative to rice, early-maturing groundnut varieties were tried in one such paddy field in the Hakmana area during the South West Monsoon,1989.

Seventeen early-maturing varieties which performed well in the previous season were grown in a randomized complete block design with, Chico as a control for early maturity, and X-14 (a released variety in Sri Lanka as control for yield). The rice field in which the experiment was grown had not been cultivated for the three previous South West Monsoons. A mixture containing urea, triple superphosphate, and muriate of potash in the proportion of 1:4:3 by weight was applied as basal fertilizer at the rate of 120 kg ha^{-1}. No other agrochemicals were applied. Ten competitive random plants $plot^{-1}$ were used for the estimation of agronomic characters. Net plot size for yield estimation was 9 m^2.

The general performance of the early-maturing varieties was good (Table 1). They matured by an average of 20 days earlier than the released variety, X 14. The variety ICGV 87134 recorded the highest pod and seed mass plant^{-1} in the experiment and ICGV 87126 recorded the highest pod yield. The shelling percentage of this accession was 65% and 1000-seed mass was 563 g. Although Chico matured a few days earlier than other varieties, it's pod yield was much lower, and the seed size not acceptable for the market. Most of the early-maturing varieties have medium-sized seeds, popular in the local market. Their shelling percentage and pod characteristics are satisfactory. Therefore, the high-yielding varieties will be screened further in the paddy fields of the intermediate zone and introduced to farmers as an alternative to rice during the South-West Monsoon.

Table 1. Mean performance of 17 early-maturing groundnut varieties in the southern intermediate zone of Sri Lanka, South West Monsoon, 1989.

	Performance of 17 lines		Control	
Character	Mean	Range	Chico	X-14
Age (days)	88.0	82-95 (86008)[1]	80.0	108.0
Number of pods plant^{-1}	22.8	12.4-37.4 (87139)	34.2	25.6
Pod mass plant^{-1} (g)	26.7	16.5-42.9 (87134)	19.3	26.9
Shelling (%)	69.0	62-78 (87120)	66.0	61.0
Seed mass plant^{-1} (g)	17.4	10.6-28.5 (87134)	14.0	16.6
1000-seed mass (g)	528.0	431-699 (87134)	277.0	541.0
Pod yield (t ha^{-1})	1.9	1.4-2.8 (87126)	1.0	2.8

1. Figures in parentheses represent ICRISAT groundnut variety (ICGV) number of the best cultivar for the particular character.

Acknowledgments. This research was funded by the Asian Grain Legume Network and the Sri Lanka-French Agricultural Research Development Project.

TNAU 97—a Promising Spanish Bunch Groundnut Variety with Early Maturity

S. Sridharan, S.R. Sree Rangasamy, P.K. Pallikonda Perumal, T. Ramanathan, S. Thangavelu, and T.K. Ramachandran
(Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu 641 003, India)

Spanish Bunch varieties released so far, including CO 2, VRI 1, and VRI 2, have maturity period of about 105 days. Groundnut in Tamil Nadu state is predominantly cultivated under rainfed conditions and fluctuation in monsoon is common, resulting in reduced yields due to drought. Development of early-maturing varieties will help in reducing or avoiding yield losses caused by terminal drought. Breeding efforts initiated at Coimbatore have resulted in the development of a variety, TNAU 97 which matures in 90 days in the rainy season. TNAU 97 is a three-way cross derivative of G 961 × (CO 1 × PPG 3).

TNAU 97 was evaluated along with CO 1 and CO 2 for 4 years, with JL 24 and VRI 1 for 3 years, and VRI 2 for 1 year during the rainy seasons (1986-89), and the data are presented in Table 1. Yield differences were significant during 1988 and 1989. TNAU 97 has recorded the highest mean pod yield of 2.0 t ha^{-1} reflecting its superiority over the control varieties. Similarly, based on the mean pod yields for two summers TNAU 97 showed an yield superiority of 98.2% over JL 24, 56.1% over VRI 1, and 46.4% over VRI 2. In addition to higher pod yields, TNAU 97 has synchronized flowering, uniform maturity, and basal setting of pods (Fig. 1).

Table 1. Pod yields (t ha^{-1}) of TNAU 97 and other groundnut cultivars at Coimbatore, Tamil Nadu, India, rainy seasons 1986-89.

	Rainy season				
Variety	1986	1987	1988	1989	Mean
TNAU 97	1.3	2.1	2.3	2.3	2.00
CO 1	1.1	1.8	1.2	1.7	1.45
CO 2	1.0	2.0	1.6	1.9	1.63
JL 24	-	2.4	1.1	1.3	1.60
VRI 1	-	2.0	1.2	1.2	1.47
VRI 2	-	-	-	1.2	-
SE	±0.105	±0.131	±0.043	±0.035	

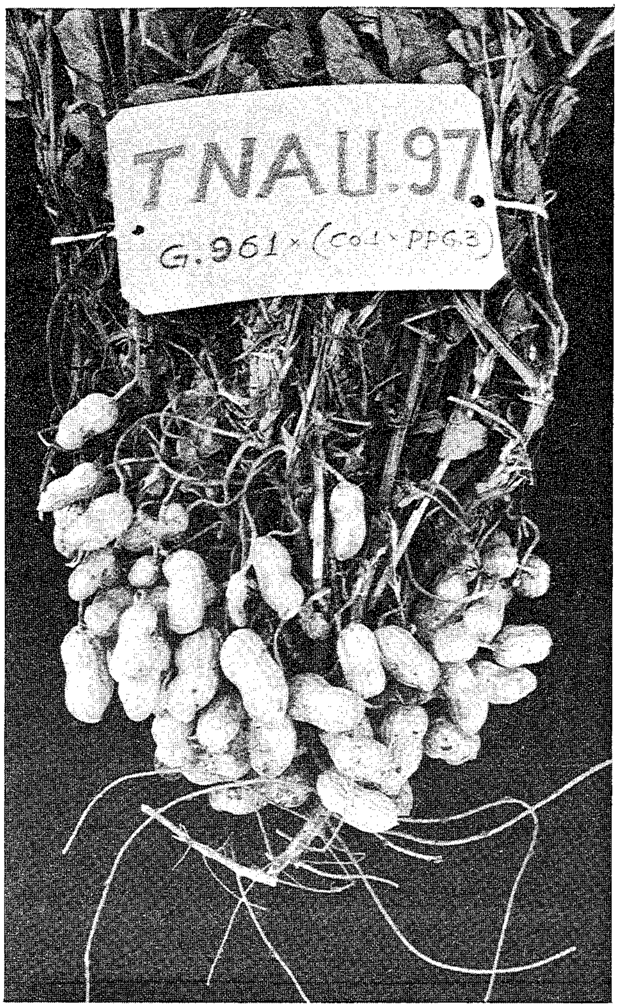


Figure 1. TNAU 97—a promising spanish bunch groundnut variety with early maturity.

The pods and seeds of TNAU 97 are smaller and the 100-pod and 100-seed mass are lesser than the control varieties. The shelling percentage is equal to JL 24, but slightly lesser than VRI 1 and VRI 2. However this variety is superior to CO 2 in shelling percentage.

TNAU 97 is as susceptible as the presently released spanish bunch cultivars in Tamil Nadu, India, to the major diseases and insect pests of groundnut.

A New Record of Extra-early Virginia Bunch Groundnut Variety

P. Vindhiya Varman and **T.S. Raveendran**
(Agricultural Research Station, Aliyarnagar, Tamil Nadu 642 101, India)

In groundnut (*Arachis hypogaea* L.) two subspecies, i.e., *hypogaea* Krap. et. Rig. and *fastigiata* Waldron are recognized. The former is characterized by longer growing season (120-180 days), alternate branching pattern, and larger fruit size. While, the latter is recognized by shorter duration (105-115 days), sequential branching pattern, and smaller pods (Gibbons et al. 1972). Both the subspecies are commercially important, as the cultivars belonging to virginia group are popularly grown in the northern belt and the spanish bunch varieties are extensively cultivated in the southern part of India. However, extra-early groundnut varieties will be ideal for cultivation in most parts of the country to suit the rainfall patterns, cropping systems, and availability of water in the irrigation source (Reddy 1988).

In the breeding programs aimed to incorporate earliness, a series of donor parents belonging to subspecies *fastigiata* Waldron, i.e., Chico, 91176, 91776, Ah 316/S, TG(E) 1, TG(E) 2, and TG(E) 3 were extensively used in hybridization and the resulting progenies are in the national testing programs. However, in the subspecies *hypogaea* Krap. et. Rig. such extra early donors are not available and hence the medium-duration (115-125 days) variety Kadiri 3 is being used (Basu et al. 1986).

At the Agricultural Research Station, Aliyarnagar, Tamil Nadu, India, we identified segregants possessing earliness equaling Chico in F_3 generation of a cross CO 2 × ICGV 86687 (GBFDS 92). Through pedigree breeding of these segregants, we developed a homozygous line in F_7 generation. This line designated as ALG(E) 57 was found to be virginia bunch type and possessed earliness similar to Chico.

The plants are characterized by alternate branching pattern without having flowers on the main stem. The morphological description of the culture is presented in Table 1. The pods and seeds are slightly larger than Chico. Though, it flowered and matured along with Chico (Table 2), the main distinguishing features between these two genotypes are the higher number of pods and more profuse branching pattern observed in ALG(E) 57 than Chico. The positive correlations of secondary branches to the number of matured pods and pod yield (Bhargava et al. 1970) coupled with very high heritability values for this character (Dixit et al. 1971) suggest that ALG(E) 57 will serve as a good combiner for yield.

Table 1. **Morphological description of the extra-early virginia bunch variety ALG(E) 57.**

Descriptor	Descriptor state
Growth habit	Decumbent III
Number of n+1 branches	5
Number of n+2 branches	10
Number of n+3 branches	Nil
Length of the main axis (n)	15.4 cm
Length of the n+1 branch	26.7 cm
Branching pattern	Alternate
Flowers on the main stem	Absent
Leaf color	Light green
Leaf shape	Oblong-elliptic
Leaf size	Small
Testa color	Rose

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Table 2. Comparison of the extra-early virginia bunch variety ALG(E) 57 with Chico, Aliyarnagar, Tamil Nadu, India, 1989 rainy and 1989/90 postrainy seasons.

	Rainy season 1989		Postrainy season 1989/90	
Characters	ALG(E) 57	Chico	ALG(E) 57	Chico
Time to 1st flowering (days)	25	25	30	30
Time to 50% flowering (days)	28	27	32	33
Time to maturity (days)	95	92	104	102
No. of matured pods $plant^{-1}$	19	15	22	17
100-pod mass (g)	66.0	53.5	70.5	55.0
100-seed mass (g)	29.5	24.4	30.3	25.5
Pod yield ($g\ m^{-2}$)	198	156	220	165

Varietal Differences for Calcium Deficiency in Groundnut

M.V.C. Gowda, H.L. Nadaf, and **P.L. Patil**
(University of Agricultural Sciences, Dharwad, Karnataka 580 005, India)

The absorption of calcium from the soil solution and transport through the plant is passive; besides it is highly immobile in the phloem (Hanson 1984). Calcium is essential for pod formation in groundnut. However, the geocarpic pod lacks the functional evaporative surface and hence its calcium requirement must be met directly from the soil solution. About 1 cmol exchangeable Ca kg^{-1} soil in the root zone and three times this in the pod formation zone are considered as threshold levels for groundnut (Biswas et al. 1985). Calcium deficiency in the field is manifest most often as 'pops', a term for pods containing shriveled seeds with a darkened plumule (Cox et al. 1982).

Cultivation of groundnut during postrainy season in the rice fallows of coastal Karnataka, India, has become popular in recent years (Channabyregowda et al. 1989). The soil of this region is alluvial, very acidic (pH 4.5) in nature and deficient in Ca (1.6 cmol kg^{-1} in pod zone). The crop is usually prone to end-of-season drought and thus further reduction in Ca uptake by the pods can be expected. Actually, deficiency symptom of calcium in the form of 'pops' was observed in a varietal trial conducted at Agricultural Research Station, Ankola—a typical acid soil area in the coastal Karnataka, during the postrainy season, 1987. The pops were characterized by aborted seeds and darkening of plumule in terminal seeds. Genotypes differed significantly for the proportion of pops to normal pods (Table 1). The proportion was lowest in an early-maturing genotype, Chico (0.1%), and highest in the smooth podded cultivars such as JL 24, TGS 2, and DH 40 (14.0%). Analysis of Ca concentrations in shells and seeds revealed drastic reductions of concentrations of this element in pops. The average reduction was about 28% in shell and 41% in seeds.

A further evaluation of selected groundnut genotypes during 1988 postrainy season confirmed the existence of wide genotypic variation for proportion of pops (Table 2). An analysis of different features of pods, i.e., shelling percentage, pod volume, pod surface area, shell thickness, specific shell mass, 100-pod mass and 100-seed mass revealed the existence of variability for these characters. Correlations of these traits with percentage of pops were worked out. A strong negative association of shelling percentage with pops percentage was observed, while the correlations with pod surface area and shell thickness were positive and significant indicating poor translocation of Ca to seeds in pods. The genotypes JL 24, JL(E) 55, and DH 40 with thicker and smooth shells recorded higher proportion of pops as compared to cultivars of similar duration namely Dh 30-30 and TMV 2. The positive correlation between pod surface area and pops percentage in this experiment is surprising as a large pod surface area is expected to improve Ca uptake (Kvien et al. 1988). It is possible that shell thickness and absence of reticulation (smoothness) were dominating factors in reducing movement of Ca to seeds and thus leading to higher percentage of pops in genotypes such as JL 24 and JL(E) 55.

Table 1. The percentage of pops and concentration of calcium in shells and seeds of normal pods and pops in 10 groundnut genotypes, field trial, coastal Karnataka, India, postrainy season 1987.

		Calcium content (mg g^{-1})			
		Shell		Seeds	
Genotype	Pops (%)	Normal pods	Pops	Normal pods	Pops
Chico	0.1	3.4	3.0	3.6	1.6
TG 23	4.7	3.4	1.8	2.4	2.0
Dh 3-30	5.1	4.2	2.2	2.4	1.6
TMV 2	7.0	2.6	2.2	3.4	1.4
TGE 2	7.8	2.6	2.0	3.2	2.4
TG 9	10.5	3.6	2.8	2.0	1.2
TG 24	13.0	2.0	2.0	1.8	1.0
JL 24	14.5	4.0	2.8	3.0	1.4
TGS 2	15.0	2.6	2.0	2.0	1.0
Dh 40	15.3	3.2	2.4	3.4	2.4
Mean	9.3	3.2	2.3	2.7	1.6
SE	±4.92	±0.66	±0.50	±0.64	±0.49

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Table 2. The variation for pod features and its association with occurrence of pops in selected seven groundnut genotypes, field trial, Coastal Karnataka, postrainy season 1988.

Genotypes	Pops (%)	Shelling (%)	Pod volume (cm^3)	Pod surface area (cm^2)	Shell thickness (mm)	Specific shell mass (mg cm^{-2})	100-pod mass (g)	100-seed mass (g)
TMV 2	7.0	70.5	1.91	4.04	0.88	58.6	96.0	37.4
Dh 3-30	7.3	72.2	2.44	3.96	1.03	67.4	98.5	42.2
ICGS(E) 21	7.3	73.5	2.17	4.69	1.02	57.8	108.8	43.4
TGE 2	10.0	69.9	1.47	6.51	0.88	28.5	85.5	26.1
Dh 40	15.3	69.3	2.17	4.05	1.12	63.8	102.4	41.1
JL(E) 55	12.3	66.8	2.45	14.63	1.18	31.7	110.8	43.6
JL 24	26.0	65.3	2.71	10.47	1.22	30.3	110.3	44.0
Mean	13.6	69.6	2.19	6.91	1.05	48.3	101.7	39.7
SE	±2.03	±1.13	±0.06	±0.65	±0.02	±2.48	±1.21	±0.63
Correlation coefficient (r) with percentage of pops	-	0.94[1]	0.61	0.82[1]	0.85[1]	–0.64	0.59	0.38

1. Significant at 5%.

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Economic Status of Neem Cake Mulch for Termite Control in Groundnut

D.V. Ranga Rao, K.N. Singh, J.A. Wightman, and **G.V. Ranga Rao** (ICRISAT Center)

Termites are a serious pest of groundnut throughout the semi-arid tropics, particularly when rainfall is sparse during the growing season (Wightman et al. 1990). Termites damage or kill plants by boring into the roots and stems, destroy foliage, and damage the pods by piercing the shell or by removing the corky material between the strands of vascular tissue (scarification). The complete destruction of crops has been observed throughout Africa where it is often associated with drought. Pod damage increases the risk of an infection of *Aspergillus* spp that can lead to mycotoxin (aflatoxin) buildup during on-farm or commercial storage (McDonald and Harkness 1967).

Farmers in Africa also suffer up to 40% crop loss caused by termites during the time the harvested crop dries in field. Experiments at ICRISAT Center showed that plants stacked for drying could be protected from termites by piling them on a mulch of neem cake or chopped *Ipomaea fistulosa* branches (Gold et al. 1989).

Following this observation, a neem cake mulch was evaluated for its ability to protect the pods of growing plants from termite attack. This experiment was carried out because the only effective insecticidal treatments available for protecting groundnut plants from termites are centered on chemicals that are either banned or are highly toxic to mammals (e.g., phorate).

The test field had a long history of termite incidence. It is located in an area of low fertility Alfisol that receives no inputs other than those needed to sustain the termite population (straw, cut weeds, and other organic trash). The main species present are *Odontotermes obesus*, *O. brunnei*, *O. wallonensis*, and *Microtermes obesi*. Groundnut cultivar ICGS 44 was sown on five 1.5-m wide raised beds on 29 Jun 1990 with four rows bed^{-1}. Sowing was carried out at a spacing of 15 cm between plants and 30 cm between rows. The beds were 100-m long and were divided into twenty 5-m long plots. Half the plots were treated with neem cake at 100 kg $(30\ m^2)^{-1}$ after sowing. This gave a neem cake layer of about 2-cm thickness across the bed. The rate was based on previous experience (Gold et al. 1989). Mulch disappeared by 6 weeks after sowing, presumably by the action of persistent and often heavy rain. It was repeated 40 days after crop emergence (DAE).

Termite activity was monitored by counting the termites associated with 20 cm × 30 cm long bamboo pegs that were lightly covered with soil in each plot. The mulch had no effect on the insects living on the foliage (jassids, thrips, and the groundnut leaf miner). The crop was harvested late (at 150 DAE) to increase the possibility of scarification.

After 40 days, a greater percentage of bamboo pegs had been attacked in the treated plots than in the nontreated plots (Table 1), although this equilibrated at a high level by 80 DAE. There was no significant difference between the number of termites on baits in the two treatments. Neem cake reduced the proportion of pods scarified by 14.3% and increased the pod yield significantly.

However, the yields were low, reflecting the nonimproved nature of the soil, so that the increase of 0.11 t pods ha^{-1} did not compensate for the high cost of the treatment. The purchase price of the two applications of neem cake, at Rs 1.6 kg^{-1} was Rs 67 000 ha^{-1}. If the pods were sold for Rs 10 kg^{-1}, the two neem cake applications would have to increase the pod yield by 6.7 t ha^{-1} to compensate for the cost of this input under the conditions of this experiment. This excludes transport and application costs.

In conclusion, a small benefit in terms of the yield of nondamaged groundnut pods was achieved by mulching a termite-prone groundnut crop with neem cake. However, the mulch proved labial, it appeared to increase the early-season termite population and gave no economic benefit. There was no evidence that insects other than termites were influenced by the treatment. We would not recommend farmers to apply this mulch to groundnut crops for termite control and yield enhancement unless they have a source that is cheaper. We believe that neem cake may still play a part in protecting the drying crop from termites.

Table 1. Influence of neem cake mulch [two applications of 100 kg $(30\ m^2)^{-1}$] on termite incidence and damage (scarification) in a groundnut field, ICRISAT Center, rainy season 1990.

	Termite incidence (numbers[1]) ± SE	
	Neem cake mulch	Control no mulch
Bamboo baits attacked (%)		
40 DAE[2]	57.5±5.2	39.5±4.7[3]
80 DAE	94.5±2.9	97.5±0.8
Termites $bait^{-1}$		
40 DAE	2530±457	2070±527
80 DAE	1380±333	1150±197
Pods scarified (%)	42.4±2.0	56.7±3.9*
Pod yield (t ha^{-1})	0.46±0.04	0.35±0.01

1. Mean of data from 10 plots $treatment^{-1}$.
2. DAE = days after crop emergence.
3. Significant at $P = 0.05$ (Student's 't' test).

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Influence of Water Stress on Groundnut Aphids

G.V. Ranga Rao, J.A. Wightman, K.D.R. Wadia, D.V. Ranga Rao, and **R.C. Nageswara Rao** (ICRISAT Center)

The groundnut aphid *Aphis craccivora* Koch is cosmopolitan in distribution and infests many host plants belonging to the leguminous group. The alates (winged) invade the groundnut field from the nearby alternate hosts and produce nymphs parthenogenetically. Both nymphs and adults suck sap from the tender shoots, flower buds, and pegs. This species is generally considered as a pest of the rainy season groundnut crop in southern India. The impact of this species is greater under moisture-stress situations. However, the effect of moisture stress on aphid populations was not clear. In the past couple of seasons at ICRISAT Center, this species attained pest status unusually during the postrainy season crop. This unusual appearance of aphids during the 1989/90 postrainy season enabled us to observe aphid distribution across the water-stress gradient created by a line source overhead sprinkler irrigation system (Hanks et al. 1976). The crop was sown on beds of 1.5-m width during the 2nd week of December and there were eight beds across the gradient (range was complete wet to totally dry). Two different water stress situations were created, i.e., one was continuous water stress which was imposed from 40 days after sowing (DAS) and the other was end-of-season water stress introduced at 80 DAS. One week after the imposition of end-of-season stress on 8 Mar 1990 observations on aphid population were taken on 40 terminals sample^{-1} in three replications. The results (Fig. 1) indicate that the aphid density was much higher in plants that had sufficient moisture. The difference in population from wet to totally dry end of the gradient was significant. There was a clear-cut negative relationship in population development as the distance from the water source increased. Similar trend was also noticed even 1 week after the initiation of end-of-season stress. Thus, these observations clearly indicated that aphids build up more rapidly on plants without moisture stress rather than on plants under stress. Two days after the aphid counts in the above trial, there was 70 mm rain at ICRISAT Center. The observation immediately after the rain showed that there was about 90% decline in population. The effect of rain on aphid population suggests that although the density was maximum close to the irrigation source, it had probably been suppressed by the physical effect of the water landing on the plants. The plants that were provided with irrigation during postrainy season, attracted a large number of aphids which had the potential of reducing the yields significantly.

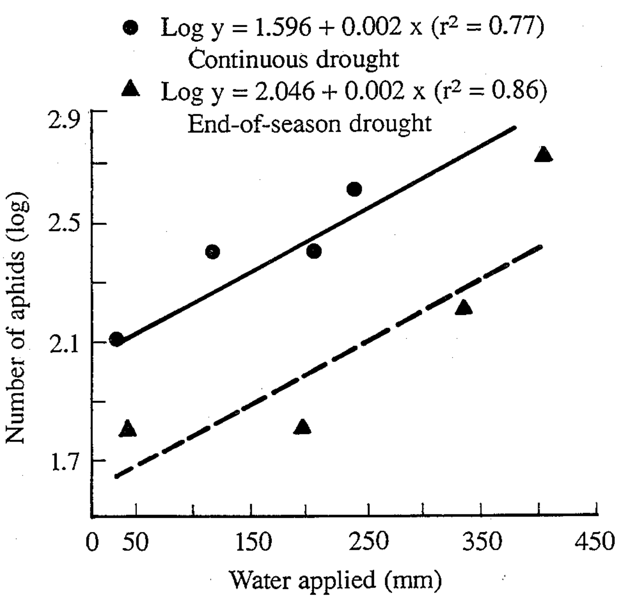

Figure 1. Distribution of aphid populations across a drought-stress gradient created by line-source overhead irrigation.

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Sex Pheromone in Groundnut Leaf Miner, *Aproaerema modicella*

V.L. Lalita Kumari and **D.D.R. Reddy**
(Department of Entomology, College of Agriculture, Rajendranagar, Hyderabad 500 030, India)

The groundnut leaf miner (GLM), *Aproaerema modicella* Dev. is a serious pest of groundnut in India. Outbreaks of this pest are common every year. The intensity and damage has also been increasing in recent years (Amin 1987) perhaps due to changes in the cropping patterns and the intensity of management practices. Serious losses caused by GLM can often be avoided by timely application of insecticides. An efficient monitoring method would facilitate the measurement of adult populations to predict the need for insecticide application. The use of sex pheromones in insect pest control was first indicated by Gotz (1951) for monitoring, mass trapping, and disruption of mating. However, to date, they are most often adopted for monitoring purposes only.

Living virgin female moths, excised female extracts of abdominal tips have been used as baits for luring males in wind tunnels in laboratory conditions as well as in field traps to demonstrate the presence of sex pheromone (e.g., Von 1985; Sardana 1988). This paper describes the demonstration of the presence of sex pheromone in *A. modicella*.

Male and female pupae were kept singly in glass vials at room temperature. Emerged adults were fed 5% sucrose solution on cotton. Female and male, moths 24 h posteclosion were used in the laboratory tests. In the bioassay test, one whole female, three excised abdominal tips and 1, 2, and 3 female equivalents wind tunnel^{-1} (FE) were used (Lalita Kumari 1989). Crude extracts were prepared from the abdominal tips of 24 h posteclosion females excised at calling time, extracted in methylene chloride and concentrated to one FE mL^{-1}. Measured amounts of the extracts of the desired number of FE were impregnated on cigarette filter tips. The response was considered positive when the males became excited, ran and flew about in the wind tunnel in a wild erratic manner and tried to copulate with the source of pheromone. Observations continued from 1800 to 0800

In field tests, live females or excised abdominal tips or abdominal tip extracts were placed inside a perforated plastic container hung in sticky traps (supplied by Pest Control India Ltd.). Sticky traps were suspended 30-cm above the crop canopy in a GLM-infested groundnut field. The traps were positioned at 1800 and removed for observation at 0800 the next day. A sticky trap without a possible pheromone source was also provided as a control and each treatment was replicated three times.

The males showed a response and orientation towards the pheromone source in the wind tunnel. The observations revealed a mean (out of 10) of 7.0, males were attracted to the pheromone sources of virgin female, 6.7 to excised abdominal tips, and 6.3-8.0 to crude abdominal tips extract in the wind tunnel (Table 1).

Field tests confirmed the production of pheromone by female moths. Sticky traps baited with virgin female moths, excised abdominal tips, and crude extracts of abdominal tips trapped 61-88 males trap^{-1} night^{-1} (Table 1).

Table 1. Response of *A. modicella* male moths to different types of female pheromone in laboratory and field conditions.

		No. of males responded/trapped				
	Mean no. males released wind^{-1} tunnel	Type of female pheromone source				
				Extract in mL (female equivalents)		
Type of assay		Virgin female[1]	Female abdominal tips[2]	1	2	3
Wind tunnel (Laboratory)	10.0	7.0	6.7	0.0	6.3	8.0
Sticky trap (Field)	-	61	88	0	65	85

1. One female confined in a cage.
2. Three female abdominal tips in a cage (All figures are mean of 3 replicates).

The results of laboratory bioassays in the wind tunnel and field trapping provide evidence that a sex pheromone is produced by Virgin calling-females and the terminal abdominal tips contain the glands that produce the sex pheromone. The response of males to the solvent extracts of the female abdominal tips indicated that the pheromone could be extracted. The fact that one female equivalent did not induce mating or trap males is indicative of loss of pheromone material in the course of solvent extraction. Thus the leaf miner has potent sex pheromone and any attempt to identify the chemical component(s) involved leading to synthesis will be very useful in monitoring the pest.

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Effect of Pod Infestation by Mealy Bugs on Seed Quality in Groundnut

J. Kannaiyan and **S. Sithanantham** (Food Legumes Research Team, Msekera Regional Research Station, Box 510089, Chipata, Zambia)

In groundnut, pod scarification by termites is known to affect the quality of seeds, especially in terms of contamination by *Aspergillus flavus* (Feakin 1973). During the 1988/89 season, we observed that roots and pods of groundnut were infested by mealy bugs in several research plots at Msekera (plateau) and Masumba (valley) in Eastern Province, Zambia. The identity of this pest is yet to be determined. Sithanantham (1988) reported that pod infestation by mealy bugs resulted in an overall reduction in seed mass. We present herein the observed effect of such infestation on the germinability and fungal seed contamination in groundnut.

During the 1988/89 season, we collected six replications, each of 50 pods, of mealy bug infested, and healthy categories, in plots of two cultivars—Makulu Red and Egret at the Msekera Regional Research Station. From each sample, we collected 50 random seeds, to assess the seed germinability and seed contamination by the blotter test recommended by the International Seed Testing Association (ISTA).

In Makulu Red, the seeds from mealy bug infested pods recorded substantially less germinability, along with increased overall contamination (%) as well as contamination by *A. flavus* alone (Table 1). In the other cultivar Egret, however, the infestation showed no apparent effect on germination as well as in the extent of seed contamination. The overall differences between seeds from infested and healthy pods, were not significant for germinability, but were significant for the two cultivars and for the interaction between cultivars and the two treatments (infested, healthy) were significant for all the three parameters studied. The coefficient of variation, however, was very high for contamination parameters probably due to the small sample size. Although seeds of

Table 1. Effect of mealy bug infestation of pods on seed germinability and fungal contamination in two groundnut cultivars, Msekera, Zambia, 1988/89.

	Germinability (%)		Fungal seed contamination (%)			
			by *A. flavus*		Overall	
Cultivar	I[1]	H[2]	I	H	I	H
Makulu Red	52	74	9.3	07	48.3	0.3
Egret	77	74	0.0	1.0	3.0	6.7
Mean	65	74	4.7	1.0	25.7	3.5
CV (%)	17		96		85	

1. I = Mealy bug infested pods.
2. H = Healthy (noninfested) pods.

healthy pods from both the cultivars did not show any appreciable difference between them in germinability and seed contamination, the seeds from mealy bug infested pods showed clear adverse effects in quality only in Makulu Red and not in Egret. Such differences in the response of cultivars to the insect infestation may be because, the extent of injury/severity of feeding damage by mealy bug was different, and/or that Egret was able to tolerate the infestation, so minimizing the predisposition of the seeds to greater contamination. Nevertheless, the germinability of seeds appeared to be clearly reduced when seed contamination substantially increased, as seen in seeds of mealy bug infested pods in Makulu Red.

Kannaiyan et al. (1989) had shown that at the same location (Msekera), pooled seeds from Makulu Red showed greater *A. flavus* contamination than Egret. Perhaps the greater contamination in Makulu Red may be also contributed by mealy bugs as seen presently or due to other factors. However, they did not find any appreciable affect of *A. flavus* contamination on germinability across cultivars, but in some other studies of farmers' seed-lots by us, we found appreciable overall affect of seed contamination on germinability (Kannaiyan and Sithanantham, unpublished). Apparently a range of factors associated with seed quality, both before and after harvest, as well as the adequacy of sample size and replications may all influence the extent of seed contamination vis-a-vis the germinability. The high CV (%) for contamination parameters points to the need for improving the sampling strategy in such studies.

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Residue Proofness of Monocrotophos Spraying on Groundnut

M.D. Dethe and **V.D. Kale** (Department of Entomology, Mahatma Phule Agricultural University, Rahuri, Ahmednagar, Maharashtra 413 722, India)

Harvest-time residues of monocrotophos were studied in groundnut samples from the experiment carried out in a randomized-block design with four replications, to evaluate the monocrotophos spraying schedules against pests of groundnut. The experiment was conducted by the Oilseed Research Station, Jalgaon, Maharashtra, India, by sowing variety JL 24 on 27 Jun 1988. The details of different treatments with monocrotophos (Nuvacron 36 WSC®) followed after germination (3 July) are given in Table 1. The seeds from the pods harvested on 8 October were subjected to analysis by colorimetric method sensitive to 0.1 ppm (Getz and Watts 1964). An average recovery of the monocrotophos from the fortified samples at 1 ppm level was 88%.

Table 1. Levels of monocrotophos residues in groundnut seed.

Particulars of treatment	Residue level[1]
Four sprays of 0.05% monocrotophos at 30, 45, 60, and 75 DAE[2]	BDL[3]
One spray of 0.05% monocrotophos at 30 DAE[2]	BDL
One spray of 0.05% monocrotophos at 45 DAE	BDL
Two sprays of 0.05% monocrotophos at 30 and 45 DAE	BDL
Two sprays of 0.05% monocrotophos at 30 and 60 DAE	BDL
One spray of 0.05% monocrotophos at 60 DAE	BDL
One spray of 0.1% monocrotophos at 60 DAE	BDL
Control (Nontreated)	BDL

1. Mean of four replicates.
2. DAE = Days after emergence.
3. BDL = Below detectable limit of 0.1 ppm.

The residue levels of monocrotophos given in Table 1 indicate that the residues were below detectable limit in groundnut seed from the crop treated with 1 to 4 sprays of 0.05% monocrotophos. Even at higher concentration of 0.1%, residues were not detectable in the seed. Thus spraying the schedule with suitable number of sprays (1 to 4) of 0.05% monocrotophos given from 30 to 75 days after germination could be considered residue proof.

Acknowledgment. Authors are grateful to Dr S.A. Ghorpade, Entomologist, Oil Seed Research Station, Jalgaon, for providing an opportunity to undertake the work.

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Getz, M.E., and **Watts, R.R.** 1964. Application of 4-(p-Nitrobenzyl) pyridine as a rapid quantitative reagent for organophosphate pesticides. Journal of the Association of Analytical Chemistry (USA) 47:1094-1096.

Effect of Soil Application of Two Insecticides on Groundnut Yield and Quality in Zambia

S. Sithanantham and **J. Kannaiyan** (Food Legumes Research Team, Msekera Regional Research Station, Box 510089, Chipata, Zambia)

In Zambia, soil insect pests—especially termites, white grubs, and wireworms—cause appreciable damage to groundnut roots and pods (Sithanantham et al. 1989). Scarification of pods by termites is known to favor seed-contamination by *Aspergillus flavus* (Feakin 1973). The occurrence of *A. flavus* contamination, often associated with aflatoxin problem, has been found to be substantial in Zambia (Kannaiyan et al. 1989). In this report, we discuss the effect of soil application of two insecticides, intended to control soil insects, on the yield and seed quality as observed in a field experiment conducted at Masumba, Eastern Province, Zambia, during 1987/88.

The experiment was in a split-plot design, with two groundnut genotypes, MGS 2 and Makulu Red as main plots and the following three treatments as subplots:

T_1 - Dieldrin - soil application - 2 kg a.i. ha^{-1}.

T_2 - Carbofuran - soil application - 1 kg a.i. ha^{-1}.

T_3 - No treatment (control).

There were four replications and the plots were of four rows of 4-m length, with a spacing of 75-cm between rows and 20-cm between plants within the row. The insecticides were applied in the seed furrows at sowing. The effect of the treatments on soil insect pest damage (pod damage, pod scarification), and disease severity (leaf spots) was assessed by visual rating on a 1-9 scale (1 = no apparent damage; 9 = very severe damage). The seed yield was also recorded. Seed germinability and seed contamination were assessed, based on samples of 200 seeds each by the blotter test as per International Seed Testing Association (ISTA) procedure.

The results (Table 1) showed that pod scarification (by termites) was only slightly reduced by carbofuran treatment, while dieldrin tended to enhance the scarification. On the other hand, dieldrin appeared to marginally reduce the pod damage, but not carbofuran. Apparently, the severity of damage by soil insect pests was not adequate enough to evaluate the effect of the treatment. Interestingly, carbofuran treatment resulted in significant reduction of severity of the leaf spots (early and late) disease. This effect possibly led to a higher seed yield in carbofuran treated plots, while dieldrin had no beneficial effect on disease control or yield. Therefore, the yield differences between the treatments were more directly attributable to effects on leaf spot disease severity than to the control of damage to pods by soil insects.

The germinability of seeds was found to be significantly enhanced by both the insecticides. The extent of overall seed contamination by fungi was also found to be significantly reduced by the two insecticides, although the contamination by *Aspergillus flavus* was not substantially affected. These results suggest that the two insecticides had resulted in reduction of overall seed contamination with a consequent increase in seed germinability. Our recent studies of groundnut seed samples from farmers in this region have shown that seed contamination is negatively correlated with seed germinability (Kannaiyan and Sithanantham, unpublished).

Among the two groundnut genotypes, the effect of the two insecticides on seed contamination and seed germinability was more distinct in Makulu Red than in MGS 2. The extent of seed contamination was 27% in MGS 2 and 45% in Makulu Red while the germinability was 64% in the former and 91% in the latter. Evidently, the higher natural seed contamination in Makulu Red resulted in greater response to the treatments, leading to more distinct improvement in seed germinability.

The present results have shown that soil application of the two insecticides, especially carbofuran, tended to reduce the leaf spots and increase yields. This has also resulted in low seed contamination and good germinability, and the extent of such effect differed with the genotype and its susceptibility to seed contamination.

Table 1. Effect of soil application of two insecticides on pod damage, yield, and seed quality in two groundnut genotypes, Masumba, Eastern Province, Zambia, 1987/88.

Genotype	Soil application treatment[1]	Pod scarification by termites (1-9 scale)[2]	Pod damage by other insect pests (1-9 scale)	Leaf spot disease (1-9 scale)	Seed yield (kg ha^{-1})	Seed germinability (%)	Seed contamination (%) By *A. flavus*	Seed contamination (%) By all fungi
MGS 2	T_1	3.3	1.3	8.7	671	95	8.0	19.7
	T_2	2.5	2.3	6.5	770	98	13.0	25.3
	T_3	2.8	2.0	8.0	733	91	11.7	36.0
	Overall	2.9	1.9	7.7	725	95	10.9	27.0
Makulu Red	T_1	3.5	1.7	8.2	517	82	30.0	43.0
	T_2	2.5	1.8	6.3	664	81	24.0	38.7
	T_3	2.7	2.0	7.5	464	64	31.0	51.7
	Overall	2.9	1.8	7.3	548	76	28.3	44.5
Overall	T_1	3.4	1.5	8.4	594	89	19.0	31.3
	T_2	2.5	2.1	6.4	717	90	18.5	32.0
	T_3	2.8	2.0	7.8	599	77	21.3	43.8
	Mean	2.9	1.9	7.5	637	85	19.6	35.7
	CV (%)	24	34	9	15	9	30	34
Main treatment (Genotype)	SE	±0.25	±0.24	±0.11	±16.3	±1.8	±1.4	±2.9
Subtreatment (insecticides)	SE	±0.20	±0.14	±0.21	±19.5	±2.3	±1.7	±3.6

1. T_1 Dieldrin (2.0 kg a.i. ha^{-1}); T_2 = Carbofuran (1.0 kg a.i. ha^{-1}); T_3 = Control (no treatment).
2. Scored visually on a 1-9 scale, where 1 = no apparent damage; and 9 = very severe damage.

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Protein, Oil Content, and Fatty Acid Composition of Bolivian Groundnut Cultivars

N.R. Grosso[1] and C.A. Guzmàn[2] (1. Facultad de Ciencias Agropecurias, UNC, Avda. Valpartàiso s/n, 5000 Còrdoba, Argentina; 2. Facultad de Ciencias Exactas, Fìsicas y Naturales, UNC, Avda. Velez Sarsfield 299, 5000 Còrdoba, Argentina).

Groundnut probably originated in Bolivia. Many international institutions, such as the International Board for Plant Genetics Resources (IBPGR), the "Centro Internacional de Mejoramiento de Maiz y Trigo" (CIMMYT), and ICRISAT conduct expeditions to collect wild species or landraces in the place of origin so as to preserve this material and use it in plant improvement projects.

This work aims at improving groundnut quality. Eighteen cultivated groundnut varieties (*Arachis hypogaea* subspecies *hypogaea*) originating in Bolivia were studied. The samples belonging to the Agricultural Experimental Station, Instituto Nacional de Technologia Agropecuaria (INTA) collections (RCM) are shown in Table 1.

The protein content was determined by (the Kjeldah method (N × 5.46). The percentage of oil was calculated from the difference in the material weight before and after its extraction with n-hexane. The fatty acid composition of the seminal oil was expressed as methylic esters. The oils was saponified with 1 N KOH in methanol and then esterified with 1 N sulfuric acid in the same solvent. The fatty acid derivatives were studied by gas-liquid chromatographic method, using a silar column 10% on Chromosorb W®, and a temperature program of 150°C for 15 minutes, then a temperature rise of 2°C $minute^{-1}$ to 175°C. The compounds were identified by comparison of their retention data with those of authentic samples of SIGMA Chemicals Company.

The sample dry mass was 96% of total mass, with 4% moisture. The protein content varied from 27.0% (RCM 1741) to 32.7% (RCM 1959), and the percentage of oil ranged between 44.3% (RCM 1792 and RCM 1959) and 50.6% (RCM 1728).

The fatty acid composition is shown in Table 1. C 18:1 and C 18:2 were the ones that showed the major differences among the varieties. The C 18:1 showed the largest concentration, except in RCM 1707 and RCM 1719. The percentage of C 18:0 was lower than those previously described for other cultivars (Ahmed and Young 1982). The presence of C 22:1 in groundnut oil is reported for

Table 1. Percentage of oil, protein content, and fatty acid composition of Bolivian groundnut cultivars.

Variety	Oil (%)	Protein (%)	Percentage of fatty acids								
			16:0	18:0	18:1	18:2	20:0	20:1	22:0	22:1	24:0
RCM 1707	45.5	26.7	10.9	1.7	37.7	39.2	1.3	3.2	4.4	0.2	1.4
RCM 1719	45.2	27.9	11.3	1.9	35.6	43.2	1.3	2.2	3.1	—	1.4
RCM 1722	47.2	26.5	10.6	1.7	40.5	37.9	1.3	2.9	3.6	0.2	1.2
RCM 1728	50.6	24.2	10.1	1.9	42.7	36.2	1.3	2.7	3.8	0.1	1.2
RCM 1741	46.1	23.6	10.9	2.0	42.4	36.8	1.3	2.7	3.3	—	0.8
RCM 1757	48.2	25.9	9.8	1.5	45.1	34.5	1.5	2.9	2.9	0.6	1.2
RCM 1759	46.4	25.9	11.8	1.1	38.8	38.7	1.0	2.7	3.8	0.3	1.7
RCM 1764	45.2	26.3	9.9	1.7	46.5	32.6	1.1	2.8	3.6	0.2	1.4
RCM 1792	44.3	26.8	10.7	1.7	44.5	34.6	1.1	2.5	3.5	0.1	1.2
RCM 1809	48.4	26.4	10.6	1.5	42.7	36.9	1.0	2.6	3.5	—	1.1
RCM 1838	45.2	27.0	10.2	1.9	46.0	33.0	1.2	2.3	4.0	tr.	1.4
RCM 1855	47.0	27.9	10.0	1.7	50.9	29.8	1.1	2.1	3.2	tr.	1.2
RCM 1859	44.3	28.6	10.2	2.2	49.9	30.6	1.3	1.7	2.9	tr.	1.1
RCM 1888	50.1	25.6	10.2	2.1	46.5	33.2	1.3	1.9	3.6	tr.	1.2
RCM 1896	47.8	25.3	10.0	1.9	47.9	32.5	1.2	2.0	3.4	tr.	0.9
RCM 1898	46.4	26.3	9.4	2.0	48.9	31.5	1.2	2.2	3.5	tr.	1.2
RCM 1901	49.4	25.7	9.3	2.0	44.6	35.3	1.2	2.4	3.5	tr.	1.5
RCM 1910	46.7	24.3	11.8	1.6	41.9	35.4	1.2	2.3	4.4	tr.	1.3

the first time (except in RCM 1719, 1741, 1809).

The reported data on Bolivian groundnut can be used when food aspects are considered; moreover, these sources are worth evaluating further for the genetic improvement of the cultivars.

Acknowledgment. We thank Ag. José R. Pietrarelli for providing the sample.

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A Storage Method to Prolong Seed Viability in Groundnut

P.C. Nautiyal, Y.C. Joshi, and **P.V. Zala**
(National Research Centre for Groundnut, Junagadh, Gujarat 362 015, India)

Rapid loss of seed viability has become a major problem of postrainy season/summer produce of groundnut, since within 4 to 5 months of storage about 50% viability is lost (Nautiyal et al. 1989). Seeds obtained from pod samples collected from the farmers' fields showed loss of viability to the tune of 50% to 80%, and were unsuitable for sowing. For this reason, farmers in various parts of India are unable to utilize their postrainy season/summer produce for subsequent sowings. The prevalent high temperatures during drying of postrainy season summer produce (May-June) and storage under high humidity conditions during the subsequent rainy season could be responsible for rapid loss of viability. Therefore, attempts were made at National Research Centre for Groundnut to develop a viable storage technique to prolong seed viability in postrainy season/summer groundnut.

Postrainy season/summer 1988 produce of cultivar GG 22 was dried by the conventional farmers' method in small heaps for 2-3 days; later, pods were picked and dried in the sun till they attained a moisture percentage between 5.8-6.5. Then the pods were stored as follows:

Treatment (T_1) : 30 kg of pods in sealed gunny bag

Treatment (T_2) : 30 kg of pods in sealed polythene-lined gunny bag

Treatment (T_3) : 30 kg of pods in polythene-lined gunny bag with a centrally positioned plastic container containing 250 g anhydrous $CaCl_2$ (Fig. 1). The wide-mouthed plastic container had several perforations on its upper half. About 250 g $CaCl_2$ wrapped in the single layer of muslin cloth was hung half way inside the container with some extra muslin cloth resting on the rim of the container. The screw cap-lid was then tightened to ensure the proper positioning of $CaCl_2$ bag. Moisture absorbed by $CaCl_2$ during storage dripped to the bottom of the plastic container.

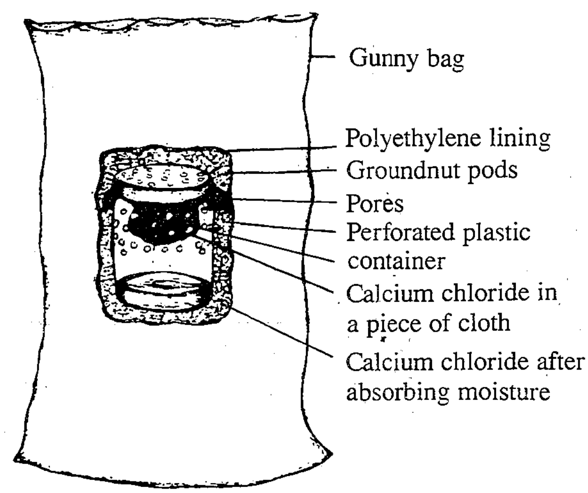

Figure 1. Diagrammatical view of gunny bag containing groundnut pods along with plastic container containing calcium chloride.

Seeds were tested at 2-months interval for laboratory germination following the rules of Seed Testing (ISTA 1976) with three replicates of 100 seeds each. After 8-months of storage seeds were sown in the field in 5 m × 3 m size plot in randomized-block design (RBD) with three replications. Field-emergence was recorded 30 days after sowing.

Pods stored under the three storage conditions showed significant differences in their seed viability (Table 1). The differences in seed viability became apparent imme-

Table 1. Germination percentage, seedling vigor index, field emergence (at the end of 8 months storage) and pod yields of groundnut cultivar GG 2 as influenced by different storage conditions for different periods.

Treatment[1]	Storage period (months) 0	2	4	6	8	Field sowing Emergence (%)	Pod yield (kg ha^{-1})
	Germination (%)						
T_1	90.0±4.08	86.7±4.02	38.3±2.35	11.72±2.35	4.0±1.63	4.4	172
T_2	89.7±2.05	84.7±3.68	48.3±2.35	16.7±2.35	10.7±2.49	7.5	321
T_3	91.0±4.32	92.3±2.05	80.0±4.08	78.3±2.35	71.3±2.62	69.8	1615
SE						±0.60	± 48.4
	Seedling vigor index						
T_1	554.4	331.9	128.0	35.0	6.6		
T_2	539.3	436.8	193.3	58.8	36.2		
T_3	560.6	537.4	466.4	417.5	330.3		

1. T_1 = Storage in plain sealed gunny bags.
T_2 = Storage in polythene lined sealed gunny bag.
T_3 = Storage in polythene lined sealed gunny bag with plastic container containing $CaCl_2$.

diately after start of storage period and 4-months later the differences ranged between 30% and 40% in various treatments. After 8-months of storage seed viability and seedling vigor in T_1 and T_2 treatments reduced drastically. Pod yield (kg ha^{-1}) of various treatments showed significant differences (Table 1).

These results indicate that postrainy season/summer produce of groundnut can be stored using $CaCl_2$ as dehydrant for sowing up to 8-months at ambient conditions. The estimated cost for the storage of 100 kg of pods is about Rs 25/- (about US$1.3), and does not require any special skill. This technology will help the groundnut farmers in hot and humid regions, i.e., coastal parts of Karnataka, Andhra Pradesh, and Orissa states of India, who are deprived of a chance to store their seed locally and have to incur additional expenditure on its transport from the neighboring places.

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Book Review

J. Smartt. 1990. Grain Legumes: Evolution and Genetic Resources. Cambridge University Press, Cambridge, U.K. ISBN 0521 30797X. Price £ 55.00.

This book is a valuable addition to the recent books on legumes. It is written by an author with rich research experience on legumes. Unlike most other multiauthored books, which are more detailed and specialized, this book reflects the author's wholistic approach and thinking on a much broader front, in a more lateral vein. The author should be congratulated for the nice synthesis and articulated presentation of his thoughts on a wide range of disciplines such as crop evolution, genetic resources, plant breeding, agronomy, microbiology, soil nutrition, socioeconomics, and human nutrition, related to legumes.

The book gives a comprehensive account of the biosystematics of major grain legumes including, groundnut, pigeonpea, chickpea, and *Phaseolus* and *vigna* species, and other minor grain legumes such as yam, bean, guar, velvet beans, hyacinth bean, horse gram, and the Hausa (Kersting's) groundnut.

The author brings to the fore the unanswered questions in biosystematics of groundnut such as whether *Arachis nambyquarae* should be regarded as anything other than a form of *A. hypogaea*, whether there is enough justification in maintaining a distinct species status to *A. monticola*, and whether cultivated groundnut had a monophyletic or dual origin.

In the chapter on germplasm resources and the future, the factors controlling development of gene pools, genetic resources profiles, genetic resources and breeding objectives, and innovative approaches to germplasm exploitation are presented.

The author feels that there has been some imbalance in our germplasm evaluation efforts in *Arachis*, where most efforts have gone in the direction of studying the collection of wild species, resulting in the comparative neglect of landraces.

He also points out to the inappropriate breeding strategies and objectives adopted in the production of pulse crops for the developing countries and states that the breeding objectives should be related to an appropriate level of technology. The author is more down to earth when he states that 'the sophisticated and advanced methodologies are quite out of place in most breeding programmes in the developing world, when the basic strategies of local collection, introduction, and selection have not yet been fully exploited.

Under future prospects, the author provides justification for the need for new domestication and suggests development of alternative crops to obtain agricultural self-sufficiency in developing countries. He indicates two guiding principles in the selection of potential domesticates; (1) application of Vavilov's law of homologous series to identify potentially useful taxa, and (2) critical evaluation of plants which are extensively used in times of food shortage and famine.

The book is very informative and valuable to the students and researchers of crop evolution and to the scientists of various agricultural disciplines working on legumes. The book also will be educative to the agricultural policymakers and research managers.

L.J. Reddy
ICRISAT

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Journal articles

English language article	**Sangster, A. G.** 1978. Silicon in the roots of higher plants. American Journal of Botany 65(9):929-935. 36 refs.
When only English title is available or possible to reproduce	**Robertse, P. J.** 1978. [The adaptability of grain sorghums under South African cultivation conditions.] (In Af. Summaries in En, Fr.) Agroplantae 10(2):21-27.
When only original title is available	**Saint-Clair, P. M.** 1980. Effet de l'age et des conditions de croissance sur la resistance a la desiccation de cultivars de sorgho grain. (In Fr. Summaries in En, Es.) Agronomie Tropicale 35(2):183-188.
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Proceedings with independent title

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C. *Physiology/Microbiology*

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32. Drought screening
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37. Temperature tolerance

D. *Pathology*

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42. Aflatoxin
43. Bacterial diseases
44. Nematodes
45. Deficiency and toxicity diseases
46. Foliar diseases
47. Pod and soilborne diseases
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55. Transmission
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57. Sources of resistance
58. Integrated management
59. Surveys

F. *Entomology*

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72. Evaluation
73. Maintenance and conservation
74. Documentation

H. *Agronomy*

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84. Plant population
85. Rotations
86. Harvesting, seed technology, postharvest management
87. Irrigation and water management
88. Tolerance of adverse soils
89. Machinery

I. *Other*

91. Training
92. Extension
93. Library science/Information technology
94. Sociology or Anthropology
95. Other

ıation on Groundnut Cultivars in the World

ıltivars released in various parts of the world

Country: ________________ Cooperator's name and address: ____

S. No.	Cultivar name	Other identity[1]	Pedigree[2]	Breeding method followed[3]	Type[4]	Growth habit[5]	Other plant, pod, and seed characters[6]			Agronomic characters[7]	Area of adaptation[8]	Extent of culti-vation[9]	Year of release[10]	Breeders' name/ori-ginating center[11]
								Number of branches						
							Branching pattern	Primary	Secondary	Potential yield	Geogra-phical area			
							Leaf shape and color	Seeds/pod	Pod size	Time to maturity (days)	Season			
							Pod con-striction	Pod beak	Pod reticu-lation	Reaction to disease and insects	Soil type			
							Pod ridge	Pod shell thickness	Seed color		Annual rainfall			
							Seed size	Oil (%)	Protein (%)		Altitude			

Key for filling the proforma:

1. Other identity, such as PI number or EC number. e.g. PI 314187; UPL-Pn4; DHT 200.
2. State parentage (if it is cross derivative) e.g. NC 1 x C 12; Introduction (Cultivar Jacana - Introduction from USA as PI 262042); Reselection from an Introduction (e.g. cultivar M 13 - selection from NC 13 inroduced from the USA); Mutant (e.g. x-ray mutant of NC 13).
3. Pedigree method/bulk pedigree/single pod/seed descent, etc.
4. (a) Oil type, (b) Confectionery type, (c) Dual-purpose type.
5. (a) Spanish bunch, (b) Valencia bunch (c) Virginia bunch (d) Virginia runner.
6. (a) Branching pattern (Sequential/Alternate/Irregular); (b) Number of primary and secondary branches; (c) Leaf shape and color; (d) Seeds/pod (give the majority number first); (e) Pod size (small/medium/medium/large/very large); (f) Pod constriction (Absent/slight/moderate/deep/very deep); (g) Pod beak (Absent/slight/moderate/prominent/very prominent); (h) Reticulation (Smooth/slight/moderate/prominent); (i) Pod ridges (Absent/moderate/prominent) (j) Pod-shell thickness (Thin/medium/thick/very thick); (k) Seed color (Tan/pale tan/rose tan/purple/red/variegated); (l) Seed size (Small/medium/large); (m) Oil (%), (n) Protein (%).
7. Potential yield ($t\ ha^{-1}$); days to maturity; reaction to diseases and insects (Resistant/moderately resistant/susceptible).
8. Indicate the geographical area (e.g. state/province), season (rainy/postrainy/spring/autumn), soil type (Alfisol/Vertisol/acid soils/etc.); Annual rainfall (mm); Altitude (low/medium/high).
9. Area in ha under this variety presently grown by the farmers.
10. The year in which the cultivar is officially released in a country/province.
11. Originating center where the cultivar was developed and name of the breeder.

Note: Please use a separate sheet for each cultivar.