Strategies to Enhance Collaborative Research for Increased Production and Productivity of CLAN Mandate Crops 1997

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Strategies to Enhance Collaborative Research for Increased Production and Productivity of CLAN Mandate Crops 1997

Report of CLAN Country Coordinators' Steering Committee Meeting held during 24-28 Nov 1997 at Batu, Malang, Indonesia

Edited by

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and
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1998

Preface

The Country Coordinators' Meetings are now organized every year to encourage and facilitate increased interaction among CLAN Country Coordinators and to monitor the progress of collaborative research activities within and across the member countries.

The meeting is also useful in charting future course of action with appropriate changes if any. Summary of papers presented at the CLAN Country Coordinators' Steering Committee Meeting, 24-28 November 1997, Batu, Malang, Indonesia have been compiled for ready reference to the interested researchers and research administrators. The summary of discussions and minutes of the CLAN Steering Committee are also included.

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Welcome Address

Suyamto
Director, Research Institute for Legumes and Tuber Crops
Malang 65101, Indonesia

Distinguished guests, ladies and gentlemen;

The Cereals and Legumes Asia Network (CLAN) Country Coordinators' Steering Committee Meeting held in Bangkok in 1996 had decided that Indonesia will host the next Steering Committee Meeting in 1997. The Research Institute for Legumes and Tuber Crops (RILET) of the Central Research Institute for Food Crops (CRIFC) is glad to host this meeting. On behalf of the organizing committee, I extend our warm welcome to all of you to the fourth CLAN Country Coordinators' Steering Committee Meeting.

The objectives of this meeting are to evaluate the network related activities within each member country; to share ideas, information, and experiences; and to provide guidance to the CLAN Coordinator for future network activities.

All participants will move to Malang City on 28 Nov 1997 giving opportunity to see RILET, Malang and Muneng Research Station. I am confident that we will have enough time for intensive discussions and mutual interactions.

We preferred to hold this meeting in Batu, a small town away from the busy Malang city, to enable participants to have enough time for individual and group discussions.

As you all know, Indonesia has been a member country of CLAN since 1992, and had been involved actively in many collaborative activities with ICRISAT since 1986. Indonesia has benefited from the network. Some varieties of legumes, such as "Zebra" in groundnut and "Mega" in pigeonpea have been released for general cultivation. In addition, some of the collaborative research results have been published. One of them containing research results of 1994-97 will be distributed to all of you during this meeting.

I take this opportunity to extend our thanks to the Director of CRIFC, the representative of ICRISAT; Director General and the CLAN Coordinator for attending this meeting. I also wish to acknowledge the Asian Development Bank for sponsoring this meeting.

Please let us know if we could be of any assistance to you during this meeting, to make your stay enjoyable and this meeting a success. We apologize for any inconveniences and deficiencies.

I wish you all an enjoyable stay with us in Batu-Malang, and a very successful meeting.

Thank you.

Opening Remarks

S Parthasarathy
Assistant Director General, ICRISAT
Patancheru 502 324, Andhra Pradesh, India

It gives me great pleasure to welcome you all to this meeting, on my behalf and that of Director General and the Associate Director General-Research of ICRISAT. Both of them have asked me to convey their best wishes to all of you, and for the successful deliberations of this meeting. I thank Dr. A. M. Fagi, Director, Central Research Institute for Food Crops, Indonesia, for agreeing to host and co-sponsor this meeting, and Dr. Suyamto and his staff for making all the arrangements for the meeting. I would also like to acknowledge the support of the Asian Development Bank in co-sponsoring this meeting.

This is the fourth Steering Committee Meeting of the Cereals and Legumes Asia Network (CLAN). I understand that these meetings have been a good opportunity to review network activities and exchange views among the country coordinators. I earnestly hope that this meeting too will provide the necessary guidance and advice to the CLAN Coordinator.

The objectives of the meeting are to

- Review generic research activities within each country, and the region, for increased complementarities and a cost-effective research agenda;
- Review and suggest ways to improve effective exchange of genetic material, technology, and information among network member countries, and human resource development activities;
- Assess interactions and linkages of CLAN with regional and international institutions and NGOs with similar interests and/or activities in research and development, and explore opportunities to forge closer links with other networks operating in the region; and
- Provide guidelines for future network activities to enhance close cooperation among the members for increased productivity, production and natural resource management of CLAN priority crops in the region.

Changes at ICRISAT

As you are aware, Dr. Shawki M. Barghouti joined as the new Director General of ICRISAT in September 1997. The process of appointing a new Deputy Director General-Research is underway, and we expect the incumbent to join in the early part of 1998.

ICRISAT completed 25 years of dedicated service to the farmers of the semi-arid tropics in July this year. We organized the Silver Jubilee Celebrations on 17th and 18th November, starting with a Workshop on "ICRISAT in the 21st Century: Towards sustainable food security".

ICRISAT Research 'Priorities for 1998-2000

At the last Steering Committee Meeting in Bangkok, Thailand, I spoke of the preparation of the ICRISAT Medium Term Plan (MTP) for 1998-2000. During the preparation of MTP, extensive consultations were held with the national agricultural research systems (NARS), non-governmental organizations (NGO), and other stakeholders. ICRISAT will work in partnership with national and regional organizations, in which each partner contributes according to their expertise and mandate. ICRISAT will concentrate on basic and strategic research and provide broadly-acceptable international public goods, while its regional and network partners will be involved in applied and adaptive research to provide final products (adapted varieties and technologies) which will help improve the lives of the farming community in the semi-arid tropics. The major targets for MTP - prosperity, inclusiveness, diversity, and environment - will continue to drive our research agenda.

Restructuring of Global Research Projects

As you know from earlier communications, ICRISAT has 12 research projects. These include five commodity projects (sorghum, pearl millet, chickpea, pigeonpea, and groundnut), one project on crop genetic resources, four systems projects, and two economics projects (one concerned with impact assessment, and the other addressing markets and policy). Research partnership with NARS in both developing and developed countries is an integral part of all the projects.

From 1998 onwards, we will have further consolidation of projects in to three research program areas: Genetic Resources and Enhancement, Natural Resource Management, and Socioeconomics and Policy. There will also be consolidation of research efforts of different locations in Africa and Asia. We also envisage greater emphasis on natural resource management to balance the commodity-oriented research. It is expected that the future research agenda of ICRISAT will extend along the full continuum of strategic/applied/adaptive research, in partnership with NARS.

Given the current resource crunch, ICRISAT's emphasis will be on doing more with less, and become even more efficient in the delivery of research products. There will be enhanced Visiting Scientist arrangements, and development of joint funding proposals to harness all available resources. We, therefore, seek your support and guidance in furthering the joint cause of agricultural research for the SAT farmers.

I wish you all a pleasant stay and fruitful discussions during the next four days.

Thank you.

Keynote Address

A M Fagi
Director, Central Research Institute for Food Crops
Bogor 16111, Indonesia

Distinguished Steering Committee Members and Guests;

It is a great honor for the Research Institute for Legumes and Tuber Crops (RILET) of the Central Research Institute for Food Crops (CRIFC) to host the fourth CLAN Country Coordinators' Steering Committee Meeting. On behalf of the Agency for Agricultural Research and Development, Government of Indonesia, I would like to extend my warm welcome to you.

I, personally, have been involved in several international research networks and research consortium, but CLAN is the largest, consisting of twelve countries (Bangladesh, China, India, Indonesia, Iran, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam). This reflects the importance of CLAN priority crops - groundnut, sorghum, pigeonpea, chickpea and pearl millet - for most of the participating countries.

RILET established collaboration with ICRISAT since 1986 through the erstwhile Asian Grain Legumes Network (AGLN) and now CLAN. Several achievements have been possible:

- research related to peanut stripe virus (PStV) has resulted in initiation of a project for transgenic groundnuts with resistance to PStV,
- improved variety of groundnut 'Zebra' and pigeonpea 'Mega' were released,
- improved groundnut production technology developed through on-farm research was further adopted by CRIFC and expanded to wider area in east and west Jawa,
- research capability of some junior scientists was improved through training in ICRISAT, and
- exchange of information has been improved and strengthened.

At present, RILET uses breeding lines of groundnut with high protein content introduced from ICRISAT, in a breeding program for low fat content. Low fat content in groundnut seed is required for the European market. A private company "Kacang Garuda" may join this breeding program in later stages.

Breeding lines/varieties of pigeonpea from ICRISAT have high yielding potential, but are susceptible to insects and diseases. Attention has to be paid to improve these breeding lines/varieties for resistance to insects and diseases.

Research Institute for Maize and Other Cereals (RIMOC), a sister institute of RILET located in Maros, South Sulawesi, is responsible for sorghum research. Sorghum has recently received particular attention because of its tolerance to drought and its potential for animal feed. CLAN has involved RIMOC for testing forage sorghum and sweet sorghum breeding materials in the drought prone areas in eastern Indonesia.

I envisage that comprehensive subjects will be discussed in this 4-day meeting, and most attention is expected to be on interaction and linkages with regional and international institutions. It is the responsibility of each participating country to solve the problems of CLAN priority crops through joint research efforts, and multilateral research arrangements.

The CLAN priority crops address the needs of poor people in the harsh semi-arid regions of Asia. Yet, support from donor community to the International Agricultural Research Centers (IARCs) has been decreasing annually. Donors are putting more emphasis on environmental protection and natural resource management and giving low priority to agriculture and production. This will affect funds for CLAN activities too. Obviously, there is a need to reverse the trend of declining donor support for research on CLAN priority crops. It is time that participating countries begin supporting CLAN more than ever before. Scientists have a responsibility to enlighten the donors to provide increased funding to CLAN.

In closing I stress the need for better interaction among participating countries. The future activities of CLAN may be focused more on strategic research and quick-yielding research. Hope that this meeting will be successful and fruitful.

I declare this workshop officially opened. Thank you.

CLAN Coordinator's Report

C L L GOWDA
CLAN Coordination Unit, ICRISAT
Patancheru-502 324, A.P., India

Introduction

This is the fourth meeting of the Steering Committee since the Cereals and Legumes Asia Network (CLAN) was established in 1992. The funding crisis that I had mentioned at the 1996 meeting has continued for many International Agriculture Research Centers (IARC's) in 1997 also, and ICRISAT was one of the worst hit in the process. This has resulted in rationalization of staff and reduced funding to the project activities. However, networking and research partnerships have been given prominence. The funding situation in many of the national agricultural research systems (NARS) is no better. Many national governments have resorted to cutting the budget allocations to agricultural research and development (R&D), which may prove detrimental in the long-term. In comparison to 3.29% of agricultural GDP being invested in agriculture R&D by developed countries (e.g., Australia, Japan), the developing countries in Asia are investing only 0.39% of the agricultural GDP. This amount is very meager to sustain the R&D in developing countries and we should influence the policy makers to allocate more funds. There has been a perceptible shift in the research strategies of IARCs. IARCs are likely to concentrate more on basic and strategic research that will produce "international public goods". Applied and adaptive research will be undertaken in partnership with NARS, and IARCs will provide improved germplasm and early or advanced generation breeding materials. Therefore, the onus and burden of applied and adaptive research will be increasingly on the national programs. Under these scenarios networking and collaborative research assumes greater significance and importance to IARCs and NARS to assist each other and use the existing resources effectively and efficiently.

Actions taken on earlier recommendations:

- The Terms of Reference (ToR) for the CLAN Steering Committee were circulated to all Country Coordinators, after incorporating the comments/suggestions made in the last Steering Committee Meeting, 13-14 Nov 1997, Bangkok, Thailand.

- The Heads of the national programs were requested to nominate Deputy Country Coordinator for each country. We have received nominations from all countries, except Bangladesh. Some national programs have nominated two Deputy Coordinators. A complete list of Country/Deputy Country Coordinators is in Appendix 1.

- Germplasm exchange among member countries was initiated, involving China, Vietnam, Thailand, Pakistan, Sri Lanka, Nepal, and India. These exchanges were bilateral, without involving the Coordination Unit.

- Exchange of scientists' visits was at low key in 1997. Requests were received from Indonesia, Myanmar, Pakistan, Thailand and Vietnam. Some responses were received very late. The consolidated requests were sent to the Country Coordinators and/or to the Directors of concerned institutes of China, India, and Thailand in mid-September 1997. Responses were received from China and Thailand. We are still awaiting response from India. Concerned Country Coordinators/Directors of the institutes in China and Thailand have advised that since the cropping season is ending the visit can be arranged during the next season.

- A few national program scientists were provided with funding support to participate in conferences and workshops.

  - One scientist each from Bangladesh and Pakistan participated in the 2nd International Crop Science Congress, New Delhi, India, 18-22 November 1996.

  - Two scientists from India, and one from Pakistan participated in the 3rd International Food Legume Research Conference, Adelaide, Australia, 22-26 September 1997.
  - One scientist from China participated in International Bacterial Wilt Symposium, June 1997, Guadeloupe, France.

  - One scientist from India participated in the 13th International Plant Nutrient Colloquium, 13-19 September 1997, Tokyo, Japan.

- Two ICRISAT scientists visited the Crop Research Institute, Guangxi Academy of Agricultural Sciences, Nanning, China, during July 1997 to provide consultancy in groundnut research.

- A pamphlet on "CLAN Research Priorities", which contained research priorities for each country, was circulated to all country coordinators to identify common generic areas for bilateral research collaboration. Compiled list of generic areas indicating bilateral research interests were sent to all countries (Appendix 2).

- CLAN Coordinator participated in the following APAARI Meetings.

  - APAARI Expert Consultation on Research Priority Setting by NARS in the Asia-Pacific Region, and the APAARI General Assembly Meeting, 25-26 November 1996, New Delhi, India.

APAARI Expert Consultation on Management and Strengthening of Research Networks in the Asia-Pacific Region, and the Fourth APAARI Executive Committee Meeting, 19-21 October 1997, Karaj, Iran.

Presentations were made at both meetings on CLAN activities and achievements. APAARI appreciated the network for its effective linkages, human-resource development, information exchange and collaborative research activities. Discussions were held between APAARI, ICRISAT, and ICARDA with the International Fund for Agricultural Development (IFAD), Rome for supporting network activities. APAARI has endorsed its support and requested IFAD to fund CLAN in association with ICARDA and APAARI. We have been asked to submit a proposal by end of December 1997. I need your suggestions and input in developing the proposal.

- CLAN Coordinator participated in the Third International Food Legume Research Conference, 22-26 Sep 1997, Adelaide, Australia and presented a paper on "Trends in support of research and development of cool season food legumes in developing countries", co-authored by some of the Country Coordinators. The paper dealt with the status of food legumes R&D in developing countries, and suggestions for strengthening future R&D to enable the countries to meet the demand for pulses by the year 2010.

- The CLAN Country Coordinator also presented a paper on CLAN activities at the International Mungbean Workshop, 6-8 Oct 1997, New Delhi, India. The possibilities of integrating Mungbean Network for South Asia's activities with CLAN were discussed, but response from the Asian Vegetable Research and Development Centre (AVRDC) was not positive.

Activities during 1996-97

A summary of network work activities (October 1996 to September 1997) is given below. Details are given in the Tables.

Exchange of germplasm and breeding material

- ICRISAT's Genetic Resources Division scientists have supplied 2188 sorghum, 230 pearl millet, 5750 chickpea, 768 pigeonpea, 696 groundnut, and 297 minor millets germplasm accessions to different Asian countries (Table 1).

- The scientists of ICRISAT's Genetic Enhancement Division have supplied the following quantities of early- and advanced generation breeding lines, varieties, breeders seed, and other lines for use in different countries:

Crop	Breeding material				
	Trials & nurseries	Breeders' seed	Segregating populations	Advanced lines	Others
Sorghum	110	838	-	6739	30
Pearl Millet	70	274	-	5117	-
Chickpea	113	218	892	1416	-
Pigeonpea	2	908	-	288	3953
Groundnut	16	34	36	434	19
Total	**311**	**2272**	**928**	**13994**	**4002**

Details of the breeding material supplied in different crops are given in Table 2 to 6.

Review and Work Plan Meetings

The number of review and Work Plan Meetings conducted in 1997 were more than earlier years (Table 7). This is because, the cycle (once in 2 years) of reviews for many countries happened to fall in 1997. The meetings in Indonesia and Nepal were to review and update the previous work plan, while full-scale meetings were organized in other countries. The meetings were organized by the concerned Country Coordinators, and most of the concerned national program scientists and 2-5 ICRISAT scientists participated. Results of previous 1-2 years collaborative research were reviewed to evaluate the progress and need for further research. Research priorities were also updated. Based on the research and development needs of each country, work plans for the next 2-3 years were prepared.

Regional Workshops and Meetings

Because of the budgetary constraints in ICRISAT, very few workshops and meetings were organized during the reporting period (Table 8). Apart from the CLAN Country Coordinators' Steering Committee Meeting (Thailand), a Workshop on Joint Impact Assessment of NARS-ICRISAT Technologies in SAT was organized in 1996 (at ICRISAT-Patancheru). At the latter meeting, progress of the collaborative efforts on assessing impacts of NARS-ICRISAT technologies was evaluated, and plans made for next stage of studies. In August 1997, GIS specialists and scientists from Asian countries discussed the needs for harmonization of databases for GIS analysis of cropping systems to aid researchers in better-targeting of technology development. Another workshop in September 1997 assessed nematode problems in rice-wheat cropping systems, and prepared research plans to alleviate the problem.

Monitoring Tours and Surveys

Joint monitoring of network collaborative research was continued. Details are given in Table 9. A travelling workshop was organized to monitor collaborative chickpea trials at Hisar, Pantnagar, Gwalior, and Modipuram (India). Chickpea breeders from Bangladesh, India and Nepal selected breeding materials at these locations for use in their national breeding programs. A wrap-up meeting was held at ICRISAT-Patancheru to develop future collaborative breeding projects.

Working Groups

Proceedings of the Working Group meetings on Aflatoxin contamination in Groundnut (27-29 May 1996, Vietnam) and Botrytis Gray Mold (BGM) of Chickpea (15-17 April 1996, India) were published in 1997. Copies have been distributed to all the participants and interested scientists worldwide. The proceedings of the Working Group Meeting on Nitrogen Fixing Legumes of Asia (NiFLA) (20-24 Aug 1996, India) will be published by December 1997. A meeting to discuss "Management of Agricultural Drought: Agronomic and Genetic Options" was held on 23 November 1996 at New Delhi, India. Participating scientists have agreed on the drought screening techniques, and prepared plans for incorporating drought tolerance in to high yielding varieties. A meeting of the Asian sorghum scientists was held 18-21 Nov 1997 at Suphan Buri, Thailand, to review progress and prepare action plan for future research.

Activities of a few Working Groups were low key. This is because of the departure of a few ICRISAT scientists who were Technical Coordinators: Drs. M.P. Haware (BGM of Chickpea), V.K. Mehan (Bacterial wilt and Aflatoxin in Groundnut), and Laxman Singh (post-rainy season pigeonpea, and CMS in pigeonpea). On behalf of all the Working Group members and Country Coordinators, I would like to record our appreciation and gratitude to them for their leadership and service to the Working Groups. Considering the substantial staff reduction in ICRISAT, it has become essential to identify appropriate scientists from the national programs to be Technical Coordinators. We need your input and suggestions.

Human Resource Development

Enhancing capabilities of NARS scientists by providing needed training, for skill development and learning new techniques, continued with the help of the Training and Fellowships Program (TAFP) at ICRISAT. Five special training courses were organized during October 96 to September 1997 (Table 10). However, emphasis was on in-country training courses. Four in-country training courses (2 in Vietnam, 1 each in Nepal and Sri Lanka) on "Statistical Design and Analysis of Experimental Data", one course on on-farm research methodologies in Bangladesh, and another on groundnut production technologies in Indonesia, were organized. The latter training course had leading farmers, in addition to research and extension staff. A training course on quality control of nuclear polyhedrosis virus (NPV) was organized in India.

Details of individual training provided at ICRISAT are given in Table 11. This includes 14 visiting scholars, 16 research scholars, 8 in-service participants, and 8 apprentices. In addition, one entomologist from Pakistan went to Pasteur Institute, Paris, France (3 weeks in September 1997) for training in production and quality control of bio-insecticides, with special reference to use of B.t. genes.

Memorandum of Agreement (MoA) for conducting thesis research at ICRISAT was signed with the Institute of Post-Graduate Studies in Agriculture, Salna, Bangladesh and the Central University, Hyderabad, India. MoA with the Institute of Agriculture, Yezin, Myanmar is awaiting approval from Myanma authorities.

Equipment and Supplies

Computers and printers (in a few cases) were provided to Bangladesh, China, Indonesia, Nepal, Philippines, Thailand, and Vietnam. E-mail connection was provided to Field Crops Research and Development Institute, Maha Illuppallama, Sri Lanka. Laboratory and field supplies (not available in the country) were supplied to Myanmar, Nepal and Pakistan.

Scientists' Exchange

Exchange of visits by scientists from network member countries to ICRISAT and ICRISAT scientists to member countries continued. These exchange visits have provided opportunities for interaction and exchange of research results, information, and technologies among the scientists. During October 96 to September 97, 103 national program scientists spent 986 person-days participating in workshops, meetings and monitoring tours (Table 12). During the same period, ICRISAT scientists made 49 visits, and spent 405 person-days to participate in planning meetings, monitoring tours and consultancies.

Constraints and Problems in Network Activities

- There has been considerable improvement in communication with the Country Coordinators. Some responses are received late, leading to difficulties in logistic and other arrangements.

- Many Country Coordinators have supplied the results and data in time, but delayed or incomplete information from others has resulted in late submission of reports to ADB.

- Nomination of Deputy Country Coordinator seems to have helped in the communication/submission of reports in some countries. Other Country Coordinators may consider delegating responsibilities, as and when needed.

Conclusions

Overall, this has been a difficult year for network activities, due to reduced funding and staff at ICRISAT. I do not expect the situation to improve dramatically. This means that we must do more with less. More and more responsibilities need to be shouldered by network member countries. Future collaborative research will require joint proposals from a group of countries, or bilateral proposals for funds. ICRISAT recently worked with the Ministry of Agriculture and Rural Development, Vietnam to develop and submit a proposal to the European Union for funding groundnut research and development. CLAN Coordination Unit would be willing to assist in preparation and submission of such proposals to donors. I need your guidance and advice on the future of CLAN activities.

Table 1. ICRISAT germplasm material distributed to Asian countries during Oct 1996-Sep 1997

Country	No. of samples						
	Sorghum	Pearl millet	Chickpea	Pigeonpea	Groundnut	Minor millets	Total
Bangladesh	-	-	10	-	1	-	11
Bhutan	-	-	-	-	-	130	130
China	13	-	-	-	-	-	13
India	1993	225	5740	768	390	152	9268
Indonesia	-	-	-	-	5	-	5
Malaysia	-	5	-	-	-	-	5
Sri Lanka	15	-	-	-	-	15	30
Thailand	167	-	-	-	300	-	467
Total	**2188**	**230**	**5750**	**768**	**696**	**297**	**9929**

Table 2. Sorghum trials, and breeding material distributed to Asian countries, Oct 1996-Sep 1997.

Country	Nurseries and trials	Breeding material			
		Breeder seed	Advanced lines	Germplasm/ Other lines	Total
China	-	-	599	-	599
India	110	838	5212	28	6079
Indonesia	-	-	355	-	355
Myanmar	-	-	447	-	447
Thailand	-	-	1	1	2
Total	110	838	6739	29	7609

Table 3. Pearl millet trials, and breeding material distributed to Asian countries, Oct 1996-ep 1997.

Country	Nurseries and trials	Breeder seed	Breeding material: Breeding lines	Total
China			107	107
India	65	274	5000	5339
Pakistan	5		10	15
Total	70	274	5117	5461

Table 4. Chickpea breeding material supplied to Asian countries during Oct 1996-Sep 1997.

Country	Nurseries and trials	Breeding material: Segregating populations	Advanced lines	Released varieties	Total
Bangladesh	-	166	86	-	252
China	-	43	-	-	43
Japan	-	-	5	-	5
India	100	655	1260	218	2133
Myanmar	-	11	29	-	40
Nepal	-	17	33	-	50
Philippines	13	-	3	-	3
Total	113	892	1416	218	2526

Table 5. Pigeonpea breeding materials distributed to Asian countries during Oct 1996-Sep 1997.

Country	Trial sets	Breeding material			
		Released varieties	Advanced lines	Other lines	Total
Bangladesh	-	4	3	4	11
China	-	7	13	-	20
India	1	887	254	3955	5096
Myanmar	-	7	13	-	20
Sri Lanka	1	3	5	6	14
Total	2	908	288	3965	5161

Table 6. Groundnut breeding material distributed to Asian countries during Oct 1996-Sep 1997.

Country	Trials	Breeding material				
		Released varieties	Advanced lines	Other lines	Segregating population	Total
India	6	34	413	18	-	465
Indonesia	7	-	6		-	6
Iran	-	-	8	-	-	8
Myanmar	-	-	1	-	-	1
Nepal	3	-	2	-	-	2
Philippines	-	-	-	-	36	36
Vietnam	-	-	4	1	-	5
Total	16	34	434	19	36	523

Table 7. Review and Work Plan Meetings held in CLAN Member countries during Oct 1996-Sep. 1997

Country	Dates	Place
1997		
Indonesia[1]	24-25 Feb	Malang, Indonesia
Thailand	27 Feb	Bangkok, Thailand
Philippines	17 Mar	Los Banos, Philippines
Sri Lanka	3-4 Jul	Gannoruwa, Sri Lanka
Nepal[1]	7-8 Jul	Kathmandu, Nepal
China	24-25 Jul	Beijing, China
Vietnam	28-29 Jul	Hanoi, Vietnam
Pakistan	5-6 Aug	Islamabad, Pakistan
Bangladesh	13-14 Aug	Joydebpur, Bangladesh

[1] Meetings in these countries were only follow-up reviews

Table 8. Regional Workshops and Meetings in Asia during Oct 1996 to Sep 1997.

1996

1. CLAN Country Coordinators' Steering Committee Meeting, 13-14 Nov, 1966, Bangkok, Thailand.

2. Workshop on Joint Impact Assessment of NARS-ICRISAT Technologies in the Semi-Arid Tropics, 2-4 December 1966, ICRISAT, Patancheru, India.

1997

1. Workshop on Harmonization of Databases for GIS Analysis of Cropping Systems in the Asia Region, 18-19 Aug 1997, ICRISAT, Patancheru, India.

2. Regional Training Workshop on Nematode Pests in Rice-Wheat-Legume Cropping systems, 1-5 Sep 1997, CCS Haryana Agricultural University (HAU), Hisar, India.

Table 9. Monitoring Tours, Surveys, and Visits during Oct 1996 to Sep 1997.

1996

- Monitoring of collaborative field experiment on cropping systems in Myanmar, 26 Oct-4 Nov 1996.

- Visit to collaborative chickpea research and development programs in Bangladesh, 11-22 Nov. 1966.

1997

- Monitoring of *Maha* season pigeonpea on-farm trials, 28-31 Jan 1997, Sri Lanka.

- Visit to collaborative research activities and development programs, 9-16 Mar 1997, Myanmar.

- Monitoring of collaborative chickpea and groundnut research and development programs, 13-16 Mar 1977, Bangladesh.

- Monitoring of chickpea and pigeonpea collaborative on-station and on-farm trials, 7-10 Mar 1977, Nepal.

- Travelling workshop to monitor collaborative chickpea field trials at Hisar, Pantnagar, Gwalior, and Modipuram (India), 1-7 Apr 1997.

- Monitoring of collaborative chickpea and pigeonpea nutrient management trial in Nepal, 1-5 Apr 1997.

- Monitoring of collaborative research on integrated nutrient management and sustainable cropping systems in Myanmar, 26 May-15 Jun 1997.

- Monitoring of *Yala* season pigeonpea collaborative trials in Sri Lanka, 28-31 Jun 1997

Table 10. Regional and In-country Training Programs conducted during Oct 1996 to Sep 1997.

Regional Training Courses

1996

1. Training Workshop on Modeling Management Effects on Resource Conservation and Use in Semi-Arid Tropics, 25-29 Nov. 1966, ICRISAT, Patancheru, India
2. Regional Training Course on Diagnosis of Key Nematode Pests of Chickpea and Pigeonpea and their Management, 25-30 Nov 1996, ICRISAT, Patancheru, India.
3. Modeling drought resistance traits in groundnut using PARCH-Nut, 11-14 Dec 1996, ICRISAT, Patancheru, India.

1997

4. Training Workshop on Technology Exchange on Advances in Pearl Millet Downy Mildew Research, 6-8 Aug 1997, ICRISAT, Patancheru, India.
5. Training program on Use of GIS in Analysis of Cropping Systems, 18-28 Aug 1997, ICRISAT, Patancheru, India.

No. of participants : Bangladesh (1), India (6), Nepal (4) and Sri Lanka (1)

In-country Training

1. In-country training course on statistical design and analysis of experiments, 16-28 Dec 1996, Hanoi, Vietnam
   Total participants : 20
2. In-country Training Course on Computer-aided Experimental design and Data Analysis, 30 Dec 96 - 5 Jan 97, Ho Chi Minh City, Vietnam.
   Total participants : 18
3. Training Course on Quality Control in Insect Nuclear Polyhedrosis Virus Production, 28-31 Jan 1997, ICRISAT, Patancheru, India.
   Total participants : 11 (all from India)
4. In-country Training Course on On-farm Research Methodologies, 10-12 Mar 1997, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Bangladesh.
   Total participants : 25
5. In-country Training Course on Statistical Design and Analysis of Experiments, 30 Mar-9 Apr 1997, Parwanipur, Nepal.
   Total participants : 16
6. Experimental design and data analysis, 26 May-6 Jun 1997, In-service Training Institute, Gannoruwa, Sri Lanka.
   Total Participants: 25
7. In-country Training Course on Statistical Analysis and Design of Experiments in Sri Lanka, 26 May-06 Jun 1997, Sri Lanka.
   Total participants : 25
8. In-country Training Program on Groundnut Production Technology, 26-27 Aug 1997, Malang, Indonesia.
   Total participants : 26

Table 11. Human resource development activities involving scientists from CLAN countries during Oct 1996 to Sep 1997.

Country	Visiting Scholars	Research Scholars	In-Service Participants	Apprentices	Total
China	1	-	-	-	1
India	6	14	-	8	28
Iran	1	-	-	-	1
Myanmar	1	1	-	-	2
Nepal	-	-	4	-	4
Sri Lanka	3	1	3	-	7
Thailand	1	-	-	-	1
Vietnam	1	-	1	-	2
Total	**14**	**16**	**8**	**8**	**46**

Table 12. Travel and visits of scientists associated with network activities during Oct 1996-Sep 1997.

Country	Visits by NARS scientists to ICRISAT or ICRISAT-supported Meetings/Workshops			Visits by ICRISAT scientists to Asian countries (other than India)		
	No. of visits	No. of scientists	No.of person days	No. of visits	No. of scientists	No. of person days
Bangladesh	5	5	35	6	4	30
China	-	-	-	8	6	40
India	10	79	343	-	-	-
Indonesia	1	1	10	2	2	16
Iran	1	1	8	1	1	10
Myanmar	1	1	6	2	2	48
Nepal	6	8	66	8	10	105
Pakistan	1	1	6	2	2	8
Philippines	-	-	-	2	2	18
Sri Lanka	4	4	26	10	6	98
Thailand	1	2	10	2	2	12
Vietnam	1	1	5	6	4	20
Total	**57**	**113**	**986**	**49**	**-**	**405**

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Generic Areas for Research Collaboration Among the CLAN Member Countries

Bangladesh[1]

Groundnut

- Develop appropriate cultural practices and genetic resistance to fungal infection/aflatoxin contamination (**China, India, Vietnam**)
- Develop short-duration varieties with resistance to abiotic (chlorosis, drought and acid soils) and biotic (early and late leaf spots, rust, jassids and white grub) stresses with limited seed dormancy (**China, Indonesia, India, Myanmar, Nepal, Pakistan, Philippines, Thailand, and Vietnam**).
- Collection, evaluation, and documentation of germplasm (**Thailand and Indonesia**)
- Evaluate management practices for control of aflatoxin contamination (**Vietnam**)

Pigeonpea

- Evaluate grain and vegetable-type pigeonpea varieties with earliness, high yield and high biomass production (**China**).
- Incorporate resistances to diseases--sterility mosaic, fusarium wilt and stem canker, and to insects *Helicoverpa* pod borer and pod fly (**India and Myanmar**).
- Collection and documentation of local germplasm (**Indonesia**).
- High-yielding (large seeded) short-, and medium-duration pigeonpea for different cropping systems for green peas and dry seeds (**Philippines**).

Chickpea

- Develop short-, medium-, and long-duration cultivars *(desi and kabuli)with* high yield and stability, and large seed size (**India and Nepal**).
- Develop varieties suitable for late sowing, and as relay, or after harvest of rice (**India, Myanmar, and Nepal**).
- Develop appropriate management practices to minimise botrytis gray mold incidence (**India, Myanmar, and Nepal**).
- Develop varieties with resistance to abiotic stresses drought, cold, heat, and salinity (**India, Myanmar, Nepal, and Pakistan**).
- Short-duration, wilt, root rot and Helicoverpa resistant *desi and kabuli* types (**Myanmar and Nepal**).
- On-farm adaptive trials to tailor existing technology to farmers' needs and to offer a basket of technology options (**Myanmar and Nepal**).
- Management of moisture and nutrients in heavy paddy soils (**Myanmar**).

[1] The listing gives generic areas identified by the country for bilateral/multilateral collaborative research with the country/countries listed in parenthesis.

- Exchange of germplasm and breeding material (**Pakistan**).
- Sustainability of chickpea cropping systems through BNF (**Pakistan**).

China

Pigeonpea

- Evaluate short- and medium-duration lines for intercropping (**Bangladesh**).

Iran

Chickpea

- Collection, evaluation, and documentation of germplasm (**Bangladesh**).
- Incorporate resistance to diseases--root rot, fusarium wilt and aschochyta blight (**China**).
- Develop short-, medium-, and long-duration cultivars *(desi and kabuli)* with high yield and stability, and large seed size (**China, India and Nepal**).
- On-farm adaptive trials (**Nepal**).

Groundnut

- Short- and medium-duration, drought tolerant material with limited seed dormancy and high yield (**Bangladesh and Nepal**).
- Develop cultivars with high yield, good seed quality and resistance to pests, diseases, and nematodes (**China**).
- Develop appropriate cultural management and genetic resistance to fungal infection/aflatoxin contamination (**China**).
- Identify genotypes adapted to spring (Feb) planting (**Nepal**).

Sorghum

- Develop multicut forage hybrids (**India**).
- Develop early-maturing dual-purpose hybrids for rainy *(Kharif)* season (**India**).
- Develop high-yielding dual -purpose varieties for rainfed and irrigated conditions (**Pakistan**).
- Develop early-maturing varieties for increasing cropping intensity and drought escape (**Pakistan**).

Pigeonpea

- High yielding (large seeded) short-, medium- and long,-duration pigeonpea for different cropping systems (**Myanmar**).

Pearl millet

- Varieties with higher fodder yield, lodging tolerance and better fodder quality (Myanmar). Develop high yielding dual-purpose varieties (**Pakistan**).
- Develop early-maturing varieties (**Pakistan**).
  Develop improved production technologies (**Pakistan**).

India

Chickpea

- Develop and identify short- and medium-duration *desi and kabuli* types with high yield and stability, and large seed size and incorporate resistance to root rot, wilt, aschochyta, blight, and botrytis gray mold (**Bangladesh, China, Nepal, and Pakistan**).
- Develop varieties suitable for sowing as relay, or after rice harvest (**Bangladesh**).
- Management of moisture and nutrients in heavy paddy soils (**Bangladesh and Myanmar**).
- Short-duration, wilt, root rot and Helicoverpa resistant desi and kabuli types (**Myanmar, Nepal, and Pakistan**).
- On-farm adaptive trials to tailor existing technology to farmers' needs and to offer a basket of technology options (**Nepal**).
- Exchange of germplasm and breeding material (**Pakistan**).
- Sustainability of chickpea cropping systems through BNF (Pakistan).

Groundnut

- Short- and medium-duration, drought tolerant material with limited seed dormancy and high yield (**Bangladesh and Myanmar**).
- Develop cultivars with high yield, good seed quality and resistance to pests, diseases, and nematodes (**China**).
- Conduct research and exchange of information on management of white grubs, *Spodoptera litura*, and other noctuidae and Harry caterpillars (**China**).
- Develop confectionery varieties of appropriate maturity for irrigated and high-input areas (**Indonesia, Sri Lanka, and Thailand**).
- Identify genotypes adapted to spring (Feb) planting (**Nepal**).
- Explore the potential of inter- and mixed-cropping with cereals, especially with maize (**Nepal**).
- Develop short-duration (125-130 days), terminal drought resistant lines with bold seeds (confectionery use) for late Jun- early Jul planting (**Pakistan**).
- Enhancement of the fodder component of the crop (**Pakistan**).
- Management of crop to reduce aflatoxin contamination (**Sri Lanka and Vietnam**)

Pigeonpea

- Evaluation of perennial and long-duration types for agroforestry systems in *Barind* region (Bangladesh).
- Evaluate short- and medium-duration lines for intercropping. (**Bangladesh, Myanmar, Nepal, Sri Lanka, Thailand, and Vietnam**).
- Evaluate grain and vegetable type pigeonpea varieties with earliness, high yield and high biomass production (**China**)
- Collection and documentation of local germplasm (Indonesia and Thailand).
- Insect pest management including resistance to Helicoverpa, Maruca, and Podfly (**Myanmar and Sri Lanka**).
- Identify medium- and long-duration cultivars with large seed, high and stable yield for rainy season planting. (**Nepal**).
- Identify extra short-duration, high yielding cultivars with large seed for rainy season, short- and medium-duration lines for postrainy season plantings (**Nepal and Sri Lanka**).

Sorghum

- Collection and documentation of local germlasm (**China**).
- Develop short-duration grain and dual purpose and forage types with high yield (**China, Indonesia, and Thailand**).
- Research on drought, shoot pests and grain mold (**China, Indonesia, Myanmar, Vietnam**).
- Develop sweet sorghum for sugar industry (**Indonesia**).
- Dual purpose varieties with medium-maturity (100-110 days) and good fodder storage quality, suited for intercropping. with pigeonpea and groundnut (**Myanmar, Philippines, and Vietnam**).
- Develop sorghum x sudan grass hybrids (**Pakistan**).
- On-farm research to meet identified needs and develop technology appropriate for farmers' needs (**Vietnam**).

Pearl millet

- Varieties with higher fodder yield, ratooning ability, lodging tolerance and better fodder quality (**Myanmar**).
- Varieties suited to intercropping with groundnut and other legumes (Myanmar).
- Develop high yielding, early-maturing, dual purpose varieties (**Pakistan**).
- Develop varieties with good stand establishment in high temperature conditions (**Pakistan**).
- Develop improved production technologies (**Pakistan**).
- Collection, evaluation, characterization and conservation of germplasm (**Pakistan**).
- Evaluation of germplasm of advanced composites and open pollinated varieties to select materials with early-maturity and terminal drought tolerance (**Thailand**).

Indonesia

No specific areas mentioned

Myanmar

Groundnut

- Short- and medium-duration, drought tolerant material with limited seed dormancy and high yield (**Bangladesh**).
- Technology evaluation in farmers' fields to obtain maximum pod yield of groundnut (**Bangladesh**).
- Develop cultivars with high yield, good seed quality and resistance to pests,, diseases and nematodes (**China and India**).
- Develop appropriate cultural management and genetic, resistance to fungal infection/aflatoxin contamination (**China and India**).
- Develop varieties resistant or tolerant to abiotic stresses such as drought, cold, shade, and acid soils (**India**).

Sorghum

- Develop short-duration grain and dual purpose and forage types with high yield (**China**).

Chickpea

- Develop short-, medium-and long-duration cultivars *(desi and kabuli)* with high yield and stability, and large seed size (**India and China**).

Pigeonpea

- Identify extra short-, and short-duration, high yielding cultivars with large seed for rainy season and short-.and medium-duration lines for postrainy season (**India**).

Natural Resource Management

- Characterise production systems in terms of abiotic and biotic stresses, using GIS wherever possible (**India**).

Nepal

Chickpea

- Collection, evaluation, and documentation of germplasm (**Bangladesh and Pakistan**).
- Develop varieties suitable for sowing as relay, or, after harvest of rice (**Bangladesh and India**).
- Develop short-, medium-, and long-duration cultivars (desi and kabuli) with high yield and stability, and large seed size (**India, China, and Myanmar**).

- Incorporate resistance to diseases (aschochyta blight, botrytis gray mold, fusarium wilt, and root rot) and to Helicoverpa pod borer (**India, Myanmar, and Pakistan**).
- Develop appropriate management practices to minimise BGM incidence (**India**).
- Develop varieties with resistance to abiotic stresses--drought, cold and salinity (**India**).

Groundnut

- Short- and medium-duration, drought tolerant material with limited seed dormancy and high yield (**Bangladesh**).
- Screen for and incorporate resistance to diseases-early leaf spot, late leaf spot and rust (**Bangladesh and India**).
- Develop cultivars wit high yield, good seed quality and resistance to pests, diseases, and nematodes (**China and India**).
- Develop early-maturing varieties suitable for areas where growing season is short, end of season droughts are frequent, and in rice-based cropping systems with residual moisture (**India**).
- Develop confectionery varieties of appropriate maturity for irrigated and high input areas (**Indonesia, Pakistan, and Sri Lanka**).

Pigeonpea

- Evaluate short- and medium-duration lines for intercropping (**Bangladesh and Sri Lanka**).
- Evaluate grain and vegetable type pigeonpea varieties with earliness, hi-h, yield, and high biomass production (**China**).
- Identify medium- and long-duration cultivars with large seed, high and stable yield for rainy season (**India**)
- Identify extra short- and short-duration, high yielding, cultivars with large seed for rainy season and short- and medium-duration lines for post-rainy season (**India**).
- Incorporate resistances to diseases- sterility mosaic, fusarium wilt and stem canker, and to insects *Helicoverpa* pod borer and pod fly (**India and Myanmar**).
- Develop IPM practices of *Helicoverpa and Maruca* pod borers (**India**).

Sorghum

- Collection and documentation of local germplasm (**China**).

Pakistan

Chickpea

- Collection, evaluation, and documentation of germplasm (**Bangladesh**).
- dentify short- and medium-duration kabuli types with high yield and stability, and large seed size and incorporate resistance to root rot, and wilt (**Bangladesh and India**).
- Management of moisture and nutrients in heavy paddy soils (**Bangladesh**).
- Incorporate resistance to diseases (aschochyta blight, BGM, fusarium wilt, and root rot) and Helicoverpa pod borer (**India**)
- Develop varieties with resistance to abiotic stresses-- drought, cold, and salinity (**India**)

Groundnut

- Short- and medium-duration, drought tolerant material with limited seed dormancy and high yield (**Bangladesh and Myanmar**).
- Develop appropriate cultural management and genetic resistance to fungal infection/aflatoxin contamination (**China and Vietnam**).
- Develop early maturing varieties suitable for areas where -rowing season is short, end of season droughts are frequent, and rice-based cropping systems with residual moisture (**India**).
- Design and develop suitable implements for farm operations such as sowing and digging (**India**).
- Collection, and documentation of germplasm (**Indonesia**).
- Develop short-duration varieties with resistance to abiotic (chlorosis, drought and acid soils) and abiotic (bacterial wilt, early and late leaf spots, rust, and gussets) stresses (**India and Philippines**).
- On-farm adaptive research to develop technologies for sustained increase in production (**India**).
- Improve seed production and distribution system for groundnut (**Philippines**).
- Develop IPM techniques (including pests and diseases) (**Vietnam**).

Pigeonpea

- Identify extra short-and short-duration, high yielding cultivars with large seed for rainy season and short- and medium-duration lines for postrainy season (**India**).
- Incorporate resistances to diseases--sterility mosaic, fusarium wilt, and stem canker, and to insects Helicoverpa pod borer and pod fly (**India**).

Sorghum

Develop short-duration grain, dual purpose and forage types with high grain yield (**China**).

- Research on drought, shoot pests and forage sorghum (**China**).
- Develop multicut forage hybrids (**India**).
- Develop early maturing dual purpose hybrids for kharif (**India**).
- Develop collaborative population improvement program of short-duration sorghum with tolerance/resistance to diseases-- grain molds and downy mildew in rainy season, and ergot and charcoal rot during postrainy season and pests-- shoot fly, stem borer, midge, ear head bug, shoot bug and ear head worms (**India**).
- Research directed to overcome the yield plateau, and identify resistance factors in good agronomic background (**India**).

Pearl millet

- Develop high yielding dual purpose varieties and hybrids (**India**).
- Screening for varieties with good stand establishment in high temperature conditions (**India**).
- Screening of germplasm and breeding material for resistance to biotic (downy mildew and ergot) and abiotic (drought, heat, salinity) stresses (**India**).
- Research on understanding mechanisms of, and development of screening techniques for, identifying resistances to drought and heat stresses (**India**).

Natural Resource Management

- Characterise production systems in terms of abiotic and biotic stresses, using GIS, wherever possible (**India**).
- Systems research on soil erosion, nutrients, and cropping systems (**India**).
- Model water balance in traditional and improved systems to explore options for increased resource use efficiency and improved management (**India**).

Socioeconomics

- Impact assessment of improved genotypes (**India**)
- Sustainability issues in both low-input and high-input agriculture (**India**).

Sri Lanka

Chickpea

- Develop and identify short- and medium-duration desi *and kabuli* types with high yield and stability, and large seed size and incorporate resistance to root rot, and wilt (**Bangladesh**).

Groundnut

- Short- and medium-duration, drought. tolerant material with limited seed dormancy and high yield (**Bangladesh and,Myanmar**).
- Screen for and incorporate resistance to diseases-- early leaf spot late leaf spot, and rust (**Bangladesh and India**).
- Develop cultivars with high yield, good seed quality, and resistance to pests, diseases, and nematodes (**China**).
- Develop early-maturing varieties suitable for areas where growing season is short, end of season droughts are frequent, and in rice-bases cropping systems with residual moisture (**India**).
- Develop varieties resistant to *Aspergillus flavus* infection and aflatoxin contamination (**India**).
- Research on methods of ensuring seed viability especially in summer season crop (**India**).
- Management of diseases and pests including resistance to late leaf spot, leaf miner, gussets, thrips, and white grub (**Myanmar and Nepal**).
- Explore the potential for inter and mixed cropping with cereals especially with maize (**Nepal**)
- Develop short-duration (125-130 days), terminal drought resistant lines with bold seeds (for confectionery use) for late Jun-Jul sowings (**Pakistan**).
- Develop high yielding short-duration varieties with appropriate disease and pest resistance (**Philippines and Thailand**).
- Identify short- and medium-duration, and confectionery type cultivars with high yield potential (**Vietnam**).
- Evaluate management practices for control of aflatoxin contamination (**Vietnam**).
- Develop IPM techniques (including pests and diseases) (**Vietnam**).

Pigeonpea

- Develop IPM practices for Helicoverpa and Maruca pod borers (**India and Myanmar**).
- Evaluate pigeonpea for intercropping with cereals and legumes (**Nepal and Vietnam**).

Thailand

Groundnut

- Develop cultivars with high-yield, good seed quality and resistance to pests, diseases, and nematodes (**China**).
- Develop early-maturing varieties suitable for areas where growing season is short, end season droughts are frequent, and in rice-based cropping systems with residual moisture (**India**).

- Develop confectionery varieties of appropriate maturity for irrigated and high-input areas (**Indonesia and Vietnam**).
- On-farm adaptive research to develop technologies for sustained increase in production (**Indonesia**).
- Varieties resistant to leaf diseases and bud necrosis (**Sri Lanka**).

Sorghum

- Develop short-duration grain, dual purpose and forage types with high yield (**China and Pakistan**).
- Research on drought, shoot pests and forage sorghum (**China and Indonesia**).
- Develop collaborative population improvement program of short-duration sorghum with tolerance/ resistance to diseases--grain molds and downy mildew in rainy season, and ergot and charcoal rot during postrainy season and pests-- shoot fly, stem borer, midge, ear head bug, and ear head worms (**India**).
- Alternative uses of grain and stalks (**India, Indonesia, and Philippines**).
- Develop sweet sorghum for sugar industry (**Indonesia**).
- Conduct adaptive on-farm research to meet identified needs and develop technology appropriate for farmers' needs (**Vietnam**).

Vietnam

- Develop integrated suitable production systems with the participation of farmers (**all countries**)

Collaborative Research in Bangladesh: Needs and Opportunities

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Introduction

The collaborative research activities between Bangladesh Agricultural Research Institute (BARI) and The International Crop Research Institute for Semi-Arid Tropics (ICRISAT) began in 1978, primarily with chickpea. The linkage continued and extended to groundnut and pigeonpea in 1982. Research and technology exchange activities expanded under the Asian Grain Legumes Network (AGLN) from 1986, and later with the Cereals and Legumes Asia Network (CLAN) since 1992.

Research Activities and Achievements

Chickpea

Chickpea ranks third among grain legumes in Bangladesh, covering 13% the total pulses area and production. It is grown in either upland rice/jute/fallow- chickpea or transplanted *aman* rice- chickpea cropping systems.

The Pulses Research Centre (PRC),BARI has been receiving germplasm, segregating populations, and advanced lines from ICRISAT on a regular basis. From these materials, PRC has developed and released six chickpea varieties. Because of unstable chickpea yields in the traditional areas, emphasis was given to extend chickpea cultivation in the north-western areas of Bangladesh called Barind where fields are left fallow after rainy season rice cultivation. BARI-ICRISAT Collaborative Program has developed suitable technology for growing chickpea in Barind area successfully after rainy season rice. The long-duration local rice variety has been replaced by a short-duration high yielding BRRI-Dhan 32 rice variety to ensure early sowing and establishment of optimum plant stand of chickpea. This has resulted in expansion of chickpea area from zero to 10,000 ha with new varieties.

Areas for future collaborative research with CLAN

- Germplasm screening against botrytis gray mold (BGM) disease for developing resistant varieties,
- Develop cultivars that can emerge under limited soil moisture situations, and
- Develop cultivars with limited vegetative growth in excess soil moisture conditions.

Groundnut

Groundnut ranks third among the oilseed crops. However, the entire produce is used locally as roasted nut and in the confectioneries. The present area is about 20,000 ha with mean yield of 1.4 t ha^{-1}. The crop has good potential and is expanding rapidly in the river basin areas where short duration varieties (<125 days) can be grown without irrigation during November to April.

Advances in collaborative research

Through collaborative research, the Oilseed Research Center (ORC) of BARI have received more than 410 germplasm lines, segregating populations, and disease nurseries. Two improved varieties BARI Badam-5 [ICGS(E)-55] and BARI Badam-6 (M-5) have been released for commercial cultivation. Some promising genotypes are in the pipeline for further testing.

Areas for future collaborative research with CLAN

- Develop short-duration spanish type cultivars (<125 days) for river basin areas,
- Develop cultivars with short dormancy period (15-25 days) and viability beyond four months after harvest,
- Develop cold tolerant and , thrips and jassids resistant cultivars, and
- Develop cultivars tolerant to aflatoxin contamination.

Pigeonpea

Pigeonpea is grown as a minor crop in about 6000 ha with a mean yield of 0.5 t ha^{-1}. Perennial varieties are grown along the roadside, in the backyard and on rice bunds for use as a fuel in tobacco curing. From the genetic materials received from ICRISAT, a short-duration variety (ICPL-76012) has been identified that can be grown successfully as an intercrop with blackgram variety (Barimash-2). This technology has found favour with the farmers in northern Bangladesh and cropped area is expanding. The collaborative research program has also established the possibility of growing the short- and medium-duration pigeonpea varieties in the hill slopes of Chittagong hill tracts in Bangladesh. ICPL-76012 maturing in 132 days has yielded 1.5 t ha^{-1} in the hill slopes. Further study is underway to investigate the usefulness of this variety in preventing soil erosion.

Areas for future collaborative research with CLAN

- Develop varieties with yield potential of 2 t ha^{-1} and tolerance to *Helicoverpa* pod borer and sterility mosaic disease.

In-country Network Activities

BARI has the mandate to conduct research on chickpea, groundnut and pigeonpea through conventional breeding techniques, while the Bangladesh Institute of Nuclear Agriculture is concerned with application of nuclear techniques in crop improvement. The Bangladesh Agricultural University, Rajshahi University, Dhaka University, Institute of Postgraduate Studies in Agriculture, and Chittagong University are also doing some basic research on these crops. The CLAN country coordinator maintains linkages with these organizations and coordinates the pulses research. This has helped greatly in avoiding duplication of research programs of CLAN priority crops in Bangladesh.

Human Resources Development

With its limited capabilities, CLAN is helping significantly towards the manpower development by providing short term training, study tours, visits, seminars, and workshops. A BARI scientist will join the training course on "Detection and estimation of aflatoxin in groundnut-based products" during 24 Nov to 6 Dec at ICRISAT, Patancheru.

An in-country training course on "On-farm Research Methodologies" was organized and sponsored jointly by BARI and CLAN. Twenty-five scientists from various disciplines of BARI participated in the course held at Joydebpur. The resource persons drawn from BARI and ICRISAT covered the need, concepts and issues concerning on-farm research, identification and prioritization of constraints, and planning and implementation of on-farm research. A diagnostic survey was conducted in Tangail district. On the final day the participants planned on-farm research trials to alleviate the identified production constraints. The participants found the program was useful, and recommended follow-up of the course.

Annual review and work plan meetings of CLAN are assisting BARI through the participation of ICRISAT scientists in national research planning. Four ICRISAT scientists participated in research review of 1996-97 and collaborative research program development for 1997-98.

Suggestions for Improvement of Linkages and Participation

- CLAN should arrange and fund monitoring tours in the partner countries during crop season.
- CLAN should arrange and fund visits of senior scientists of partner countries to ICRISAT and NARS program planning workshops and field days during the crop season.
- CLAN should arrange and help in information and germplasm exchange between the network member countries.
- Regional workshops, working group meetings, visits, and short-term training should be arranged and funded by CLAN more frequently.

Collaborative Research in China: Needs and Opportunities

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Introduction

Cooperation between ICRISAT through the Cereals and Legumes Asia Network (CLAN) and the Chinese Academy of Agricultural Sciences (CAAS) is more than 9 years old. The fruitful collaboration has resulted in significant improvement in agricultural research and human resource development in China. Research highlights and achievements after the last coordinators meeting are reported below.

Review and Workplan Meeting

The China-CLAN/ICRISAT review and workplan meeting was organized during 24-25 July 1997 at CAAS, Beijing, China to review the results of past cooperative research, and prepare plans for future collaborative research. A workplan containing detailed list of research needs, priorities, and human resource development activities for the period 1997-99 was developed.

Research Highlights and Progress

Groundnut

Germplasm evaluation for resistance to bacterial wilt

- All the twelve bacterial wilt (BW) resistant groundnut genotypes identified during 1995-96 were further evaluated for consistency in 1997 and were found to be highly resistant.
- Three-hundred and eight local groundnut germplasm accessions were tested in the natural disease nursery. Four accessions were observed to possess high survival percentage.

Breeding for resistance to bacterial wilt

- Two breeding lines (ZH 112 and ZH 212) resistant to BW developed at the Oil Crops Research Institute (OCRI), Wuhan were tested in the multilocation trials in Central China.
- An interspecific hybrid derivative developed at the Henan Academy of Agricultural Sciences was identified as highly resistant to BW with early-maturity and desirable agronomic traits at Wuhan.

[1] Co-authored by Liao Boshou, Xu Zeyong, Lu Qingshan, Wang Liangqun, Liang Xuanqiang, Wan Shubo, Zhang Xinyou, and Guo Gaoqiu.

- Forty single plants with desirable agronomic traits were selected from hybrid progenies in the natural disease nursery in Hong An, Hubei Province.
- Twenty-one crosses were made at OCRI for BW resistance breeding.
- Segregation for resistance in the F_3 families of crosses consisting BW-resistant parents of subspecies *hypogaea* and subspecies *fastigiata*, indicated that lines Lingui Make (subspecies *hypogaea*) and Taishan Sanlirou (subspecies *fastigiata*) had different loci for BW resistance.

Research on latent infection of bacterial wilt

- Latent colonization of *Rolstonia solanacearum* (=*Pseudomonas solanacearum*) in artificially inoculated BW-resistant groundnut genotypes were detected using ELISA technique.
- Influence of latent colonization of *R.solanacearum* on growth and development of groundnut plant was investigated by a comparative study through artificial inoculation.

Virus disease surveys and serological diagnosis

- Surveys on virus diseases were carried out in northern China including Luanxian, Luannan, Qianan counties and Shijazuang suburb of Hebei province during late July and early August 1997.
- Twenty peanut stunt virus (PSV) isolates from different crops and locations were used to test the pathogenecity.
- PSV isolates with low and mild virulence were mainly distributed in groundnut growing areas of Henan and Shandong province.
- Thirty-six groundnut varieties were evaluated for resistance to cucumber mosaic virus (CMV) in a field trial in Wuchang.
- Three hundred and forty-three groundnut varieties and germplasm lines were evaluated for resistance to peanut stripe virus (PStV) by natural infection in field trials in Wuchang.
- CMV incidence was reduced to 11.4% due to integrated disease management technology and resulted in substantial yield increase. The control treatment had 28.9% incidence.

Breeding

- The promising line derived from an interspecific cross of Baisha 1016 (*A. hypogaea*) x *A. chacoense* was further evaluated for its agronomic traits and bacterial wilt resistance.
- Fifty-five interspecific derivatives of crosses between *A. hypogaea* cultivars and wild *Arachis* accessions were further evaluated under field conditions.
- Sixty new crosses, either between groundnut cultivars and wild species or between cultivars and interspecific derivatives, were made for various purposes.

- The genetic transformation project initiated made some progress in standardizing the manipulation procedures.

Sorghum

- A total of 6391 accessions of sorghum germplasm were tested at the Sorghum Institute, Liaoning province.
- Two hybrids (421A/9544 and 421A/9304) developed by using ICRISAT male sterile line SPL132A (412A) are under testing in the provincial varietal demonstration tests. Two more hybrids, 421A/2826 and 421A/9304, are being tested in the provincial comparison tests.
- A new stable male sterile line 7050A selected from the offspring of SPL132B (412B)xTAM428 (having ICRISAT blood), has been used in many crosses.
- Two newly bred male-sterile lines, 7009A and 7038A, are used in crosses, to test productivity.
- Hybrids developed by using ICRISAT male sterile line 421A ["Liaoza 4" (421 A/dwarf 4), "Liaoza 6" (421A/5-27), "Liaoza 7" (421A/9198) and "Jinza 94" (421A/85)] are cultivated in about 66,670 ha.
- Male sterile gene ms_3, introduced from ICRISAT, has been transferred to 88 parental lines, including restoration and maintenance.
- A random mating population (LSRP) was established by three cycles of random crosses involving 26 lines with ms_3 gene. Fifty-six promising plants were selected for further testing.
- A new random mating population, LSBP, is being established.

Chickpea

- Two lines, FLIP 81-71c and CP 55, are being multiplied for large scale production trials in Qinghai province and Xinjiang autonomous region.
- A chickpea international nursery from ICRISAT/ICARDA is being conducted in Xinjiang autonomous region.
- ICRISAT was requested to send varieties and breeding lines for adaptability and production tests.

Pigeonpea

- A new project supported by national funding on introduction of pigeonpea cultivars (from ICRISAT) for research on production and utilization was approved.
- ICRISAT was requested to send varieties and breeding lines for adaptability and production tests in Guangxi and Jiangxi province.

Exchange of Scientists' Visit

- Liao Boshou, OCRI, Wuhan attended the Second International Bacterial Wilt Symposium, July 1997, Guadeloupe, France.
- Wang Liangqun and Yang Zhen participated in the Asian Sorghum Researcher' Meeting, 18-21 November 1997, Suphan Buri, Thailand.
- Liao Boshou, OCRI, attended the training course on "Detection and Estimation of Aflatoxins in Groundnut-based Products", 24 Nov to 6 Dec 1997, ICRISAT, Patancheru, India.
- S N Nigam and A Ramakrishna from ICRISAT visited the Crop Research Institute, Guanxi Academy of Agricultural Sciences (GxAAS). Gao Guoqing from GxAAS visited ICRISAT in Oct 1997.
- CAAS and provincial academies have agreed to exchange of scientists' from Thailand, Myanmar and Indonesia.

Collaborative Research in India: Needs and Opportunities

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Introduction

All the five CLAN priority crops (sorghum, pearl millet, chickpea, pigeonpea and groundnut) are important food crops of India. Sorghum and pearl millet together account for nearly 16.5% of the 123 million ha cultivated area in India, and 7.8% of its 185 million t of food grain production. Chickpea and pigeonpea constitute around 45% of the area under pulses cultivation in the country, and 58% of its production. Groundnut is the most important oilseed crop, accounting for 40% of the area and 35% of the total production of oilseeds in India.

India has very good collaboration with ICRISAT in exchange of germplasm and breeding materials, publication and information exchange, joint workshops, group meetings, conferences, and training programs. Most of the State Agricultural Universities also have active collaborative links with ICRISAT through CLAN.

Research Activities and Achievements

Sorghum

Diversification of genetic base for male sterility, development of dual purpose (grain and forage) lines, breeding for grainmold resistance and drought tolerance are some of the major areas of collaboration with ICRISAT. Management of insect pests and diseases, and investigations related to grain textural profile as influenced by genotype and agroecological situations are other aspects of collaboration.

The joint efforts have lead to development of materials resistant to striga and anthracnose, improved germplasm, and diversified male sterility sources. A2, A3, and A4 cytoplasms have been used to diversify cytoplasmic base of male sterile lines. This research has helped in identification and release of some promising hybrids.

Pearl millet

The major objectives in pearl millet improvement are development of drought and heat tolerant varieties, cytoplasmic diversification of male sterility sources, breeding high yielding hybrids and development of diverse gene pools.

The germplasm and breeding material supplied by ICRISAT was used extensively in developing improved pearl millet varieties. Some of these are in large scale cultivation, and others are in the final stages of testing under the All India Coordinated Millet Improvement

Project. Raj 171, developed from the materials received from ICRISAT, has been released for general cultivation in Rajasthan. Two other populations viz., CZIC 923 and GICKV 9391 developed in collaboration with ICRISAT have also been released recently for cultivation. A new topcross hybrid 'Jawahar' has been released for cultivation in Madhya Pradesh state.

Chickpea

The collaborative research included improving resistance to ascochyta blight and botrytis gray mold, high-temperature tolerance, and breeding for adaptation to late-sown conditions in rice-based cropping systems.

A large number of advanced generation lines and germplasm received from ICRISAT were evaluated at several centres in India. Selected lines are being used in breeding programs. Sixteen newly developed chickpea lines, out of selections from ICRISAT material were evaluated in All India Coordinated Trials, and two genotypes (JAKI-9218 and JG-11) were identified for release.

Pigeonpea

The major area of collaboration involves exploitation of hybrid vigour; development of short-duration genotypes for varying latitudes and rice fallows; resistance to wilt, alternaria blight, and sterility mosaic; and development of genotypes with stable yield. The program for development of cytoplasmic male sterility (CMS) in pigeonpea has now resulted in identification of CMS lines in both short- and long-duration pigeonpea.

Groundnut

Collaborative research aims to develop genotypes with foliar disease resistance, bud necrosis disease resistance, reduced aflatoxin contamination, cold tolerance, short-duration bunch varieties, drought tolerance, and resistance to insect pests.

Proposed Future Activities

Collaborative research on all crops has lead to development of a number of varieties and production technology, therefore, it should be continued. In future, emphasis will be on the following areas:

Sorghum

- Increased levels of resistance to shootfly and drought in rabi (postrainy) sorghum lines,
- Genotypes/population with enhanced tolerance to grain mold for rainy season varieties, and
- Productive forage sorghum varieties.

Pearl millet

- Develop short-duration hybrids for dry zones of Rajasthan and other areas,
- Diversify gene pools for downy mildew resistance, and
- Develop diversified B and R lines for future hybrids.

Chickpea

- Identification of stable donors for resistance to botrytis gray mold and ascochyta blight,
- Breeding for multiple disease resistance (wilt, dry root rot, and foliar diseases), and
- Identification of genotypes for high and low temperature tolerance.

Groundnut

- Develop materials tolerant to saline conditions, acid soils, cold, and heat, and
- Develop genotypes suitable for rice fallows.

Information exchange

Various ICRISAT publications have useful information on methodologies for crop improvement, production technologies, and have been helpful in updating knowledge. Awareness about ICRISAT activities has also increased. This activity, therefore, must be pursued more vigourously.

Exchange of visits and Field days

Joint visits by ICRISAT and Indian NARS scientists offered excellent opportunities for discussions. This has lead to identification of promising materials and new areas of collaboration. Joint field days organized by ICRISAT have proved very useful.

Meetings, Conferences, Workshops and Training

These activities provide a good opportunity to Indian scientists to interact with international scientists. In future, such activities should be enhanced.

There is a need for emphasis on specialized training such as new approaches to crop improvement, disease and insect pests management, biotechnology, and other advanced areas of research.

Suggestions for future improvement

- On-going programs on exchange of germplasm and breeding materials, field visits, meetings conferences, and field days, and supply of publications have proved very useful, and should be continued and strengthened.

- Technical programs of All India Coordinated Research Projects and ICAR-ICRISAT collaborative projects should be integrated to strengthen the ongoing programs. The annual meetings to develop workplans for collaborative research may be linked with the All India Workshops/Meetings rather than at separate meetings.
- Supply of germplasm and breeding material be channeled through the concerned national crop coordinators to have better monitoring.
- Any additional activity jointly agreed to by ICAR and ICRISAT may be linked with funding support through development of joint funding proposals.
- Strengthening of human resource development programs for training of young scientists.
- CLAN meetings may be held more frequently since these provide opportunities for cooperators to interact, share information, experience, and expertise leading to development of collaborative programs.
- Joint monitoring of international trials involving scientists from 2-3 countries would be more effective. CLAN may take steps to explore the possibility of such an arrangement.

Collaborative Research in Indonesia: Needs and Opportunities

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Introduction

Rice, maize, and soybean are the major food crops in Indonesia. However, crop diversification involving food legumes and coarse cereals is essential to maintain sustainability of production.

Among the CLAN mandate crops, groundnut has highest priority in Indonesia, followed by sorghum, pigeonpea, and chickpea. The production of groundnut has not increased significantly during the last two decades. Production stood at 379,683 t in 1975; 528,000 t in 1985; and 695,394 t in 1995. The productivity was about 1 t ha^{-1}. On the other hand, demand for groundnut from food industries has increased steadily. Indonesia imported around 100,000 groundnut annually during the last five years.

Sorghum and pigeonpea are low priority crops, and are usually grown on rainfed or upland areas. Chickpea is a new introduction to Indonesia.

Current Research Activities

Collaboration research activities for 1997 were developed during the Review and Workplan meeting held at Malang, 24-25 February 1997. Research Institute for Legumes and Tuber Crops (RILET), Malang; Research Institute for Maize and Other Cereals (RIMOC), Maros; and Assessment Institute for Agriculture Technologies (AIAT) at Karangploso and Naibonat are involved in conducting CLAN-related collaborative research in Indonesia.

Groundnut

Research is focussed on varietal improvement with emphasis on high yield (> 2 t ha^{-1} dry pod), resistance to diseases (rust, late leafspot, bacterial wilt), tolerance to drought and leaf chlorosis, short-duration (90-100 days), and good seed quality. Development of variety with low lipid content in seed is considered important for snack food industries. Several introduced lines from ICRISAT showed better performance than local varieties. Agronomic research is directed towards better management of nutrients, soil and water.

Sorghum

Research is focussed on varietal improvement for high yield, tolerance to drought, and short- to medium-duration. Sweet sorghum lines are also evaluated for sucrose content. ICSV 111 and Isiap Dorado matured earlier than check UPCA S1 under drought conditions.

Pigeonpea

Research on varietal improvement is focussed on extra-short, short- and medium-duration varieties with tolerance to drought. Vegetable type genotypes showed good performance with bigger pod. Short-duration genotypes gave better yield than medium-duration lines. Pests are the main constraint for pigeonpea production, and need to be properly controlled. A study on production and utilization of pigeonpea was initiated by growing pigeonpea on drylands involving 32 farmers. Processing of food products (tempe, sauce, and flour) from pigeonpea was demonstrated to farmers and small-scale (home industries) enterpreneurs. The participants also practiced the preparation and evaluation of new products.

Chickpea

Chickpea genotypes introduced from ICRISAT are being evaluated at higher altitudes in Malang (950 m above sea level). Some genotypes showed good performance. Small seeded lines gave better germination than the bold seeded lines.

Germplasm and Breeding Materials

During 1996-97, 266 groundnut, 24 sorghum, and 46 pigeonpea lines have been received from ICRISAT for evaluation and selection of promising lines for direct testing and as parents in breeding programs.

Training

An in-country training on "Groundnut Production Technology" was conducted at RILET on 26-27 August 1997. It was attended by 26 participants, consisting of key farmers, agricultural extension services staff, and researchers of AIAT from groundnut production areas in Central Java, East Java, Bali, West Nusa Tenggara, and East Nusa Tenggara Provinces. Most participants were very satisfied with the training.

Impact and Usefulness of the Network

The Indonesian NARS greatly benefited by CLAN in the following areas:

- Exchange of germplasm and breeding materials for groundnut, sorghum, pigeonpea, and chickpea,

- Support to national program in variety development and solving production constraints,
- Increase researcher's capability through training and interaction between national and international scientists,
- Exchange of information, publications, experiences and technologies, and
- Support to accelerate technology transfer to the users.

Suggestions for Future Collaborative Activities

- Continue exchange of germplasm and breeding materials (groundnut, sorghum, pigeonpea, chickpea) for specific purposes (for eg., industrial uses).
- Exchange of information, technology, and experiences among member countries.
- Monitoring tours in the major production areas and in the leading countries for study of specific research topics.
- Breeding for pest resistance, especially in pigeonpea.
- Farmer-participatory breeding.
- Pilot project on production and utilization of pigeonpea and sorghum.
- Working group meetings on specific topics.
- Development of low-cost production technologies.
- Human resources development for NARS scientists (degree and non-degree training, international seminars and workshops, visiting scientists, etc.).

Collaborative Research in Iran: Needs and Opportunities

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Introduction

The Government of Islamic Republic of Iran is giving more attention to wheat, rice and legumes for self-sufficiency. Among the CLAN priority crops chickpea is most important followed by sorghum, groundnut and pearl millet. Pigeonpea is new introduction.

Chickpea is grown on 900 000 ha with a production of 350 500 t. It is a major cash crop in rainfed areas of the country. About 6% area is irrigated. It is mostly grown in rotation with wheat and barley.

Sorghum is grown on 30 000 ha. Improvement of forage sorghum is first priority, and grain sorghum is second priority.

Groundnut is grown in 3000 ha with a production of 6000 t. Almost the entire produce is consumed as roasted nuts and in confectioneries. But, varieties with high oil content are required to meet the domestic needs of vegetable oil. Groundnut is grown in northern part of the country. However, some areas in south have shown potential upto 6 t ha^{-1}.

Pearl millet has a very small hectarage in Iran. It is grown mostly for use of grain for bird-feed. Recently, pearl millet has been considered as a source of dry and wet forage, and initial research has begun.

Pigeonpea is not grown in Iran. However, extensive testing of pigeonpea varieties in the country is needed to assess its production potential.

Areas for future Collaborative Research with CLAN

Chickpea

- Breeding for high yield with resistance to ascochyta blight, fusarium wilt and podborer;
- Develop short-duration cultivars with tolerance to salinity, drought, heat, and cold;
- Enhance nitrogen fixation in cropping systems, and
- Integrated management of pests and diseases.

Sorghum

- Develop short-duration, dual-purpose hybrids, and
- Develop cultivars with tolerance to salinity and drought.

Groundnut

- Develop short-duration confectionery cultivars,
- Develop cultivars with tolerance to drought, salinity, high temperature, and acid soils; and
- Develop cultivars with high oil content.

Pearl millet

- Develop short-duration, high yielding, dual-purpose varieties and hybrids; and
- Screening of germplasm and breeding material for resistance to biotic (downy mildew and ergot diseases) and abiotic (drought, heat, salinity) stresses.

Pigeonpea

- Identify medium- and short-duration cultivars with high and stable yield; and
- Identify short-duration varieties with tolerance to drought and heat.

Information and technology exchange

Annual reports, books, bulletins and news letters supplied by ICRISAT are of great help for scientists in Iran.

Human Resources Development

- Training staff and students through M Sc and Ph D programs, and
- In-country training course on chickpea for enhancing nitrogen fixation and drought tolerance are needed.

Exchange of visits

Visit of Iranian scientists working on chickpea, sorghum, groundnut to ICRISAT, and visit of ICRISAT scientists to Iran.

Collaborative Research in Myanmar: Needs and Opportunities

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Introduction

Crop diversity and genetic variability in Myanmar is enhanced by introduction of exotic germplasm through the collaborative crop improvement programs with international research institutions and networks. CLAN and ICRISAT play an important role in improving groundnut, chickpea, pigeonpea, and sorghum productivity and production in Myanmar. The collaborative on-farm and on-station nutrient balance studies in Nyaung Oo will definitely help upgrade soil fertility and eventually lead to increased crop production in the central dry zone area of Myanmar.

Research Activities

Groundnut

The research is focused on developing short-duration varieties with high yield and shelling percentage (>70%). Drought tolerant varieties are essential for the drought prone areas of the central dry zone.

- YZG 91062, with mid- and end-season drought tolerance, is likely to be adopted by the farmers due to its high yield and shelling capacity (71%).
- ICGV 93382 and ICGV 94323 were found to be promising among 21 varieties screened for early-maturity.
- YZS 14 and Azuma outyielded local check, Sp 121/070, by 50-60% in the yield trials of high yielding medium-duration varieties at Nyaung Oo. YZG 91062 was the best yielder at Magway and Nyaung Oo.
- ICGV 94105, ICGV 91167, and ICGV 90261 were identified as moderately resistant to late leaf spot with good yield. No rust infection was, however, observed on ICGV 90261.

Chickpea

High yielding varieties of kabuli and desi types with tolerance to wilt and root rots are needed.

- Five lines derived from Nabin x ICCV 82108 were identified as promising with higher 100-seed mass and more yield than local check, Karachi. These lines will be tested further.

- ICCVs 96012, 96017, 96024, 96001, 92934, 96008, and 96027 were well adapted at Zaloke. At Myingyan, kabuli short-duration varieties ICCV 96605 and ICCV 95607, and at Zaloke, medium-duration lines ICCV 95608 and ICCV 95617 performed well.

Pigeonpea

- Research is aimed at identifying large-seeded, short-, medium-, and long-duration pigeonpea varieties for different cropping systems; insect management for Helicoverpa, Maruca and podfly; and ensure existing levels of wilt, sterility mosaic, and phytophthora resistance in new varieties. During rainy season none of the advanced lines yielded better than the local check Shwedinga. However, many lines yielded >1 t ha^{-1} in delayed sowing (August) compared to no yield in Shwedinga (as it did not flower).

Sorghum

Main objective in crop improvement research is to develop dual purpose and fodder sorghum varieties suitable for different agroclimatic zones.

- Among grain mold resistant white grain lines, IS-30469-C-1518-T-2, IS-20469-C-1187-5, and IS-30469-C-140-2 gave more yield than the check, Yezin 1. BG-31-2-3-1-1, BG-31-27-2-2-1-1 and BG 30-22-2-1-1-1 were the best at Zaloke and BG-181-10-5-1-1-1, BG-31-8-1-2-1-1-1, and BG-185-20-1-4-2-1-1 did well at Mahlaing in the preliminary observation for dual purpose sorghum lines.
- Dual purpose sorghum lines 212-2-2, 83-3-1, 44-5-3, and 24-1-3 were good yielders both in grain and fodder compared to check Yezin White Grain 1. ICSVs 93075, 93057, 93076, 112, and 93049 were better than Yezin White Grain 1 in the national advanced yield trial. Seed increase of SDSL-89571, BF-83-3/ 3-1-1, 89/05-F 5-2778, Wad Ahmed and ICSV 94006 will be done for multi-location trials.

Pest management

Two sprays of Deltamethrin reduced the pest infectation by 22-24% and increased the yield by 4 to 7 times when compared to unsprayed plots in pigeonpea. Larvin 375 and Tephrosia were more effective than Deltamethrin against chickpea pod borer.

Virus disease survey

Yellow spot was the only viral disease observed on rainy season groundnut in central Myanmar. Disease incidence was 70-80% and severity was 30-50% in spreading varieties. Among the improved cultivars, ICGV 89355 was susceptible, but ICGV 87935 was less affected. Peanut stripe virus was not observed.

Exchange of information and technology

SATCRIS services were very informative and helpful to Myanma scientists. Rhizobium research and inoculant production are greatly enhanced by interaction with ICRISAT scientists. On-farm nutrient balance studies undertaken at Nyaung Oo will not only improve the knowledge of researchers but also the farmers.

Human Resource Development

The research findings to improve crop productivity in groundnut, chickpea, and pigeonpea were transferred to Extension Division and Research Farms through in-country training programs. Field days were conducted at the research stations during 1996-97 to expose new promising technologies to the farmers.

Two Myanma scientists attended training programs, and a research scholar was given hands-on training in nutrient analysis and data management at ICRISAT.

Future Research needs

- Crop improvement programs with tolerance/resistance to insect pests, diseases, weed (striga), cold/heat and drought,
- Breeding for high yield potential and early-maturity.
- Integrated water and nutrient management; and
- Biological nitrogen fixation.

Collaborative Research in Nepal: Needs and Opportunities

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Introduction

Chickpea and pigeonpea are important grain legume crops while groundnut is an important oilseed crop in Nepal. In recent years, there is an increasing trend in area and production of pigeonpea and groundnut. However, the trend is negative for chickpea. This is mainly due to the increased incidence of botrytis gray mold (BGM) disease and *Helicoverpa* pod borer in chickpea. Although area under groundnut is not extensive, it is gaining popularity in recent years.

Collaborative Research: Achievements:

Collaborative research on chickpea, pigeonpea, and groundnut was strengthened in Nepal through AGLN since 1986 and CLAN since 1992. Grain legumes and oilseeds programs in Nepal have benefited significantly from breeding materials and production technology developed at ICRISAT.

Chickpea

- ICCV 92123 (1.43 t ha^{-1}) followed by ICCV 92109 (1.23 t ha^{-1}) and ICCV 92172 (1.19 t ha^{-1}) were performed well and found to be promising in observation nursery (desi-1).
- BG 390 (1.88 t ha^{-1}), BG 256 (1.39 t ha^{-1}) and KWR 108 (1.83 t ha^{-1}) were found promising in observation nursery (desi-2).
- ICCV-16 (2.91 t ha^{-1}), ICCV 550 (2.29 t ha^{-1}), ICCV 5 (2.08 t ha^{-1}), and BGD-1089 (1.87 t ha^{-1}) were found to be promising in observation nursery (kabuli).
- Variety release proposals for ICCX 840508-36 and ICCX 840511-25 have been submitted to the Variety Release and Registration Committee.

Pigeonpea

- In observation nursery (long duration lines), ICPL-92057, ICPL 85036, and ICPL 85067 were found promising.
- In long-duration Pigeonpea International Trial, ICPL 95005 produced the highest seed yield of 3.05 t ha^{-1} followed by ICPL 95007 (2.83 t ha^{-1}).

- In postrainy season pigeonpea trials, Pusa 9 (3.3 t ha^{-1}), Pusa 14 (2.48 t ha^{-1}), DA 11 (2.18 t ha^{-1}), and *Rabi* (1.98 t ha^{-1}) were found promising and selected for on-farm evaluation.

- First week of September was found to be optimum for sowing of postrainy season pigeonpea in western Nepal.

- Genotypes ICP 7035 and C 11 were found resistant to sterility mosaic and wilt diseases at Nepalgunj.

- In on-farm screening of pigeonpea against wilt disease genotypes ICP 8859 and ICPL 87133 had less plant mortality, suggesting high level of disease resistance/tolerance to wilt.

- In on-farm trials, ICPL 87133 and ICPL 84072 were higher yielding than local check (Bageshwari) in Banke and Bardia districts.

- Pusa 9 and Pusa 14 were found suitable in postrainy pigeonpea farmers' field tests, for sowing after summer maize in September in Bardia district. Seeds of Pusa 9 and Pusa 14 are being multiplied at Nepalgunj for supply to farmers.

Groundnut

- ICGV 93383 produced the highest pod yield of 2.02 t ha^{-1}, followed by ICGV 86300 (1.9 t ha^{-1}) in observation nursery.

- In international medium-duration varietal trial (Spanish bunch), ICGV 89356 was the top yielder (2.39 t ha^{-1}) followed by ICGV 90011 (2.23 t ha^{-1}), and Jayanti (2.16 t ha^{-1}).

- In international medium-duration varietal trial (Virginia bunch), ICGV 86201 produced the highest pod yield of 2.86 t ha^{-1}, followed by ICGV 90039 (2.77 t ha^{-1}) and ICGV 91074 (2.55 t ha^{-1}).

- In coordinated varietal trial (normal), ICGV 88473 was the top yielder (1.79 t ha^{-1}) compared to check Janak (1.73 t ha^{-1}).

- In on-farm trials, high-input practice resulted in pod yield increment of 48% over farmers' practice, while low-input practice resulted in 22% incise over farmers' practice.

- Application of gypsum, press-mud and lime resulted in increase of groundnut pod yield by 43.7%, 25%, and 18% over control, respectively.

Conclusions

The support provided by CLAN to Nepal's legumes and oilseed research and development program has been very useful. Collaboration in human resource development and on-farm research should be further strengthened.

Collaborative Research in Pakistan: Needs and Opportunities

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Introduction

A brief summary of the research and other related activities carried out under CLAN in Pakistan is as follows:

Chickpea

Breeding

Eight short-duration chickpea genotypes obtained from ICRISAT were crossed with eight ascochyta blight resistant genotypes developed at the National Agricultural Research Centre (NARC), Islamabad to develop ascochyta blight resistant extra-short duration genotypes.

Eighteen F_1 populations were evaluated for ascochyta blight resistance. The F_4 seed from the selected resistant/tolerant plants has been planted at Hilly Agricultural Research Station, Kaghan for advancing the generation.

Ninety-eight F_6 progenies obtained from ICRISAT were evaluated at NARC, Islamabad. Twelve progenies were found susceptible, but rest of the progenies were tolerant with a disease index of 4-5, on a 1-9 scale, where 1=resistant and 9=susceptible. Sixty five progenies with good grain yield have been selected for evaluation in preliminary yield trials.

In Preliminary Yield Trial (A1) three genotypes (CMC40T, CMC132T and CMC70T) yielded better. Chickpea material was also evaluated in Bahawalpur, Cholistan. Highest yield at Bahawalpur was obtained from ICC11514xILC482/51 (13000 kg ha^{-1}) followed by ICC11514xILC3279/26 (1289 kg ha^{-1}). The maximum yield was obtained from ICC11514xILC482/3 (1955 kg ha^{-1}) at NARC, Islamabad followed by CM72xILC3279/159 (1623 kg ha^{-1}).

Seed of 12 elite lines was increased for the inclusion in 1997-98 on-farm trials. About 600 kg seed of chickpea improved verities was produced involving growers. Chickpea national uniform yield trial with 15 advanced lines was conducted at various locations in the country. The most promising lines performing better in Pothwar area were selected.

Pathology/Virology

Four national and two international chickpea screening nurseries were evaluated against ascochyta blight at Islamabad (a hot-spot for chickpea blight screening). Eighty-six resistant lines were selected from this material.

A preliminary experiment to observe the effect of microbial antagonists for the control of *Ascochyta rabiei* was conducted in growth chambers. Promising results were obtained with *Gliocladium virens*.

Two hundred and fifty breeding lines were screened for virus resistance. Thirty-six lines were selected as resistant/tolerant to chickpea chlorotic dwarf virus. These lines are also resistant to ascochyta blight, therefore showing multiple resistance.

An extensive survey of major chickpea growing areas of Punjab was conducted. Chickpea was infected with fababean necrotic yellow virus (FBNYV), luteo viruses, chickpea chlorotic dwarf virus (CCDV), bean western yellow virus (BWYV) and pea seed-borne mosaic virus (PSbMV). FBNYV, BWYV and PSbMV infecting chickpea are reported for the first time in Pakistan.

Entomology

Chickpea genotypes CM 72 and CM 68 are resistant to bruchid *Collosobruchus maculatus*, and Mash 133, Mash Pasroor are resistant to *C. chinensis*, and could be used as genotypes for incorporation of bruchid resistance into high yielding genotypes.

Sorghum and Pearl millet

International nurseries and trials received from ICRISAT were distributed for evaluation at the Provincial Cooperating Units.

Sorghum scientists at NARC have selected two sorghum varieties, PARC-SS-1 (ICSV 107) and PARC-SS-2 (IRAT-204). These varieties have shown good performance in National Uniform Yield Trials, and in demonstration plots in farmers fields in Pothwar region. Sorghum hybrid (PARC-SH-1) has shown yield potential of 3.5 to 4 t ha^{-1} compared to 0.6 t ha^{-1} of local varieties.

ICSV 745, ICSV 843, ICSV 680, CSV 13, IS 18531 and IS 22129 were resistant to shootfly and stem borer, while ICSV 197 was found to be resistant to midge.

Groundnut

Major emphasis in on developing short-duration varieties that fit in the existing cropping system of rainfed areas.

Three hundred and fifty groundnut germplasm accessions were evaluated at Islamabad. The lines are being harvested and the promising lines will be selected.

Seed of newly released variety BARD-92 is being multiplied for distribution among the farmers. Seed of the promising lines ICGS(E)-130 and L-40 is also being increased.

Four international groundnut varietal trials were received from ICRISAT and are being evaluated at Islamabad and other locations.

Meeting/Conference/Training

The annual review meeting of CLAN activities in Pakistan was held at NARC, Islamabad, 5-7 August, 1997. The work done during 1996-97 was reviewed and the work plan for 1997-99 was developed.

Mr. Khalique Ahmed, Entomologist, Pulses Program, NARC, Islamabad, participated in the Third International Food Legume Research Conference, Adelaide, Australia, 22-26 September 1997, and presented a poster "Effect of temperature on adult and larval populations of *Helicoverpa armigera* on chickpea in northern Pakistan"

Dr Feeroza Khalique, Entomologist, Pulses Program, NARC, Islamabad, attended a short-term (8 - 25 September 1997) training course on "Identification, isolation, characterization, culture and preservation of *Bacillus thuringiensis*" at Institute Pasteur, Paris, France.

CLAN-Collaborative Research in the Philippines: Needs and Opportunities

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Introduction

Higher agricultural productivity, self-sufficiency and global competitiveness are the targets for the major agricultural commodities in the country. Among the commodities in the Science and Technology Agenda for National Development (STAND), cereals and legumes (CLAN priority crops) fall under the "basic domestic need" category where self-sufficiency and higher productivity are being aimed for.

Among the CLAN priority crops, Philippines is giving importance to groundnut. In fact, groundnut is the flagship commodity of the Cagayan Valley Agricultural and Resource Research and Development (CVARRD) based in Region 2. The consortium implements the groundnut integrated research and development program with the objective of increasing groundnut production as a viable enterprise for the Cagayan valley farmers. The program is being supported by PCARRD, Department of Agriculture (DA) and international organizations such as CLAN-ICRISAT.

Minimal research on chickpea and pigeonpea are being undertaken, since they are considered as minor legumes in the country.

In-country research activities

Groundnut research is based in Cagayan valley, while pigeonpea and chickpea research is at Ilocos Norte. Two study areas each for groundnut and chickpea are being undertaken, while a trial for pigeonpea was just started at Ilocos Norte.

Evaluation of Groundnut Breeding Materials

This project is being conducted at Ilagan, Isabela primarily to screen and identify promising groundnut selections and to increase seed of promising materials. These promising materials are potential entries for the National Cooperative Testing Project, a trial required for National Seed Board approval.

About 84 high yielding entries of groundnut from ICRISAT were evaluated during the 1996-97 dry season. These included medium-maturity lines (37), drought resistant lines (36), foliar disease resistant line (1), confectionery elite line (1), foliar disease resistant advanced breeding lines (7) and germplasm lines (2). Out of the 37 medium-maturity lines, 29 were

selected due to higher yield. Twenty one drought resistant lines, and 3 foliar disease resistant advanced lines and were found promising.

Another study was conducted to evaluate 14 medium-duration, and 15 each of confectionery type, short-duration, and drought resistant varieties. These entries were compared to the check variety UPL Pn10 (JL-24). Five confectionery type and four entries each of short- and medium-duration and drought resistant lines outperformed local check UPL Pn10 (JL-24).

Commercialization of low cost groundnut seed storage technology

The expansion of groundnut for commercial production is limited due to non-availability of quality seeds during the dry season when the crop is most productive. The use of cold storage system under village level is very expensive and impractical. Hence, a simple storage technique using an air-tight sealed steel drum purged with 15% CO_2 was recommended by the National Postharvest Institute for Research and Extension (NAPHIRE) and field tested in Cagayan valley. This method has proven that seed viability of the stored groundnut was maintained at 92% even after 6 months of storage. However, it was also found effective even without purging CO_2. The farmers found it to be more practical and economical compared to use of CO_2. This technology of using tightly covered steel drum without CO_2 was disseminated on a commercial scale to 31 farmers in groundnut producing areas in Cagayan valley.

On-station Trial of Chickpea Varieties

Eleven chickpea lines from ICRISAT were evaluated for two seasons at the Mariano Marcos State University, Batac, Ilocos Norte. Three entries viz., ICCV 5, ICCV 92325, and ICCV 92337 were found to be consistently promising. Chickpea production can be profitable in Ilocos Norte.

Storage was reported as a constraint. Hence, a study on the storability of chickpea as affected by storage at different moisture levels were initiated.

Future plans

The groundnut industry in Philippines is becoming more secure with the support coming from the national and international agencies. With the assistance from CLAN/ICRISAT collaboration in the following areas need to be further strengthened:

- provision and exchange of germplasm materials,
- technical information and publications,
- training programs; and
- support to groundnut aflatoxin and bacterial wilt research.

Collaborative Research in Sri Lanka: Needs and Opportunities

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Introduction

Among the CLAN priority crops, groundnut, pigeonpea and chickpea are important to Sri Lanka. However, groundnut is the only crop that is being traditionally grown in Sri Lanka, and the other two are new to Sri Lanka.

The cost of import of lentil in 1995 was Rs.1900 million (US$ 38 million), and for chickpea Rs.118 million (US$ 2.4 million). However, both these crops are not cultivated in Sri Lanka at present. Land and climatic conditions suitable for lentil cultivation in Sri Lanka are limited. Research was done in 1980's to explore the feasibility of chickpea cultivation of in Sri Lanka, but with limited success because the available varieties were not well adapted to local conditions. However, in 1994, with the assistance from ICRISAT and ICARDA, a program was reinitiated to identify suitable varieties and production technology. The results are very encouraging.

Pigeonpea is a close substitute for lentil and an extensive research program was initiated in 1990 with the assistance from the Asian Development Bank and ICRISAT. Suitable varieties, production technologies, processing technologies have been developed. Several farmers and extension workers have been trained in various aspects of pigeonpea cultivation and processing. Cultivated area at present is small (300 ha) but has a potential to expand, especially in rainfed uplands during the wet season (*Maha*) and fallow paddy lands in the dry (*Yala*) season.

Research and Development Activities

Groundnut

Severe drought during 1996/97 *Maha* season restricted groundnut program activities. During the last 5 years, three new groundnut varieties (Tissa, Walawe and Indi) were released in Sri Lanka. The main research focus during 1996 was to test the newly released varieties with improved technology package in farmers fields. These experiments were carried out in Anuradhapura, Vavuniya and Hambantota districts. Results clearly indicated that the newly released varieties, especially Indi (ANK-G2) and Tissa gave better yield over farmers' varieties. Field days were also arranged at all experimental sites at the time of harvesting.

Chickpea

Initially, chickpea research was confined to *Maha* season where the night temperatures are low and crop matures towards the dry period. However, trials were also conducted to explore the feasibility of growing chickpea during *Yala* season. Performance of chickpea during *Yala* season was encouraging. One-hundred-and-eight desi and kabuli varieties/lines were evaluated during 1996 *Yala* season. Seed yield ranged from 20 to 1380 kg ha^{-1}, with eight varieties giving yields over 1.0 t ha^{-1}. Late May to early June was found to be the best time for sowing chickpea during *Yala* season.

Pigeonpea

Adaptability testing of two promising varieties, MPG 587 (*Maruca* tolerant, determinate) and ICPL 90050 (indeterminate) were repeated under farmer management during *Maha* 1996/97 season. Mean yields were low due to terminal drought. However, indeterminate varieties performed better than determinate varieties.

Development of varieties for tolerance/resistance to *Maruca* was given high priority. Fifty one selected lines were evaluated with and without insecticidal protection during *Maha* 1996/97. Sixteen lines with high level of tolerance were selected for further testing.

Intercropping studies of seven different legumes with maize under rainfed situation has shown that groundnut and pigeonpea are the best crops for intercropping. These two crops gave 20 to 40% yield advantage over sole cropping.

Future Plans

Pigeonpea

- Host-plant resistance studies on *Maruca* and on-farm evaluation of resistant lines with minimum spraying ,
- On-farm evaluation of promising determinate and indeterminate lines for cultivation during *Yala* season in paddy fallows,
- Evaluation of insecticides for the control of podfly in pigeonpea (*Yala*),
- Use of pheromone in controlling *M. testulalis* and *H. armigera*,
- Demonstration of maize/pigeonpea intercropping system in farmers fields,
- Residual effect of pigeonpea and other tropical crops (sesame, cowpea and maize) cultivation on the performance of succeeding rice (*Maha* season), and
- Quality and utilization studies.

Chickpea

- Germplasm/variety evaluation of extra-short and short-duration Kabuli and Desi types,
- On-farm testing of promising chickpea varieties,

- Screening of chickpea varieties for drought,
- Time of sowing, fertilizer response and seed viability studies, and
- Identification of Rhizobium inoculum strains for chickpea under local conditions.

Groundnut

- Evaluation of new groundnut varieties.
- Development of suitable technology package (spacing, irrigation and fertilizer) for confectionary type variety 'Walawe'.
- Demonstration and popularization of improved varieties of groundnut.
- Assessment of pod damage by insect pest, its identification and control measures, and
- Survey on the extent of nodulation of groundnut in different cropping systems.

Collaborative Activities

Collaboration with ICRISAT was useful, and a few of our scientists visited ICRISAT for training and joint research planning. ICRISAT scientists participated in pigeonpea and groundnut monitoring program in Sri Lanka. Collaborative research activities among member countries on the development of technology for the storage of seeds is a priority. Requests were made to several member countries to send identified germplasm. However, only Thailand responded to our request. Therefore, further strengthening of exchange of germplasm and information among member countries is essential. Assistance in training of scientists on the mandate crops is also a requirement for the future.

Collaborative Research in Thailand: Needs and Opportunities

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Background

Thailand has participated in the collaborative research activities with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) since 1983. Many activities have been undertaken in the areas of exchange of germplasm, breeding materials and information; and human resource development. A dual purpose sorghum variety, Suphan Buri 1 derived from cross with ICRISAT-supplied breeding material, has been released for general cultivation. Some more germplasm lines provided by ICRISAT have been integrated into varietal improvement programs, and some promising lines have been identified in both sorghum and groundnut. Training provided to Thai scientists by ICRISAT under human resource development program has improved the scientific knowledge and resulted in research efficiency.

Research activities in 1997

The research activities carried out in sorghum and groundnut as agreed in the Work Plan for collaboration between Thai Department of Agriculture and CLAN/ICRISAT are given below:

Sorghum

Following sorghum trials and nurseries were evaluated in Suphan Buri:

- Germplasm evaluation and characterization (167 lines)
- Advanced varieties and released hybrids (12 entries)
- Evaluation on Russian-derivative lines (155 lines)
- Evaluation of grain and forage sorghum lines (143 lines)
- Evaluation of disease and insect resistant lines (146 lines)
- Anthracnose virulence nursery (15 lines)

The participants of the Asian Sorghum Researcher's Meeting during 18-21 November 1997 held at the Suphan Buri Field Crops Research Centre also evaluated the performance of these lines and identified/selected lines with desirable characters for inclusion in their respective breeding programs. ICRISAT had agreed to provide the seed material of selected lines.

Groundnut

The following activities were conducted at Khon Kaen Field Crops Research Center.

- Evaluation of promising groundnut lines selected from ICRISAT-supplied breeding material and trials, and
- Characterization and evaluation of 300 germplasm accessions of groundnut.

Seven varieties of groundnut viz., Lampang, SK38, Tainan 9, Khon Kaen 60-1, Khon Kaen 60-2, Khon Kaen 60-3, and Khon Kaen 60-4 were sent on the request to Sri Lanka under exchange of germplasm between CLAN member countries program.

Human resource development

Woothisak Butranu, Pathologist, Department of Pathology, Kasetsart University, Bangkok visited ICRISAT for training on "Detection and Identification on Peanut Bud Necrosis Virus" during 4 August - 15 September, 1997.

Exchange of visits

There was a request from Pakistan to arrange for visit of the Pakistani scientists to interested institutes in Thailand for getting acquinted with the research activities and to have hands-on job training from Thai scientists under exchange of scientist visits among CLAN member countries program. This was agreed and was communicated to Pakistan and CLAN Coordination Unit.

Problems and solutions

Some problems occurred in groundnut germplasm supply. We received material in excess of what was requested. Any change from agreed workplan should be notified.

Information and publications have been received from CLAN/ICRISAT only. No publications have been distributed from member countries. Each CLAN member country should distribute any information or materials concerned with CLAN mandate crops.

Exchange of scientists' visits is most valuable and should be pursued.

Suggestions for effective functioning of the network:

- Germplasm exchange should be among all member countries, not just between CLAN/ICRISAT and individual country. The promising varieties from each national program should be sent to interested countries for evaluation.
- New and successful technologies should be exchanged among member countries for mutual benefit.

- Member countries should help each other in human resource development activities, with funding support from CLAN.

Suggested Future Research Activities

Sorghum

- Continue germplasm exchange, especially for shoot pest resistance, drought tolerance, grain mold resistance, and forage or dual purpose sorghum lines.
- The working groups should be further strengthened for increased interaction, effective use of resources, and sharing of research results.
- Greater emphasis and use of molecular biology (gene mapping, marker assisted selection, etc.) in sorghum breeding programs.
- Increased emphasis on on-farm adaptive research.

Groundnut

- Accelerate exchange of germplasm and improved varieties among CLAN member countries.
- Provide short training course on germplasm documentation and computerization.
- Play active role in collaborative breeding programs
- Encourage mechanization of groundnut cultivation to reduce production costs.
- Develop integrated management technologies for groundnut bud necrosis disease.

Collaborative Research in Vietnam: Needs and Opportunities

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Introduction

Among the legume crops grown in Vietnam, groundnut is the most popular and important. Hence, groundnut is the first priority crop for collaborative research in CLAN, followed by pigeonpea and sorghum. In recent years, Vietnam has achieved significant improvement in research and development of groundnut and has benefited from collaboration with CLAN.

Major in-country CLAN activities (1996-97)

On-Farm and on-station research

On-farm adaptive research is given a high priority with emphasis on dissemination of improved groundnut cultivation technologies and organizing of farmers' days to show new technologies and to get farmers' feedback. Several new technologies found to be promising have been included in large-scale on-farm trials. In northern Vietnam, on-farm trials with improved technology package increased groundnut pod yields by 30-58%. Polythene film mulching technique was also found to be effective for the spring-season groundnut in different areas of northern Vietnam. This technique increased groundnut pod yield by 30-35% and improved seed quality markedly. In southern Vietnam, replacement of expensive coconut ash by Alternative Cocoash (ACA) - a mixture of N, P, K, Ca, Mg and micro-elements-reduced input cost by 10% and increased groundnut yield by 6%. Chemical seed treatment combined with Rhizobium inoculation increased groundnut yield by 15%. Several new groundnut varieties with high yield (3.5-4.0 t ha^{-1}) and resistance to diseases have performed well in farmers' fields.

Integrated Pest Management (IPM) practices jointly developed by ICRISAT and Vietnamese scientists are now well accepted and followed by the farmers in both northern and southern Vietnam.

During 1997, 9 farmers' days were organised in Ha noi, Ha tay, Ninh binh, Nghe an, and Thanh hoa provinces with participation of 825 farmers and local extension workers. These activities have been highly appreciated by Vietnamese farmers.

Improved groundnut production technologies developed through on-farm adaptive research were also widely disseminated through various audio-visual media viz., newspapers, extension newsletters, radio and television. On-farm research methodology is now popularly used in research planning and problem identification on many other crops in Vietnam.

Germplasm exchange and collaborative breeding

In groundnut, high priority is given to breeding for high yield, seed quality, short-duration, drought tolerance and disease resistance. Many groundnut genotypes supplied by ICRISAT are now widely used in groundnut breeding programs in Vietnam. Promising genotypes selected from the national and international trials were tested in different agroecological areas for their adaptability. Several ICRISAT lines such as ICG 8666, ICG 5273, ICGV 86143, and ICGV 87391 performed well in farmers' fields and are now being multiplied. A local groundnut variety (Gie Nho Quan) has been found to possess very high level of resistance to bacterial wilt in Vietnam.

The Vietnam Agricultural Science Institute (VASI) has recently developed a project for collection, evaluation, and conservation of local groundnut germplasm to assist groundnut breeding programs in Vietnam, and for germplasm exchange with other CLAN member countries.

Pigeonpea and sorghum research is focused mainly on testing of ICRISAT developed genotypes for adaptability in marginal and drought-prone areas. Two sets of extra-short-duration pigeonpea genotypes were tested by VASI to identify suitable varieties for sloping soils of hilly regions. ICPL 90005 was found to be promising. A local pigeonpea variety with medium-duration was found suitable for sloping soils of Ha tay province, especially for intercropping with groundnut.

Natural resource management and impact assessment studies

VASI in partnership with ICRISAT conducted research on development of sustainable cropping systems in sloping soils of hilly areas in Bac giang and Ha tay provinces during 1996-97. Initial results showed that the new crop rotation including spring-season groundnut followed by summer soybean and winter maize was the most appropriate to these regions.

More recently, the Oil Plants Institute (OPI) and ICRISAT economists have initiated joint project on adoption and impact assessment to evaluate the benefits of improved groundnut cultivation technologies.

In country training

In-country training courses on statistical design and analysis of experiments was jointly organized by CLAN/ICRISAT and VASI in Hanoi and OPI in Ho Chi Minh City. Thirty-eight scientists attended the training courses and found it very useful.

Review and work planning meeting

CLAN/ICRISAT-Vietnam Review and Work Planning Meeting was held on 28-29 July, 1997 at Hanoi. Forty scientists participated in the meeting and actively discussed CLAN activities conducted during 1995-96 and developed work plan for 1997-98.

Suggested Future Collaborative Activities

- *Collaborative breeding in groundnut (for high yield, seed quality, short-duration,* tolerance to drought and cold, and resistance to pest and diseases).
- Research on groundnut aflatoxin, bacterial wilt, collar rot, damping-off, virus diseases, and integrated management of major pests.
- Research on plant nutrition and biological nitrogen fixation.
- Dissemination of promising groundnut varieties and technologies through on-farm research activities with larger involvement of farmers.
- Exchange of germplasm and scientists' visits with other CLAN member countries.
- Identification of pigeonpea and sorghum cultivars suitable for hilly and upland regions.
- Research on natural resource management to develop sustainable production systems with active farmer participation.
- Develop collaborative projects in partnership with CLAN/ICRISAT to obtain external funding to accelerate research in Vietnam.

Opportunities for Collaboration with CLAN: The case of Yemen

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Introduction

Agriculture contributes nearly 18% to the gross national product and provides employment to over 61% of the Yemen's work force. Annual cropped area varies depending on the amount of precipitation. On average, it is about 1.1 million ha, but in years of well-distributed rainfall, it could reach 3.5 million ha. Cereals occupy about 81% of the cultivated area, while legumes, fruits, and pastures occupy the remaining area.

Sorghum and pearl millet are considered the most important summer and winter cereal crops. Sorghum (446 000 ha) and pearl millet (98 800 ha) are grown under both rainfed and irrigation, and are adapted to nearly all agro-ecological zones of Yemen.

The total area of legume crops in Yemen during 1994 was 52 466 ha with a total production of 108 254 tons. Main crops cultivated were: cowpea, lentil, beans, broadbeans, chickpea and groundnut.

Yemen is situated in the northern stretches of the tropical climatic zone. Temperature varies greatly due to the extreme differences in elevation. Mean annual temperatures ranges from less than 15°C in the highland region to 30°C in the coastal plain region. Temperatures may rise to 40°C during summer in the coastal plain region and to over 40°C in the desert plateau region. However, the winter temperatures may go to freezing levels in the highland region.

Rainfall is highly erratic and occurs in two periods -- the first from March through May, and the second from July until September, which is the main rainy season. There is little or no rain from November to February. Rainfall varies from 50 mm in the coastal plains and desert plateau region, to >1200 mm in the western mountainous highland region.

Past Research on Sorghum, Pearl millet and Legumes

Germplasm, landraces, varieties and segregating material of sorghum and pearl millet were introduced during 1990-96 from different regional and international sources, ICRISAT as a primary cooperating agency. The elite material were utilized for developing improved varieties, and relevant management technologies were developed through adaptive research.

Some of the highlights are:

- Initiation of the National Breeding Program at the Southern Upland Agricultural Research Station (SUARS) at Taiz, which has the core sorghum breeding program for Yemen.
- Promising sorghum varieties ICSV 88013, Naga White (introduced from ICRISAT) and Tajareb (local selection); and pearl millet varieties WC-C75, IVC-C6 and RCB-1C-912, ICMV-83118 and ICTP 8203 were identified.
- A large number of production technology experiments were conducted at different agricultural research stations of Agricultural Research and Extension Authority (AREA) in Yemen. These experiments identified optimum dose and type of fertilizer, plant density, date of sowing and water requirements of important crops.

Present Research Status and Future Plans

From 1996, AREA is emphasizing on-farm research, with problem-solving approach and oriented to farmers' and production problems. ICARDA is assisting in this process.

The Agricultural Sector Management Support Project (ASMSP) research component has helped AREA in research strategy and planning. On-farm research was initiated in all agro-ecological zones of Yemen in 1997.

Based on the research strategy, the 1998-2000 medium term plans have been prepared for AREA research stations/centres, and will be executed from 1998.

Linkage with CLAN was established in July 1997 when a group of senior staff led by Vice-Minister for Agriculture, and AREA Director General Dr. A. M. Bamatraf, visited ICRISAT and a few Indian agricultural research institutions.

The major fields of mutual benefit between Yemen and CLAN member countries (with ICRISAT as the primary cooperating agency) can be summarized as follows:

- Germplasm exchange: Yemen can offer a flow of relevant genetic material and necessary technologies.
- Technology exchange: Research in Yemen is more applied, and will expect to benefit from ICRISAT and other CLAN member countries in the fields of basic and strategic research.
- Yemen can also offer its experience in the field of watershed management and genetic resources.
- CLAN can help Yemen in human resource development, participation in annual workshops and/or meetings to strengthen linkages between researchers and scientists from participating CLAN countries, and to improve their research skills.

If the Steering Committee approves, Yemen will be happy to join the Cereals and Legumes Asia Network.

CLAN Steering Committee Meeting, Batu, Malang, Indonesia 24-28 Nov 1997

Summary of Discussions

The members of the steering committee discussed and endorsed following topics for future collaboration.

♠ Technology Transfer/On-farm Research

The participants opined that there are many promising technologies in the region which may be helpful for improving productivity at farmers' field in their own country, and other countries, if adaptive research trials are conducted. Some participants felt that a better terminology for technology transfer may be "**Technology Exchange/Technology Refinement**" or "**Fine Tuning of Production Technologies**".

On-farm research that is on-going in some countries can be further strengthened. The group felt that there is a need to chalk out a targeted activity in each country for technology exchange. It was also emphasized that in addition to variety and agronomic practices, natural resource management (NRM) technologies need to be included. Technology exchange activities should be focused on a systems perspective rather than individual crops. Farmer-participatory research approaches be adapted to ensure that newly developed technologies meet farmer needs.

All participants felt that additional funding is required to make this initiative successful.

♠ Spillover of Technology

Potential of technology spillovers among the CLAN member countries is very high. For example, polythene film mulch – a popular technology in China – has proved successful for groundnut cultivation in India and Vietnam. It may also perform well in other countries where soil temperatures are low at the time of groundnut sowing.

Improved variety: Improved cultivars developed by one country can be found useful in other countries. For example, sorghum cultivars from India are in evaluation trials in Thailand and Indonesia; and some Indonesian groundnut varieties were reported promising in Vietnam.

***Maruca* pod borer tolerance (Pigeonpea)** available in Sri Lanka can be shared among the pigeonpea growing regions where *Maruca* is a major production constraint.

♠ Nomination of Technical Coordinators for Working Groups

The participants felt that Technical Coordinators (TC) are essential for each of the six technical Working Groups. TC should be nominated on the basis of technical capability and willingness of the person, and quantum of research in the country of the potential TC. The following scientists were nominated as the TCs for different Working Groups (the TCs for the latter three Working Groups are already in place):

a. Botrytis gray mold of chickpea	Dr. M.A. Bakr (Bangladesh)
b. Bacterial wilt of groundnut	Dr. Liao Boshou (China)
c. Aflatoxin in groundnut	Dr. Phan Lieu (Vietnam)
d. Groundnut viruses	Dr. D.V.R Reddy (ICRISAT)
e. Biological nitrogen fixation in legumes	Dr. O. P. Rupela (ICRISAT)
f. Drought tolerance in legumes	Dr. N. P. Saxena (ICRISAT)

It was agreed that the term for TC should be for three years, with yearly reviews and possibility of re-nomination.

♠ Regional and In-Country Training Programs

It was felt that regional and in-country training programs have a great impact on the technology generation and dissemination. Therefore, regional as well as in-country training programs need to be continued and strengthened in the future. Country Coordinators provided areas for proposed training programs (both regional and in-country).

It was also agreed that Country Coordinators will provide additional list of required training programs (after consultation in each country) to CLAN Coordinator. These will be consolidated, prioritized, and plans will be made to organize these, subject to availability of funds.

♠ Bilateral funding

The participants felt the need for accessing bilateral funds to address country specific priority problems. It was suggested that respective NARS and ICRISAT should look for bilateral donors for funding, and develop proposals jointly.

♠ Exchange of scientists/study tours

All the member countries acknowledged the benefit of the study tours and exchange of scientists. Scarcity of funds was identified as the main constraint for such activities. To augment the funds, it was proposed that the host country may bear the in-country costs (e.g., food, lodging and in-country transport, etc.) while the international travel costs (air ticket) can be provided by CLAN-ADB funds. The Country Coordinators agreed in principle to this proposal. Since this is a policy issue, firm commitment can be made only

after consultation with the respective country authorities. It was suggested that CLAN Coordinator should write as soon as possible to all the Country Coordinators to facilitate discussions in each country.

♠ Exchange of Germplasm and Information among countries

All the member countries agreed that they have been greatly benefited from germplasm exchange activities. They also acknowledged the benefit of exchange of publications and information. Some countries mentioned the problems faced in receiving germplasm from others. It was agreed that in future more attention will be paid to such requests and help each other in exchange of desired germplasm. It was also agreed to circulate publications (Annual Reports, Research papers, etc.) among the member countries for disseminating technical know-how and enhancing each other's technical capabilities. CLAN will help member countries, on a need-basis, to translate publications published in languages other than English.

To have an effective exchange of released varieties among the member countries, it was decided to have bilateral and multilateral exchange. A one-row nursery of available elite varieties in the member countries can be initiated with the help of ICRISAT. This will be a need based activity for each country.

Some member countries (Myanmar, Nepal, Yemen) also expressed the need for collecting the landraces for conserving biodiversity; and exploring the possibility of getting the best germplasm available with various organizations and countries around the world. The information on such material should be made available to all members so that they can request for the required germplasm.

♠ Joint studies on adoption of technologies and impact assessment

The participants acknowledged the importance of conducting impact assessment studies to generate information on the impacts made by NARS-ICRISAT joint research. The members felt that the joint impact assessment studies conducted so far have implications for satisfying donors' demand about impact in farmers' fields, as well as identifying the constraints for non-adoption of certain technologies. The generated information would be useful in setting future research priorities and technology generation.

On-going impact studies in Indonesia, Nepal, India, Bangladesh, and Sri Lanka need to be strengthened. The success of the study proposals submitted by Vietnam and ICRISAT to the UNDP also inspired the member countries to develop such proposals for funding. Impact assessment activities in Vietnam, China, Thailand and Philippines will commence soon.

♠ Others

Some member countries expressed the need to include other legumes (lentil, soybean, and mungbean) in the CLAN activities. It was agreed to include lentil in CLAN as necessary technical backing is promised by ICARDA. Since no other international institutes have yet committed for technical support for soybean and mungbean, it was decided that these crops can be included in later.

Minutes of the CLAN Country Coordinators' Steering Committee Meeting held on 26 Nov 1997 at Royal Orchid Garden Hotel, Batu, Malang, Indonesia

- The meeting was held under the Chairmanship of Mr Narongsak Senanarong, Chairman CLAN Steering Committee. C L L Gowda (Coordinator, CLAN) was the Secretary for the meeting.

- The meeting was attended by all 12 members (Bangladesh, China, India, Indonesia, Iran, Myanmar, Nepal, Pakistan, Philippines, Srilanka, Thailand, and Vietnam). Representative from Yemen (Dr A S Muallem), and five ICRISAT staff attended as observers.

Agenda item 1: Adoption on Agenda

- The chairman put forward the Agenda for the meeting and was adopted without any changes.

Agenda item 2: Action on Recommendations

- Action on recommendations of the previous meeting and activities undertaken during 1996/97 were approved. Bangladesh Country Coordinator was requested to expedite nomination of Deputy Country Coordinator. India Deputy Country Coordinator promised to respond regarding exchange of visit of scientists by end of Dec. 1997.

Agenda item 3: Work Plan for 1997/98

- Since all members had already participated in the discussions on country reports the workplan for 1997/98 was endorsed.

Agenda item 4: Budget statement and reallocation of budget for extended period (up to March 1999) of ADB-RETA 5603

- The budget statement and proposed reallocation of budget were approved, with the following comments:
  (a) Send statement to each country
  (b) Submit the budget statement at least one day before meeting
  (c) Budget statement of ADB project on "Legume-based technologies for rice and wheat production systems in South and Southeast Asia" should also be circulated to country coordinators.

Agenda item 5: Funding proposal for to IFAD, Rome for supporting CLAN activities

- As the proposal was discussed in detail during the morning session, members endorsed their support and asked CLAN Coordinator to finalize and submit the proposal, in collaboration with ICARDA and APAARI. CLAN coordinator will send a draft concept note to all Country Coordinators by mid December requesting inputs. The proposal needs to be submitted to IFAD by 31 Dec.

Agenda item 6: Application of Yemen for CLAN membership

- The issue was debated as to whether Yemen fulfilled the criteria for CLAN membership, as per the 'Terms of Reference' (TOR) for CLAN. Since Yemen fulfilled the criteria, Yemen was welcomed to become a new member. Yemen representative expressed happiness and assured full support to network activities.

Agenda item 7: Date and venue of next meeting

- Dr B A Malik agreed to host the next meeting in Islamabad, Pakistan during late October/early November 1998. Bangladesh would be alternate host country.

Agenda item 8 : Any other business

- A few participants expressed concern over the low-level of per-diem (out-of-pocket) allowance paid, especially to group of senior research administrator from member countries. They wanted a higher level of payment, as being done by the Rice-Wheat Consortium. ICRISAT-ADG (Mr. S. Parthasarathy) mentioned that this is a policy issue, and will be refereed to ICRISAT management.
- The chairman queried whether CLAN SC chairmanship should be for two years or one year. Since the TOR provides a two year term, it should be followed unless the clause is amended.
- The Chairman and all the other members expressed their gratitude and thanks to Dr. Suyamto and his staff for the excellent arrangements for the meeting.
- The meeting closed with thanks to all who participated.

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