वार्षिक प्रतिवेदन
Annual Report
1997-1998

NRCG

राष्ट्रीय मूंगफली अनुसंधान केन्द्र
National Research Centre for Groundnut

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National Research Centre for Groundnut
P.B. 5, Ivnagar Road
Junagadh , Gujarat

राष्ट्रीय मूंगफली अनुसंधान केंद्र
पो. बा. 5, ईवनगर रोड
जूनागढ़, गुजरात

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Cover Page
Biological Control as a Component of IPM
In the backdrop: A sclerotium is parasitized by *Trichoderma* (a fungal biocontrol agent)
Photos (From top):
1. Stem rot (in pots)
2. Rust on leaves
3. Fungal biocontrol agent (naturally ocurring)
4. Spores of biocontrol agent

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Preface

The year 1997-98 too has been a year of change, especially for research. One of the significant changes has been a thorough overhauling of the research programme under the expert guidance of the Research Advisory Committee of the Centre and reorientation to make it the instrument of executing the Perspective Plan of the Centre, NRCG Vision-2020. The project activities do fulfil the primary charge of the National Research Centres i.e. to provide the basic and strategic research backstopping to technology development. Eleven research projects have been identified keeping in view the priorities, and expertise and resources available for the IX Five Year plan. Some of the new fields which get emphasis through these projects are biotechnological approaches to groundnut improvement, a systems approach for groundnut cropping, weather-based prediction systems, biopesticides, biofertilizers and value added groundnut and its products.

The efforts have continued for the development of human resource to meet the current demands at all levels: scientific, technical and administrative.

Under the TAR-IVLP project, the farmers of the adopted villages have been convinced of the practical utility of the wheat straw mulch technology developed by this Centre, for hastening germination, conservation of moisture and maintaining favouable temperature regime in the summer crop. The Centre has also joined hands with the Central Marine Salt and Chemicals Research Institute, Bhavnagar in implementing the Biovillage. This programme has been sponsored by the Department of Biotechnology for an integrated development of villages for self-sustainability and clean environment.

The Centre has now taken the recourse to exploring the possibilities of obtaining competitive grants from the external funding agencies as one of the means of augmenting the financial resources for research at the Centre.

Whatever little we could achieve has been due mainly to the guidance and encouragement from the Indian Council of Agricultural Research and the enthusiasm and dedication of all my colleagues. I look forward to the same in the years to come to make to Centre reach its peak.

I welcome the constructive criticism, if any, from one and all for further improvement of the progress of the Centre.

A. Bandyopadhyay
Director

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दो सौ पच्चासी जनन द्रव्य क्रमांकों को 15 परिमाण तथा 6 गुणवत्ता सम्बन्धी गुणों के लिए मूल्यांकित किया गया।

दो वर्षो के अध्ययन के बाद 56 जननद्रव्य क्रमांकों की पहचान उनकी उत्पादकता से जुडे हुए गुणों के लिए एवं एक या एक से अधिक जैवीक तथा अजैवीय विक्रियाओं के प्रति प्रतिरोधिता अथवा सहिष्णुता के लिए की गयी । होनहार क्रमांकों (NRCG 5199, 7720, (44B), 1463, 698 (HYR), 9573 (WL), और 1339, 4659 (FST) की इच्छितउपज एवं सम्बन्धित गुणों के साथ पहचान की गयी ।

ग्यारह बड़े बीजों वाले जनन द्रव्य क्रमांकों के उपज एवं गुणवत्ता से जुडे गुणों के मूल्यांकन ने संकेत दिया कि NRCG 879 एक होनहार किस्म है तथा इसमें तेल व प्रोटीन अवयव क्रमशः 50.4% तथा 21.9% के साथ 100 बीजों का वजन 61 ग्राम पाया गया।

रा. मू. अनु. के. के outreach केन्द्र भुवनेन्धर केन्द्र से 1425 ननद्रव्य क्रमांकों की आपूर्ति अखिल भारतीय मूँगफली अनुसंधान समन्वय प्रयोजना केन्द्रों पर की गयी।

PStV नामक वायरस से मुक्त जनन द्रव्यों का दो स्थानों, सरदार कृषि नगर (875 जननद्रव्य क्रमांकों) तथा भूवनेश्वर केन्द्र (1500 जनन द्रव्य क्रमांकों) पुर्नयौविनान्वयन किया एवं कार्यशील संग्रहों का बहुगुणन किया गया।

ग्रीष्म ऋतु में मूँगफली की फसल उगाने के लिए 23 वैलेन्शिया (valencia) तथा 32 स्पैनिश (spanish) प्रकारों का 6 सस्यीय गुणों के लिए मूल्यांकन किया गया उन्नत जननद्रव्य क्रमांको की पहचान की गयी जो इस प्रकार है: NRCGs 615, 1176, 1727, 3491, 3812, 3978, 3546, 3902, 5202, 6828, 7198.

रा. मू. अनु. के. पर आरम्भ से ही विभिन्न अनुभागों द्वारा पहचान किए गये उन्नत जननद्रव्य क्रमांकों का एक संक्षिप्त संग्रह तैयार किया गया। सन 1996 तक पहचान किये गये 676 जननद्रव्य क्रमांकों की संक्षिप्त सूचना अभिलेख में प्रदान की गयी।

रा. मू. अनु. के. के outreach केन्द्र भुवनेश्वर पर परिरक्षित (maintained) जननद्रव्य क्रमांकों की एक वस्तु सूची तैयार की गयी।

विभिन्न उदेदश्योां के साथ खासतौर पर जैवीय तथा अजैवीय विक्रियाओं हेत 88 अन्तर्जातीय (कृष्ट प्रजातियों) के संकर बनाये गये कुल 44 F2 तथा 70 संकरों को F2 से F6 तक, की पीढ़ी के लिए प्रोन्नत किया गया पीढ़ी से 38 होनहार कल्चरों का चयन किया गया।

दो प्रजातियों TAG 20 तथा J 11 को मादा के रूप में तथा *A. duranensis*, *A. Cardlnassii*, *A. pusilla*, *A. paraguariensis*, *A. stenosperma*, ICG 8192, *A. chacoense*, *A. correntina* तथा *A. prostrata* को नर जनक के रूप में उपयोग करके 18 अन्तर्जातीय एकलसूत्रकों के संकर बनाये गये।

मोनोसोमिकों को उत्पन्न करने के क्रम एवं जीनों को स्थानापन्न करने में एक नलीसोम लाइन को विभिन्न गुणों वाले जैसे छुरीदार पर्ण चिल्लीदार बीज कवच, स्वर्ण के बीज पर्ण, के साथ क्रास किया गया। परीक्षण की दृष्टि से संकेतक जीनों के सहलग्नता देखने के लिए अनुवांशिक सामग्री संकीर्ण पर्ण उत्परिवर्ती स्वर्ण पीत पर्ण छुरीदार पर्ण तथा चिल्लीदार बीज कवच आदि सभी गुणों के सम्भव (पन्द्रह) क्रास बनाये गये।

पुष्प प्रफुल्लन के प्रारम्भ में मुख्य अक्ष को काट देने पर प्रतिदिन 2 - 3 अधिक पुष्प उत्पन्न हुए इस विधि का उपयोग संकरीकरण कार्यक्रम के लिए प्रभावी ढंग से किया जा सकता है।

पराग अंकुरण व आपेक्षिक आर्द्रता में सकरात्मक सहसम्बन्ध तथा तापक्रम के साथ नकारात्मक सहसम्बन्ध पाये गये।

गिरनार - 1 जिस में कि दोनों एवं छिलकों का अनुपात कम पाया जाता है। के 7 उत्परिवर्तितों में फलियों में छिलके उतरने के बाद दानों का प्रतिशत 71.7 से 74.8% प्रतिशत पाया गया।

GA 3, 200 ppm के दर 30 प्रतिशत तक पराग बंध्यता उत्पन्न की जब कि इथरल तथा 2,4 - D से मात्र 10% प्रतिशत परागबंध्यता उत्पन्न की जा सकी। गामा देदीप्यमानित (बिकीर्णित) M2 पीढ़ी के जीवांगों (जीन प्ररूपों) में बंध्यता का प्रतिशत 50 तक प्रलेखित किया गया।

चार प्रवृत्ति वर्गों में बैलेन्शिया जीवांग अधिकतम पुर्नउत्पादक क्षमता वाले पाये गये लेकिन पुष्पों की संख्या निम्नतम पायी गयी। यहसंकरीकरण कार्यक्रम में अधिक उत्पादन क्षमता को पाने के लिए उपयोग में लायेजा सकते है दो संकरों के पीढ़ी दर पीढ़ी से मध्यमान विश्लेषण से F1 में कुल पुष्पों के लिए विचारणीय heterosis पायी गयी कुल पुष्पों के लिए इन क्रासों नेपरस्पर प्रतिक्रिया प्रभावों खासतौर पर दोहरी प्रवृत्ति दर्शायी। क्रास M13 x Chico में पुष्पों प्रारंम्भ के दिनों में परस्पर प्रतिक्रिया प्रभावों को अनुपस्थित पाया गया।

पछेती पर्णधब्बा के प्रति प्रतिरोधिकता और गेरू के संयोगों के साथ जनकों के बीच क्रासों के के लिए अध्ययन में पाया गया कि गेरू के प्रतिरोधिता स्पष्ट रूप से प्रबल परिलक्षित हुई लेकिन इस प्रकार का सामन्यीकरण LLS के प्रति प्रतिरोधिता के लिए नही बनाया गया। प्रजनन वंशक्रम, PBS 105, PBS 228 तथा IR 14 (NRCG के) और ICGV 86020 (ICISAT का) तथा ICG 781, NCAc 343 और NCAc 927 जननद्रव्य क्रमांकों को LLS और गेरू के विरूद्ध प्रतिरोधी पाया गया विभिन्न जैवीय तथाअजैवीय विक्रियाओं के विरूद्ध प्रतिरोधकता के लिए प्रजनित उन्नतपीढ़ी के 154 कल्चरों में 23 कल्चरों का चयन किया गया इन का उपयोग भविष्य में होने वाले प्रजनन कार्यक्रमों में किया जायेगा।

भूमी में सूखे की स्थिति के लिये तीन कल्चरों, PBS 11050, 19003 तथा 21065 की पहचान भूमि में नमी की कमी से होने वाली विक्रिया के प्रति सहिष्णुता के रूप में की गयी यहसहिष्णुता पुर्नोत्पादन क्षमता, कुल पुष्पों की संख्या व अधिक परिपक्व फलियों से सन्दर्भ में पायी गयी।

कल्चर PBS 11015, 11040, 11050, 14017, 20027 तथा 21018 लौह हरितहीनता (दृश्य हरित मापदर 1.5) के प्रति अपेक्षाकृत सहिष्णुता पायी गयी।

NRCG 1308 तथा 7599 में एल्यूमिनियम विषाक्तता के प्रति अपेक्षाकृत सहिष्णुता पायी गयी।

कुछ जीन प्ररूप जो कि विभिन्न रोगों वनाशी कीटों के विरूद्ध प्रतिरोधक मध्यम प्रतिरोधक पाये गये है वह इस प्रकार है CS 19, Code 7, Code 30 तथा PBS Nos 20026, 21063 एवं 21063 अगेती पर्णधब्बा के लिए CS19,

Code 7 तथा Code 30, PBS 20026, 22028, 12028, 12029, 12032, 12038, 12063, 20142, 20147 तथा 22030 पत्तेती पर्णपच्चा के लिए PBS 29033, 29035m, 29017, 11019, 12017, 12029, 12032, 12038, 12063, 20142, 22030, तथा CS19 गैर के लिए तथा 24003, 24001, Code 11 और Code 7 थिएस।

सन् 1997 में 70 में से 2 जीन प्ररूप CY9 और DRV 12B (NRCG के वंशक्रम) का प्रयोगशाला में किये गये प्ररूप Peanut bud necrosis disease (PBND) के संक्रमण से मुक्त पाये गये चार अन्य जीवागों CY5 और PBDR 32, ICGV-86652 तथा ICG 239 में PBND का संक्रमण 2 प्रतिशत से कम पाया गया।

NCAc 927 तथा ICGV 86594 तना सड़ने की बीमारी से मुक्त पाये गये तथा IR 14, CY 7 तथा PBDR 48, CY 14, DRV 1, PBS 1-1, 27(7), PBS 145, PBS 2297 तथा ICGV 86280 में तना सड़ने की बीमारी की घटना 2 प्रतिशत से कम पायी गयी सत्ताइस प्रजातियों में से CSMG 84-1 तथा GG 20 ने *Sclerotium rolfsil* के प्रति शुष्कबीज प्रतिरोधिता दर्शायी हालांकि पौधावस्था में प्रयोगशाला में किये गये परीक्षणों में सभी तना सड़न के प्रति ग्राही खरीफ 1996-97 तथा रबी ग्रीष्म 1997 की अवधि में बीमार प्लाट के अन्तर्गत कृत्रिम संक्रमित कंक्रीट ब्लाकों में परीक्षित किये गये 15 जीवागों में से में ICGV 86020 तना सड़न की घटना सबसे कम 8.11 प्रतिशत पायी गयीजबकि इस घटना क्रम को NCAc 341879 में 35% तथा GG2 में 22.14% अभिलेखित किया गया। सन् 1997 की खरीफ तथा ग्रीष्म ऋतु के दरम्यान फसल की कटाई से पूर्व संक्रमण के लिए मूल्यांकित किए गये 20 जीवागों में से J11 में बीज संक्रमण तथा बीज कोलोनाइजेशन नही पाया गया। NRCG 5850 को ग्रीष्म 1997 में तथा NRCG 734 को खरीफ 1997 में बीज संक्रमण से मुक्त पाया गया।

पात्र में (in vitro) बीज संक्रण तथा बीज कोलानाइजेशन का औसत क्रमश 10 से 100 प्रतिशत तथा 13.33 से 100 प्रतिशत रहा। प्रजाति ग्राही तथा J11 (प्रतिरोधी) चेकों के विरूद्ध ICHNG 88448, BAU 13, JSP (HPS) 24, JSSP (HPS) 8, JSP (HSP) 19 को AUCROG को HPS प्रजाति-मूल्यांकन प्रयोग परीक्षित किया जा रहा है। प्रजाति SB XI के प्रयोगशाला में बनाये गये पौधों के एक्सप्लान्ट (explants) से जीवद्रव्योकों (protoplast) को निकाला गया तथा इनका शुद्धिकरण किया गया। बीजपत्राधार (hypocotyl) से बनाये गये एक्सप्लान्ट (explants) ने 2 प्रतिशत सेलूलोज तथा 1 प्रतिशत पैक्टिनेज (pectinase) के साथ अधिक मात्रा में जैविक (viable) जीवद्रव्यों का शुद्धिकरण किया। बीजपत्राधार एक्सप्लान्ट्स से जैवद्रव्याकों का शुद्धिकरण पर्तिकरण (layering) विधि से 20 प्रतिशत सुक्रोज (sucrose) केसाथ 1.65×10^5 प्रति मि. लि. पाया गया। इन जीवद्रव्यों का संवर्धन करने के लिये MS मीडिया, 9 प्रतिशत मैनीटोल (mannitol) के साथ तथा V47 मीडिया व वृद्धि हारमोन (growth hormones) के तीन संयोजनों को प्रयोग में लाया गया। MS मीडियम एवं V47 मीडियम (V 47 medium) में संर्वधन किये गये जैवद्रव्यकों में केवल कलीकरण (budding) ही पाया गया जबकि सात दिनों में संवर्धन के पश्चात द्वितीय व तृतीय संयोजन में जीवद्रव्यकों में प्रारम्भिक विभाजन की अवस्था पायी गयी। प्रोटोकोल रूपान्तर मानकीकरण के लिए biolistic के साथ-साथ Agrobacterium mediated तरीकों का प्रयास किया गया। कायिक भ्रूणों पर बौछावर (bombard) के लिए plasmid DNA के साथ GUS तथा हरा fluorescenece protein (GFP) का उपयोग किया गया। GUS जीनों ने बहुत उच्च बारम्बारता में transient expression दर्शाये। जबकि GFP ने कोई transient expression नही दर्शाये। प्रजाति J11 से व्युत्पन्न भ्रूण को osmotin जीन तथा NPT II संकेतक मुक्त Agrobacterium के साथ सह संबर्धन नही किया जा सका भ्रूणों को पुर्नोत्पादन तथा रूपान्तरिकतों को आगे पुष्टीकरण के लिए रखा गया।

अन्तर्जातीय सम्बन्धों को समझने के लिए, F1 संकरों के द्विगुणीकरण व्यवहार और इसके J11 X A. cardenasii (ICG 1158) के allo-hexaploid का विश्लेषण किया गया। संकरों में ring trivalent ने जीनोमों में कम से कम एक isochromosome संयुक्त होने का संकेत दिया। आइसोक्रोमोसोमों की उपस्थिति ने, genus Arachis के उद्भव क्रम में, chromosome arm का उनके अपर्याप्त अलगाव के अनुकरण द्वारा निश्चित द्विगुणन सुझाया। चार सूत्री (Quadrivalent) के -O- रूप को रेणुमातृकोषिकों (pollen mother cell) में समजा गुणसूत्रक युग्मता के संकेत के रूप में निरूपित किया और संदेह की सम्भावना को स्थान दिया कि genus *Arachis* की मूल संख्या 10 से कम है। षट्गुणसूत्री J11 x *A. cardensii* की एक स्वनिषेचित संतति को प्रत्येक में गुणसूत्रीय बनावट के लिए समसूत्र विभाजिनीय विश्लेषण किया गया। यह निरूपित किया गया कि अधिकतर संततियों (94.3%) में 60 गुणसूत्र वर्ग निहित हैं। भिन्न एकाकी सूत्रियों का औसत 56 से 62 के बीच पाया गया। जब कि कुछ एक संततियों में 62 + 1 खण्ड निरूपित किये गये।

सस्य उत्पादन

चार माह भण्डारण के बाद बीजों को 0.05 कैल्शियम क्लोरइड विलयन में भिगोकर बीज ओजस्वता के द्वारा रबी ग्रीष्म कालीन उत्पाद का बीजांकुरण तथा पौध ओज को बढ़ाया जा सकता है। NRCG फार्म की मृदा में पोटैशियम के अनुप्रयोग ने वर्ष 1996 के रबी-ग्रीष्म मौसम में अर्थपूर्ण अधिक फलियों का उत्पादन दिया।

वानस्पतिक अवस्था पर मृदा नमी-कमी विक्रिया ने जो कि बुआई के 20 दिन बाद से प्रारम्भ होकर 25 दिनों के लिए थी तथा 5 दिन के अन्तराल पर दो सिचाइयों का अनुसरण करने पर परिणाम में अधिक फली उपज (28-34 प्रतिशत दर्शायी।

सामान्यत: पर्णताप सहिष्णु जीनप्रारूप, ग्राही प्रकारों में अधिक जैवभार उत्पन्न करने की क्षमता पायी गयी। बीजों को 40^{0}C पर 4 घंटे के लिए पानी में भिगोकर बुआई से पूर्व दिये गये इस गर्म तापमान के उपचार ने शीघ्र पुष्प प्रस्फुटन, अधिक पुष्प तथा फली उत्पादन दर्शायी। यह बुआई कम तापमान पर जनवरी के प्रथम सप्ताह (अधिकतम तापमान 8-10^{0}C)।

उत्तर प्रदेश के चन्द्रशेखर आजाद कृषि एवं प्रौद्योगिकी विश्व विद्यालय के मैनपुरी केन्द्र पर शीत सहिष्णु जननद्रव्यों की स्क्रीनिंग का कार्य शुरू किया गया व उन्नत जननद्रव्य की पहचान की गयी जो इस प्रकार है: ICG 4071, 4091, 4114, 1086, 2067, 4710, 2210 और ICG 2036.

HPS मूंगफली में छिलका हटाने के बाद दानां (shelling outturn) प्रतिशत तथा बीजभार को उन्नत करने के लिए Ca तथा K तत्वों को महत्वपूर्ण पाया गया। बूंद-बूंद सिचाई विधि द्वारा सूक्ष्म तत्वों के अनुप्रयोग से उर्वरक क्षमता को बढ़ाया मिला, इस बात का प्रमाण फलियों की बढ़ी हुई संख्या, अधिक shelling outturn तथा अधिक 100 बीजों के भार से मिला।

भूवनेश्वर की अम्लिय मृदा से ही ब्रैड़ीराइजोबियम मिलाते गये। नाइट्रेट सहिष्णु ब्रैडी राइजोबिया (Bradirhizobia) की 33 प्रभेदों को अलग किया गया धान के खेतों तथा नये फफूदी आइसोलेटों, PSM 1 तथा BHU1, चार नये जीवाणु आइसोलेओ को ट्राइकैल्शियम फोस्फेट (Tricalcium Phosphate) को प्रभावी ढंग (48.52-74.34mg 100 ml^{-1} मीडियम) से विलायक करने में सक्षम पाया गया।

विभिन्न कार्यकीय वर्गो के 423 राइजोबेक्टीरिया, पौधों की वृद्धि को बढ़ाने तथा घातक गुणों के लिए परीक्षित किए गये आइसोलेट न. 180 तथा 188 ने क्रमशः *Sclerotium rolfsii* तथा *Aspergillus niger* के प्रति फफूंदी विरुद्ध गतिविधियां प्रदर्शित की। आइसोलेट नं. 362, 397, 359 तथा C 185 ने IAA की सराहनीय मात्रा उत्पन्न की। आइसोलेट नं C 220, C 63 तथा C 103 (प्रबल साइनाइड उत्पादक) ने मूल वृद्धि को घटाया तथा आइसोलेट नं C 185 (अनुत्पादक) ने मूंगफली की पौध bioassay में अर्थपूर्ण जड़ वृद्धि दिखायी।

गेहूं की लाइनो (30 से.मी. लाइन से लाइन की दूरी) के बीच मूंगफली को या तो गेहूं में दाना भरने की अवस्था में या कटाई से 15 दिन पहले डिबलिंग करना लाभ दायक पाया गया। खरीफ मूंगफली के बाद उगाये गये चना, गेहूं तथा सरसों ने नत्रजन एवं फासफोरस की संस्तुति मात्रा तक तथा सूर्यमुखी ने संस्तुति से आधी मात्रा तक अनुक्रिया दिखायी।

खरीफ मूंगफली की खुदाई के बाद खरीफ मूंगफली और खरिफ पड़ती के बीच Organic कार्बन की मात्रा % में विभिन्नता पायी गयी।

पाया गया कि ग्रीष्म कालीन मूंगफली के साथ किनारे की पट्टी की मेंडो पर बाजरे की दो कटाइयों ने रू. 10,049 प्रति है. का अतिरिक्त लाभ दिया। इसी तरह सब्जियाँ जैसे पालक, धनियां, और मूली ने ग्रीष्म कालीन मूंगफली की सह फसल के साथ एक महीने के अन्दर ताजी सब्जी की कटाई के रूप में क्रमश रू. 22,042 रू. 28,413 तथा रू 34,669 प्रति है. का अतिरिक्त लाभ दिया।

अन्तरसस्यों में आपसी आनुवाशिक प्रतिक्रिया के बीच के सम्बन्धों को अध्ययन का एक प्रयास किया गया। मूंगफली की किस्म M13 (फैलने वाली) के साथ अरहर की एक छोटी प्रजाति ICPL 87 के संयोजन में अधिक तम फली उत्पादन 959 कि.ग्रा./है. प्रलेखित किया गया जबकि मूंगफली के तीन प्रवृत्ति प्रकारों (वर्जिनिया रनर, वर्जिनिया बंच तथा स्पैनिश) को अरहर की चार किस्मों के साथ संगम किया गया। एक सम्बन्धित अध्ययन में जब मूंगफली के तीन प्रवृत्ति प्रकारों (वर्जिनिया रनर, वर्जिनिया बंच तथा स्पैनिश) के साथ अरण्डी की तीन किस्मों का संगम किया गया, अरण्डी की लम्बी किस्म DCS 59 के साथ संगम में मंगफली की फैलने वाली किस्म कादिरी-3 में अधिकतम फली उत्पादन प्रलेखित किया गया।

मूंगफली की खेती के लिए सामान्य व्यवहार तथा उथले भूपरिष्करण की संस्तुति के विपरीत जब एक-एक बार दाती + मिट्टी पलटने वाला हल चलाया गया तो परिणाम स्वरूप फलियों की संख्या तथा फलियों का प्रति पौधा वजन व उपज अधिकतम (1150 कि.ग्रा./है.) पायी गयी।

फसल सुरक्षा

मूंगफली की प्रति 5 पंक्ति में जैसिड व थ्रिप्स अधिकतम कीट संख्या क्रमशः 2 nos/sweep तथा 1.5 nos./sweep के साथ फसल के पूरे वृद्धिकाल में थ्रिप्स तथा जौसिड की संख्या ETL'S से कम पायी गयी ।

कीटनाशी मिश्रण (0.02 प्रतिशत फास्फोमिडान + 2 प्रतिशत नीम तेल) के साथ छिड़काव ने जैसिड के ऊपर अच्छा नियन्त्रण किया जबकि थ्रिप्स कीट संख्या (2.2 nos/m sweepnet) अधिक पायी गयी।

तीन वर्षो के संकलीत आकड़ों ने संकेत दिया कि *T. viride* (Monitor-S 62.5 कि.ग्रा. है. की दर से) मृदा में अनुप्रयोग सेतना सढ़ने की बीमारी पर अधिकतम (48%) नियन्त्रण पाया जा सकता है इसी तरह का व्यवहार बीजों की *T. viride* (Monitor w.p.4 ग्रा./कि. ग्रा. बीज) के साथ मिलाने पर तथा इन दोनो उपचारों के संयोजन द्वारा दिखाया गया अरण्डी की खली 1000 कि.ग्रा./है. की दर का मृदा में अनुप्रयोग ने अधिकतम फली उत्पादन (1060 कि.ग्रा./है) दिया

तथा *T. viride* के साथ बीजोपचार तथा *T. viride* का मृदा में अनुप्रयोग व बीजोपचार के संयोजन के द्वारा अनुसरण किया गया।

तीन वर्षों के संकलित आकड़ों ने अगेती (ELS) व पछेती (LLS) पर्णघब्बा तथा गेरू (rust) रोगों की गम्भीरता में विभिन्न फसल संयोजनों में अर्थपूर्ण भिन्नता दर्शायी। मूंगफली + बाजरा की अन्तरसस्य प्रणाली ने मुख्य फसल के ऊपर ELS, 39 प्रतिशत तक, LLS 54 प्रतिशत तक तथा रस्ट 49 प्रतिशत की गम्भीरता में अर्थपूर्ण घटोत्तरी की। अनु प्रबन्धन के लिए अगला उत्तर फसल संयोजन मूंगफली + अरहर रहा जिसने ELS 50 प्रतिशत तक, LLS 44 प्रतिशत तथा रस्ट 21 प्रतिशत तक की सघनता कम की।

अन्य

उत्तरी पूर्व पहाड़ी क्षेत्रों के लिए भा. कृ. अ. प. के अनु. काम्पलेक्स त्रिपुरा, मणिपुर, तथा मेघालय के सहयोग से उत्तरी पूर्व पहाड़ी क्षेत्रों में मूंगफली की खेती की समस्याओं पर प्रयोगों की शुरूआत की गयी।

अनुसंधान सलाहकार परिषद का गठन किया गया और 23 से 24 अप्रैल 1997 तथा 30 से 31 मार्च 1998 को दो बैठकों का आयोजन किया गया।

पूर्वविलोकित योजना Perspective plan अभिलेख (vision 2020) प्रकाशित किया गया। दो प्रतिभोगी अनुदान प्रयोजनाओं और मूंगफली के भण्डार कीट bruchid beetle *(Caryedon serratus)* के विरुद्ध प्रभावी जैवनाशी कीटनाशियों की पहचान और मूल्यांकन क्रमशः ICAR और CSIR/TMOP द्वारा की गयी।

लगभग 6 वर्षों के अन्तराल (PStV के प्रतिबन्धों के कारण) के बाद प्रजनक बीजोत्पादन कार्यक्रम प्रारम्भ किया गया।

संस्थान-ग्राम संयोग आयोजन (Institute Village Linkage Programme) कार्यक्रम का कार्य जारी रहा। उड़ीसा राज्य बीजनिगम के प्रक्षेत्रों पर रबी ग्रीष्म मूंगफली बीज जीवनशक्ति को सुरक्षित रखने के NRCG तरीकों का प्रदर्शन किया गया।

स्टाफ के सभी सदस्यों के लिए केन्द्र पर ही एक कम्प्यूटर शिक्षण प्रशिक्षण कार्यक्रम संचालित किया गया।

जननद्रव्यों को मध्यम अवधि तक संरक्षित रखने के लिए, NBPGR नई दिल्ली के द्वारा प्राप्त एक शीत भंडार (cold storage module) को प्रस्थापित किया बड़े पैमाने पर (500 वृक्ष) वृक्षारोपण किया गया।

प्रक्षेत्र बाँध में मत्स्य संवर्धन की शुरूआत की गयी एक अतिथिग्रह व 25 आवासीय भवनों का निर्माण पूरा हुआ और उन्हें अधिकृत किया गया।

Summary

Germplasm conservation, enhancement and biotechnology

Seventy released cultivars were characterized for 45 agro-morphological traits for further confirmation.

Two hundred and eighty-five accessions were evaluated for 15 qualitative and 6 quantitative traits.

Fifty six accessions identified to be resistant to or tolerant of one or more biotic and abiotic stresses were evaluated for yield attributes for two years. The promising accessions with desirable yield and related traits were identified, which were NRCG 5190, 7720(HYB), 1463, 6987(HYR), 9573(WL) and 1339, 4659(FST).

Eleven bold seeded accessions evaluated for **yield and quality traits** indicated NRCG 879 as promising with HSM of 61 g with oil and protein contents of 50.4 % and 21.9% respectively.

1425 accessions were supplied from NRCG Outreach Centre (NOC), Bhubaneshwar to AICRP(G) centres.

The rejuvenation of PStV-free germplasm was undertaken at two locations. At Sardar Krushi Nagar, 875 accessions and at the NOC, about 1500 PStV-free working collection were multiplied.

Twenty three valencia, and 32 spanish types were evaluated for six agronomic traits in the summer season. The **promising accessions** identified were NRCGs 615, 1176, 1727, 3491, 3812 and 3978 (FST) and NRCGs 3546, 3902, 5202, 6828 and 7198 (VUL).

A **compendium on germplasm accessions identified** by different sections at NRCG since the inception was prepared. The passport information on 676 accessions identified till 1996 is provided in the document. An inventory of accessions maintained at the NOC, Bhubaneswar was prepared.

Eighty-eight interspecific (cultivated sp.) crosses were made with various objectives, especially to counter biotic and abiotic stresses. A total of 44 F_1s and 70 crosses in F_2 to F_6 generations were advanced to the next generation. Thirty-eight promising cultures were selected from the advanced generations.

Eighteen **interspecific hybridizations** were made using two cultivars viz. TAG 24 and J 11 as female, and *A. duranensis*, *A. cardenasii*, *A. pusilla*, *A. paraguariensis*, *A. stenosperma*, ICG 8192, *A. chacoense*, *A. correntina* and *A. prostrata* as male parents. In order to **produce monosomics** and locating genes, a nullisomic line was crossed with parents with marker traits with a view to testing the association (linkage) among marker genes, all possible corsses (fifteen) have been made.

The cutting of main axis at flower initiation produced two to three **more flowers per day** and it may be effectively in hybridization programme.

The **pollen germination** was found to be positively correlated with relative humidity and negatively correlated with temperature.

Seven **mutants of Girnar 1**, a cultivar with low shelling percent, were found promising for shelling outturn (71.7 to 74.8%).

GA_3 @ 200 ppm **induced pollen sterility** upto 30%, whereas Ethrel and 2,4-D could induce only 10 % pollen sterility.

In M_2 generation of gamma irradiated genotypes, upto 50 per cent pollen sterility was recorded.

Among the four habit groups of groundnut, Valencia genotypes were found to be the most **reproductively efficient** but produced the least number of flowers. They can be used as parents in hybridization programme to achieve high reproductive efficiency. In generation mean analysis with two crosses considerable **heterosis** was found for total flowers in F_1. For total flowers, these crosses had shown presence of the interaction effects pre-dominantly of duplicate nature. For days to flower initiation, the interaction effects were absent in the cross M 13 X Chico.

In a study of F1s of crosses between parents with combinations of resistance to late leaf spot (LLS) and rust, it was found that resistance to rust appeared apparently to be dominant but such generalisation could not be made for resistance to LLS. The breeding lines PBS 105, PBS 228 and IR 14 (of NRCG) and ICGV 86020 (of ICRISAT) and the accessions ICG 781, NCAc 343 and NCAc 927 were found to be resistant to LLS and rust diseases.

Out of 154 advanced generation cultures bred for resistance to various biotic and abiotic stresses 23 cultures were selected for further use in breeding programmes.

The three cultures PBS 11050, 19003 and 21065 were identified as **soil-moisture-deficit stress tolerant** as their reproductive efficiency in term of mature pods to total number of flowers was higher than other cultivars tested under similar conditions.

The cultures PBS 11015, 11040,11050, 14017, 20027,and 21018 were found to be **tolerant of iron chlorosis** (visual chlorotic rating <1.50).

NRCG 1308 and 7599 were found to be relatively tolerant of Al toxicity.

The breeding lines which were found to be **resistant/moderately resistant to various diseases and insect-pests** were CS 19, Code 7 Code 30 & PBS No's 20026 ,21063 & 24006 for early leaf spot; CS 19, Code 7 and Code 30, PBS 20026, 22028, 12029, 12032, 12038, 12063, 20142, 20147 & 22030 for late leaf spot; PBS 29033, 29035m, 29017, 11019, 12017, 12029, 12032, 12038, 12063, 20142, 22030 and CS 19 for rust; and 24003, 24001, Code 11 and Code 7 for thrips.

In summer 1997, out of 70 genotypes tested two, CY 9 and DRV 12 B(NRCG breeding lines), were found to be free from **peanut bud necrosis disease** infection *in vivo*. Four other genotypes viz., CY 5 and PBDR 32, ICGV 86652 and ICG 239 had below two per cent incidence of PBND.

NCAc 927 and ICGV 86594 were free from **stem rot** and IR 14, CY 7 and PBDR 48. CY 14, DRV 1, PPS 1, PPS 1-1, 27(7), PBS 145, PBS 22017 and ICGV 86280 had less than two per cent incidence of stem rot. Out of 27 cultivars, CSMG 84-1 and GG 20 showed dry seed resistance to *S.rolfsii*. However, all were susceptible to stem rot at seedling stage *in vitro*. Out of the 15 genotypes tested during kharif 1996-97 and rabi-summer 1997 against stem rot in artificially infested concrete blocks, ICGV 86020 recorded the lowest incidence (8.11 per cent) of stem rot as against 35 per cent in NCAc 341879 and 22.14 per cent in GG 2.

Out of 20 genotypes evaluted for **pre-harvest *A. flavus* infection**, no seed infection and seed colonization were recorded in J 11 during kharif and summer 1997. NRCG 5850 was free from seed infection in summer 1997 and NRCG 734 during kharif 1997. Seed infection and seed colonization *in vitro* ranged from 10 to 100 per cent and 13.33 to 100 per cent, respectively, in ICHNG 88448, BAU 13, JSP (HPS) 24, JSSP (HPS)8, JSP (HPS) 19, being tested in the HPS varietal trial of the AICRPG, against Cv. M 13 (susceptible) and J 11 (resistant) checks.

Different explants from *in vitro* raised seedlings of cv.SB XI were tried for the **isolation and purification of protoplasts**. The combination of 2% cellulase and 1% pectinase yielded more number of viable protoplasts and the hypocotyl explants responded better. The yield of protoplasts after purification by layering over 20% sucrose was 1.65×10^5 /ml from hypocotyl explants. Both MS with 9% mannitol and V47 media, with three combinations of growth hormones were used for culturing the protoplasts. The protoplasts showed only budding in the MS based culture medium in all combinations and in the V47 medium, the initial protoplast division was observed in second and third combination after 7 days in culture.

For the standardisation of **transformation protocols**, the biolistic as well as the *Agrobacterium* mediated methods were attempted. Plasmid DNA with GUS and Green Fluorescence Protein (GFP) were used to bombard the somatic embryos. The GUS gene showed transient expression in a very high frequency and the GFP did not show any transient expression. Mature somatic embryos derived from the cv. J 11 were co-cultured with *Agrobacterium* containing the Osmotin gene and NPT II marker.

To understand the **interspecific relations**, pairing behaviour of F1 hybrids and its allo-hexaploid of J 11 x *A. cardenasii* (ICG 1158) were analysed. The ring trivalent indicated the presence of at least one isochromosome in the genomes involved in the hybrid. The presence of the isochromosomes suggests selective duplication of chromosome arm followed by their inadequate differentiation in course of evolution in the genus *Arachis*. The -o- forms of quadrivalent as observed in the PMCs are clear indication of the

autosyndetic pairing and provides a scope to doubt that the basic number of the genus *Arachis* is less than ten. A selfed progeny of the hexaploid J 11 x *A. cardenasii* was analysed mitotically for the chromosomal constitution in the individuals. It was observed that the most of the progeny (94.3%) consisted of 60 chromosome classes. The range of aneuploids varied between 56 and 62. However, a few individuals were observed to have 62+1 fragment.

Crop production

Seed germination and seedling vigour of the rabi-summer produce may be improved after four months of storage by **seed invigoration** by soaking in 0.05 M $CaCl_2$ solution.

Application of **potassium** in NRCG farm soil gave significantly high pod yield in rabi-summer 1996.

Soil moisture-deficit stress at vegetative phase starting from 20 days after sowing for 25 days followed by two frequent irrigations at five-day intervals, resulted in higher pod yield (28-34 per cent).

In general, leaf **thermo-tolerant genotypes** were able to produce more biomass than the susceptible types. Pre-sowing heat treatment of seeds at 40°C for 4 hours in a water bath showed early flowering, more number of flowers and higher pod yield when sown in the first week of January when minimum temperature was around 8-10°C.

Work on screening of germplasm for **cold tolerance** was initiated at the Mainpuri station of the C.S.Azad University of Agricultural and Technology, U.P. and promising genotypes were identified, which were ICG 4071, ICG 4091, ICG 4114, ICG 1086, ICG 2067, ICG 4710, ICG 2210 and ICG 2036.

For HPS groundnut Ca and K were important nutrients for improving the shelling outturn and seed mass. The **micronutrients** applied through drip irrigation increased the fertilizer use efficiency by increasing number of pods, higher shelling outturn and 100-seed mass.

Thirty-three strains of nitrate **tolerant** ***Bradyrhizobia*** have been isolated. *Bradyrhizobium* strains have also been isolated from rice fallows and acidic soils of Bhubaneswar.

Two new phosphate solubilising fungal isolates, PSM1 and BHU1 and four new bacterial isolates were found to solubilize tricalcium phosphate efficiently (48.52 - 74.34 mg.100 mL^{-1} medium).

Four hundred and twenty-three different physiological groups of **rhizobacteria** were tested for **plant growth promoting** and deleterious attributes. Isolate nos. 180 and 188 exhibited antifungal activity against *Sclerotium rolfsii* and *Aspergillus niger*, respectively. Isolate nos. 363, 397, 359 and C185 produced appreciable amounts of IAA. Isolates nos.

C220, C63 and C103 (potent cyanide producers) reduced root growth and isolate C185 (non producer) significantly enhanced the root growth of groundnut in a seedling bioassay.

Groundnut dibbled as a **early crop** in-between rows of wheat (spaced at 30 cm row to row) either at grain filling stage or at 15 days before harvest of wheat was found to be profitable.

Gram, wheat and mustard as **sequential crop** responded upto the recommended dose and sunflower upto half of the recommended dose of N & P when grown after kharif groundnut. Variation in **organic carbon content (%)** of soil between kharif groundnut and kharif fallow after harvest of kharif groundnut was less.

Two cuts of pearlmillet on bunds of border strips in association with summer groundnut was found to give an additional return of Rs.10,049 ha^{-1}. Similarly vegetables like fenugreek, coriander and radish as **intercrops with summer groundnut** and harvested within a months as fresh vegetables gave an additional return of Rs.22,042, Rs. 28,413 and Rs.34,669, respectively.

In an attempt to study the inter relationship of **inter genotypic interactions among intercrops**, when three habit types (virginia runner, virginia bunch and spanish) of groundnut were associated with four pigeon pea cultivars, the highest pod yield of 959 kg ha^{-1} was recorded in the combination of cv. M 13, a spreading groundnut in association with a short cv. ICPL 87 of pigeonpea. In a related study when three habit types (virginia runner, virginia bunch and spanish) of groundnut was associated with three castor cultivars, the highest pod yield was recorded in semi - spreading groundnut cv. kadiri 3 in association with tall cv. of castor, DCS 59.

The number of pods and pod weight/plant were the maximum when one cultivator + MB plough was done which resulted in the maximum pod yield of 1195 kg ha^{-1}, contrary to the general practice and recommendations of shallow **tillage** for groundnut cultivation.

Crop protection

The population of thrips and jassids were below the **economic threshold level** through out the crop growth with the highest population of 2nos/sweep/5m and 1.5 nos/sweep/5m row of groundnut of jassids and thrips, respectively.

The spray with pesticides mixture (0.02 % Phosphamidon + 2 % Neem oil) gave good control over the jassid (0.72 no./m/sweepnet), while the thrips population increased (2.2 no./m/sweepnet).

Pooled data over three years indicated that soil application of *T. viride* (monitor S @ 62.5 kg/ha) as a **biocontrol agent** gave maximum control (48 per cent) of stem rot followed by seed treatment with *T. viride* (monitor w.p. 4g/kg seed) and combination of these two treatments. Soil application of castor cake @ 1000 kg/ha gave maximum pod yield

(1060 kg/ha) followed by seed treatment with *T. viride* and combination of seed treatment and soil application of *T. viride*.

Pooled data over three years showed that the **severity of ELS, LLS and rust diseases** varied significantly among **crop combinations**. Groundnut + pearlmillet intercropping significantly reduced the severity of ELS by 39 per cent, LLS by 54 per cent and rust by 49 per cent over sole crop. The next best crop combination for disease management was groundnut + pigeonpea which reduced the intensity of ELS by 50 per cent, LLS by 44 per cent and rust by 21 per cent.

Others

Experimentation on problems of groundnut cultivation in the **NEH region** was initiated in collaboration with ICAR Research Complex for NEH region at Tripura, Manipur and Meghalaya.

Research Advisory Council was constituted and two meetings were held from 23 to 24 April, 1997 and 30 to 31 March, 1998.

Perspective plan document was published. A **competitive grant** project "Identification and evaluation of biopesticides effective against the storage pest of groundnut bruchid bittle (*Caryedon serretus*)" Olivier and "Synthesis of leaf miner (*Aproaerema modicella* ber.) sex pheromone and development of dispensors for integrated pest management in groundnut" has been awarded by the ICAR and CSIR/TMOP, respectively.

Breeder seed production programme was initiated after a gap (due to PStV restriction) of about six years.

The work on **Institute Village Linkage Programme** continued. The NRCG method of preserving seed viability of rabi-summer groundnut was demonstrated in OSSC seed farms.

An in house **computer literacy** training programme was conducted for staff members.

A cold storage module for medium duration conservation of germplasm obtained through NBPGR, New Delhi was installed.

Large scale arboricultural and horticultural plantation (five hundred trees), was done.

Fish culture was initiated in check dam.

Construction and taking over of 25 residential quarters and a guest house have been completed.

About the Institute

The National Research Centre for Groundnut (NRCG) was established in the year 1979 by the Indian Council of Agricultural Research (ICAR).

With the drafting of the perspective plan 'NRCG Vision-2000', the mandate of the Centre was reoriented to provide basic and strategic research support backstopping to the National Agricultural Research Systems on groundnut. Accordingly, the revised mandate is as follows.

- Conduct basic and strategic research to enhance production, productivity and quality of groundnut.
- Act as the national repository of working collection of groundnut germplasm and information on groundnut research.
- Establish relevant institutional linkages, offer consultancy and training, and
- Provide logistic support and coordination mechanism for generation of location specific technology through the All India Coordinated Research Project on Groundnut.

The research activities of the Centre are carried out by nine scientific sections: Genetics Resources, Plant Breeding, Genetics and Cytogenetics, Agronomy, Biochemistry, Plant Pathology, Entomology, Plant Physiology and Microbiology. Eleven research projects have been formulated to achieve the Centre's mandate during IX plan period and appropriate strategies have been followed for the successful implementation of these projects. In addition, projects funded by external funding agencies are also being implemented at the Centre. The supporting sections of the Centre are: Library, Farm, Establishment and Audit & Accounts.

The NRCG is located 4 km away from Junagadh main town on the Junagadh-Ivnagar road. Junagadh is connected by road and meter- gauge railway line to Ahmedabad which is 376 km away. The nearby airports are Keshod which is 35 km away and Rajkot which is 110 km away.

The Centre lies on 70.36° E longitude and 21.31° N latitude at an altitude of 60 m above mean sea level. The landscape of the are is generally flat. The soils are medium-black and shallow, with depths ranging from 6" to 18".

The climate of this area is semi-arid with a rainfall ranging from 800 to 1000 mm. The rainfall is highly erratic and more than 90 per cent of the rain is received during June to September with several intermittent long dry spells. The monsoon rains generally commence by the third week of June but sometimes delayed till the first week of August. The winter showers are meagre and rare. The drought is a rule rather than an exception not only for Junagadh but for the entire Saurashtra region. The occurrence of frost is rare in this region.

Agro-Meteorological data of Junagadh for the year 1997-98

Months	Temp °C		RH	Rain fall	Soil temp °C		Wind Vel.	Sunshine
	Max.	Min.	%	mm/rainy day	5 cm	10 cm	km/hour	hrs/day
Apirl'97	36.6	21.6	73	12.7	28.7	30.2	8.10	8.60
May	49.0	26.0	77	-	32.2	32.2	10.80	9.30
June	33.0	25.0	85	231.7	29.4	30.4	11.40	4.90
July	31.0	26.0	91	281.5	28.4	29.2	11.08	1.60
August	32.8	26.1	98	96.4	27.2	27.9	8.40	2.60
September	31.9	23.6	88	217.6	27.2	28.0	5.60	5.60
October	35.6	21.2	81	39.3	26.8	28.0	5.40	9.40
November	28.6	14.8	74	-	24.6	26.0	4.80	8.60
December	25.2	11.1	68	-	18.8	21.6	8.20	8.00
January'98	29.0	11.0	72	-	17.2	19.8	6.70	8.20
February	31.0	13.5	81	-	18.6	19.1	5.40	7.90
March	36.1	18.2	62	-	24.5	26.7	7.90	9.90

Research Accomplishments

Genetic Resources

Project: Collection, Mintenance, Evaluation, Documentation and Distribution of Cultivated Groundnuts and Related *Arachis* Species.

N.R. Bhagat, K. Rajgopal, K. Chandran (on study leave), P. Paria, M.P. Ghewande, V. Nandagopal, J.B. Misra and A.L. Singh

A. DISTRIBUTION OF GERMPLASM

To support the ongoing research programmes, 164 accessions were supplied to three Sections within the Centre. The supply of germplasm was also undertaken from the NRCG Out-reach Centre, Bhubaneswar to six indenters and 1425 accessions were supplied.

B. MULTIPLICATION AND EVALUATION OF CULTIVATED GROUNDNUT GERMPLASM

1. Multiplication

As a continuing cleaning up operation of germplasm collection from PStV contamination, the rejuvenation of PStV free germplasm was undertaken at (a) Gujarat Agricultural University, Sardar Krushi Nagar; and (b) NRCG Out-reach Centre, Bhubaneswar.

(a) Gujarat Agricultural University, Sardar Krushi Nagar

The working collection comprising germplasm accessions (692), disease resistant lines (119) identified at Bhubaneswar, released varieties (61) and 12 bold seeded accessions were multiplied during kharif 97. Nine accessions failed to germinate, and the pod yield (g) in 300 accessions was above 250.0.

(b) NRCG Out-reach Centre, Bhubaneswar, Orissa

About 1500 PStV-free working collection was sown in July 1997 and harvested in November 1997 for maintenance and seed multiplication.

2. Preliminary evaluation

a. Yield evaluation of specific accessions during summer 1997

Fifty-five accessions comprising 23 valencia, and 32 spanish types were evaluated for six agronomic traits during the summer season. The collection was scored for six agronomic traits (Table 1). The promising accessions identified for yield were NRCGs 615, 1176, 1727, 3491, 3812 and 3978 among valencias with more than 350 g pod yield/m^{-2}, and NRCGs 3546, 3902, 5202, 6828 and 7198 in spanish types with more than 450 g pod yield m^{-2}.

Table 1. Mean (M) and Range (R) for six agronomic traits

	Trait	M	R
1.	Days to 50 % flowering	23.3	18.0-27.0
2.	Pod bearing plants (%)	92.0	68.7-100.0
3.	Pod yield m^{-2}	336.4	140.0-585.2
4.	Shelling outturn	56.1	46.2-64.7
5.	SMK per cent	83.4	71.6-92.1
6.	100-Seed mass	37.0	25.0-61.0

b. Characterization of germplasm

Two hundred and eighty-five accessions acquired from the NRCG Out-reach Centre, Bhubaneswar were scored for 15 qualitative and 6 quantitative traits. The information generated is being catalogued.

C. CHARACTERIZATION AND EVALUATION OF RELEASED GROUNDNUT CULTIVARS

Seventy released cultivars comprising 16 Virginia bunch, 17 Virginia runner, two Valencia and 35 Spanish types were characterized. The trial was laid out for the second time for confirmation of previous observations. The cultivars were scored for 45 agro-morphological traits. The extent of variation for yield and related traits have been shown in Table 2. Wide variation in oil and protein contents was present. Oil content ranged from 45.1 % to 54.9 % and the range was between 18.5 to 28.2 % for protein content. The highest oil content (54.9%) was recorded in GG 20 cultivar and the highest protein content (28.2) was in CSMG 84-1.

It was observed that the pod and seed characters will be the most stable and useful in identifying a few cultivars. However, the overlapping of traits persists in these collections for many morphological traits. A compiled reference manual will be brought out containing information on all qualitative and quantitative traits to facilitate the seed certification agencies and the groundnut breeders for identification of released cultivars.

Table 2. Mean (M) and Range (R) for 12 agronomic traits in 70 released cultivars

	Trait	M	R
1.	Days to maturity	115.3	103.0-130.0
2.	Pod bearing plants (%)	97.6	86.8-100.0
3.	Pod yield/m^2 (g)	123.5	52.0-211.9
4.	Shelling outturn (%)	69.9	65.1-73.2
5.	Sound mature seed (%)	89.9	84.6-95.3
6.	100-Seed mass (g)	43.1	35.0-54.0
7.	Pod length (mm)	24.6	20.3-29.3
8.	Pod width (mm)	11.5	10.0-14.0
9.	Seed length (mm)	12.3	10.0-15.7
10.	Seed width (mm)	7.3	6.8-8.4

D. EVALUATION OF SPECIAL-FEATURE GROUNDNUT ACCESSIONS

Fifty six accessions identified to be resistant to or tolerant of one or more biotic and abiotic stresses were evaluated for yield attributes for two years. Table 3 lists the promising accessions identified and their yield attributes.

Table 3. Promising accessions identified and their yield traits.

NRCG	PYM	SHP	SMK	HSM	HPM
Virginia runner					
288	157.9	73.1	93.2	48.0	104
1463	147.3	67.6	79.8	51.0	108
1840	149.0	69.9	92.7	51.0	101
1978	144.7	68.6	88.2	49.0	103
3012	144.4	68.8	90.5	44.0	91
Control (Mean)	137.2	71.3	92.4	46.0	92
Spanish					
2397	106.1	72.2	91.0	36.0	72
9573	105.2	73.8	94.3	33.0	72
Control (Mean)	100.8	74.6	89.2	36.5	73

PYM= pod yield/m-2, SHP=shelling percent, SMK= Sound mature seeds %, HSM= hundred seed mass, HPM= hundred pod mass

E. EVALUATION OF LARGE-SEEDED VIRGINIA ACCESSIONS

The evaluation of large-seeded Virginia accessions (>45 g/100 seeds as per Indian Bureau of Standards specification) for desirable confectionery traits was repeated for confirmation of previous results. Eleven accessions (HYB-9, HYR-2) were scored for seven plant traits and nine agronomic traits and the mean values of selected agronomic traits and biochemical traits are as under.

Cultivar	NRCG No.	PYM	SHP	SMK	HSM	HPM	Seed* L/W Ratio	Oil (%)	Protein (%)	FAA
1. Ah 7329	3014	157.4	70.4	70.7	44.1	86	1.7	50.7	28.3	0.235
2. BP 1	4829	122.1	66.0	81.5	53.0	118	1.8	54.5	17.3	0.150
3. Basse	3026	124.0	64.3	82.1	48.2	93	1.7	52.5	17.9	0.257
4. Bold 2	671	167.9	73.5	90.1	45.9	99	1.9	51.3	25.2	0.288
5. IS-10-NC-4 X	5363	118.9	68.6	84.5	44.8	103	1.8	53.3	22.6	0.206
6. JL 56	7277	130.5	68.5	82.2	45.2	92	1.9	53.6	21.8	0.269
7. NCAc 1092	481	147.9	68.0	87.5	51.7	99	1.9	54.2	23.6	0.184
8. NCAc 17286	1039	158.6	73.6	80.6	48.5	106	1.7	50.6	22.6	0.208
9. NCAc 1861	879	163.0	72.2	91.0	60.9	113	1.9	50.4	21.9	0.264
10.NCAc 2309	1463	161.2	70.1	78.4	43.2	100	1.9	55.0	27.3	0.271
11.Spantex	2750	166.8	66.2	87.0	45.6	111	1.8	54.1	26.9	0.223
Controls										
1. BAU 13	—	142.8	70.0	80.2	59.4	122	1.8	53.4	20.9	0.453
2. GG 11	—	103.7	72.8	83.6	45.0	113	1.8	50.8	21.0	0.140
3. M 13	—	164.0	70.8	82.5	48.9	105	1.8	52.5	25.8	0.253

The NRCG 879 appeared promising for yield with lower oil content and higher seed mass keeping in view that hundred seed mass in general is poor in Junagadh condition due to the nature of soil.

F. DOCUMENTATION OF EVALUATION DATA

An inventory of 1507 accessions maintained at the NRCG Out-reach Centre, Bhubaneswar was prepared using the accession register ICRISAT as a reference. Nine passport informations have been appended.

A compendium on germplasm accessions identified by different sections at NRCG since the inception was prepared. The passport information on 676 accessions identified till 1996 has been incorporated to select the accessions by the groundnut crop improvement workers.

Plant Breeding

Project: Breeding and Genetic Studies for Improving Yield and Quality in Groundnut

R.K.Mathur, P. Manivel and M.Y. Samdur

The primary objective of this project is to develop breeding lines possessing high yield, desirable duration and quality attributes. The major thrust has been given on earliness, especially in virginia types; fresh seed dormancy in spanish types; high oil content, high kernel weight and resistance to aflatoxigenic fungi and low aflatoxin load. Basic genetic studies of applied breeding value have also been carried out. Work has been initiated for breeding for quality traits in groundnut but lack of practical methods to select these traits in segregating generation is a major obstacle.

A. HYBRIDIZATION, MULTIPLICATION, GENERATION ADVANCEMENT AND SELECTION

A total 57 crosses were made for the purposes viz., fresh seed dormancy (7 crosses), HPS and earliness in Virginia (1 cross), for genetics of mutants derived from Girnar 1 (8 crosses), high reproductive efficiency (3 crosses), high biological nitrogen fixation (3 crosses), high yield with early maturity (7 crosses) and for genetics of seed size (28 crosses). The average crossing success was 22.7%.

In kharif, five PStV free important advanced breeding lines *viz.*, 5 S, RB 46, NFP 101, NFP 140, and PBS 8 were multiplied at S.K. Nagar (GAU). The seeds of these lines were also given to the OUAT for testing the suitability for Orissa. At NRCG, a total of 44 F_1 crosses were studied and advanced to F_2 generation. Seventy crosses from F2 to F6 generations were further advanced. A total of 38 selections were made from advanced generation.

B. EVALUATION OF PROMISING ADVANCED BREEDING LINES

Two yield evaluation trials, one with spanish (*Arachis hypogaea* ssp. *fastigiata* var. *vulgaris*) and another with virginia (*Arachis hypogaea ssp. hypogaea* var. *hypogaea*) lines were conducted during rabi-summer and the salient results are given in tables 4 and 5.

Table 4. Evaluation of Spanish lines.

Name of the line	Kernel yield (Kg/ha)	% increase over check	Shelling (%)	100 seed mge(g)	Oil (%)
PBS 11049 (X 17-20)	2586	5.4	69.9	47.9	48.1
PBS 12089 (TMV2 x PI 259747)	2579	5.2	67.6	35.0	52.4
Code 9 (interspecific)	2494	1.7	71.7	33.9	51.1
PBS 21052 (C_1IV)	2485	1.3	69.8	51.7	52.8
Girnar 1 (Check)	2452	-	68.9	36.5	52.9

Table 5. Evaluation of Virginia lines.

Name of the line	Kernel yield (Kg/ha)	% increase over check	Shelling ing %	100-seed mass(g)	Oil (%)
PBS 24004 (Latur 33 x Tifrun A-3)	2679	84.3	69.9	47.7	51.1
PBS 23007 (X 17-20)	2137	47.7	70.0	36.3	52.1
PBS 21062 (GG 11xNCAc 2230)	2099	44.5	62.3	40.6	54.5
Kadiri 3 (Check)	1453	-	61.1	50.1	52.5

C. BASIC STUDIES TO INCREASE RECOMBINATION FREQUENCY IN GROUNDNUT

One of the greatest handicaps in studying groundnut genetics and breeding is the small size of segregating population that is generally available. The following experiments were conducted to get some basic information which may enhance the recombination frequency.

(1). Arresting of apical bud dominance to induce clustered flowering

To get initial clustered flowering for effective utilization in crossing programme, the experiment on arresting of apical bud dominance was conducted for the second time in rabi-summer and kharif. The pooled analysis showed that the cutting of main axis leaving two nodes from the base at flower initiation produced two to three more flowers/day than in control.

(2). Pollen germinability and crossability

In an experiment on the effect of temperature and relative humidity on pollen germinability and efficiency of hybridization, the associations between per cent pollen viability with relative humidity was positive (though the magnitude was lower in case of virginias), while with temperature the association was negative except in Kadiri 3. The mean of per cent pollen germination was lower in the two spanish cultivars (GG 2 - 85.1%; JL 24 - 84.7%) than the two virginia cultivars (Kadiri 3- 92.5%; M 13- 90.7%). When the spanish genotype (GG 2) was used as female parent the success of harvesting hybrid pods was 29% while it was 16.3% with virginia genotype (Kadiri 3).

(3). Induction of functional male sterility

a. Spray of male gametocides

With a view to inducing functional male sterility in groundnut, sprays were given with three male gametocides *viz.*, ethrel, 2,4-D and GA_3 at flower initiation, 10 and 20 days after flower initiation. GA_3 @ 200 ppm induced a maximum of 30% pollen sterility, while

Ethrel and 2,4-D could induce 10% pollen sterility. Ethrel had inhibitory action on flower production, produced more branches and more vegetative growth with reduced leaf size. 2,4-D caused more biological damage.

b. Irradiation

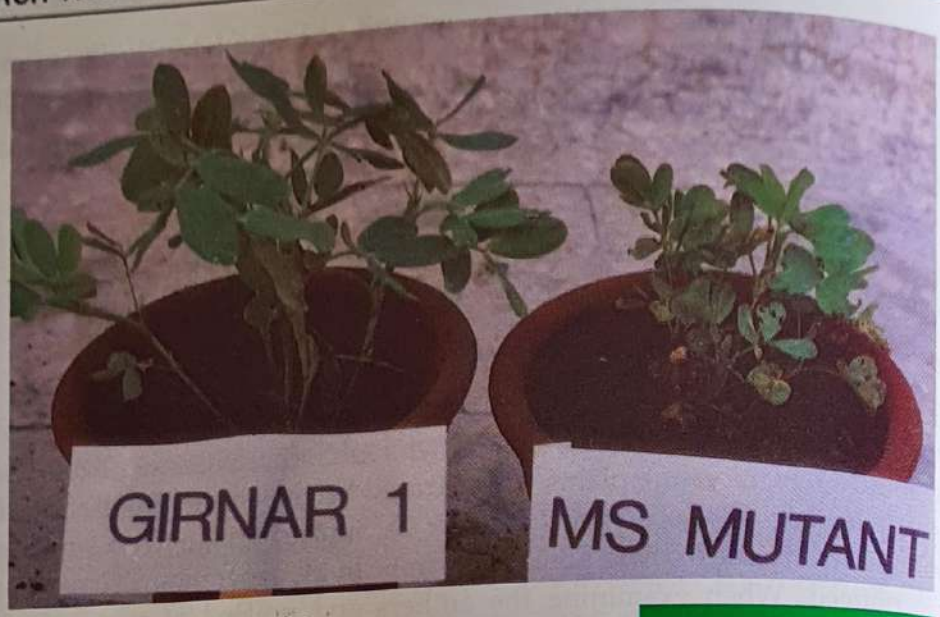
The seeds of Girnar 1, GG 2, Kadiri 3 and Somnath were irradiated with 20, 25 and 30 kR gamma rays. In M_1 generation, the range of pollen sterility varied between 5-100%. In M_2, maximum pollen sterility recorded was 50%.

c. Chemical mutagenesis: M_4 generation

To increase the shelling outturn of Girnar 1, a multiple resistant cultivar, the chemical mutagens like diethyl sulphonate (DES) and ethyl methane sulphonate (EMS) were used. In M_3 generation, a few miniature plants with reduced height, shorter inter-node and small orbicular shape leaflets were observed (Plate 1& 2). Surprisingly, even a single pod/peg was not found from any one of these miniature plants. In M_4 generation also such miniature plants were noticed. When examining the anthers and pollens of these plants under microscope by carmine test and pollen germination test, it was found that they all are male sterile plants. When these plants were pollinated with pollen of parent Girnar 1 it produced pegs and pods (Plate 3). Hence, it may be due to genetic male sterility. Fortytwo bred true mutants selected in M_4 generation were evaluated in kharif season and seven were found promising for shelling out turn (Table 6). PBSM 18 had higher yield per plant and harvest index than Girnar 1.

Table 6. Promising mutants of Girnar 1

Culture	shelling percent	Pod yield per plant (g)	Harvest index	Pods/pegs ratio
PBSM 5	72.63	5.94	38.0	74.15
PBSM 9	74.35	6.13	38.4	47.9
PBSM 18	74.82	9.37	48.8	50.04
PBSM 22	71.72	4.98	28.3	59.32
PBSM 24	72.03	4.91	30.3	49.75
PBSM 29	72.88	5.59	30.9	59.84
PBSM 41	73.74	4.47	27.1	39.01
Girnar 1	67.23	7.62	36.1	49.50



GIRNAR 1 MS MUTANT

GIRNAR 1 MS MUTANT

Plate 1. Chemically induced male sterile mutants of Girnar 1
A. Plant height B. Internodal length

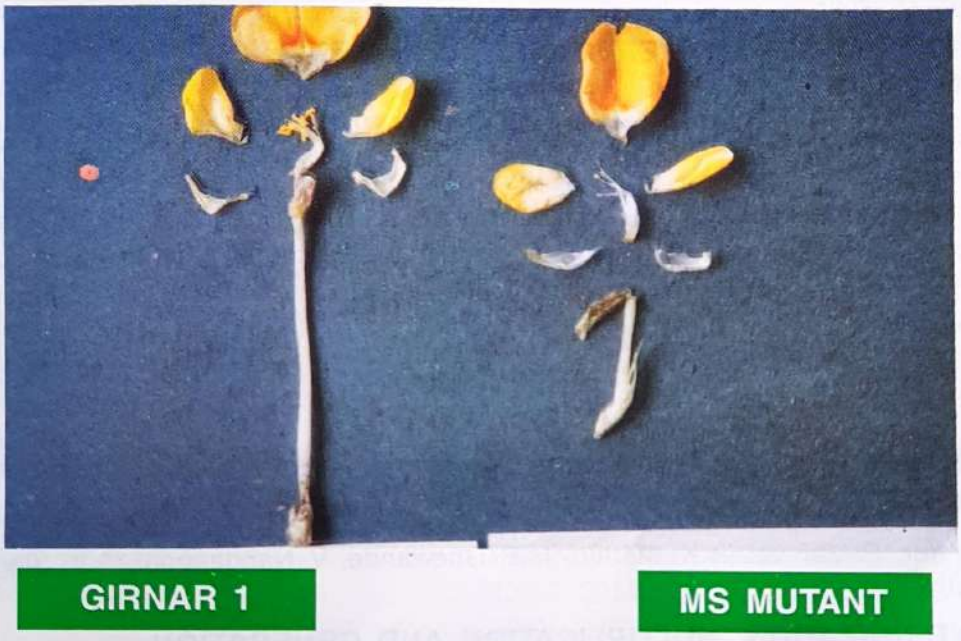


Plate 2. Chemically induced male sterile mutants of Girnar 1
A. Leaf size B. Flower structure showing transluscent anthers

Plate 3. Formation of hybrid pods on MS Mutant after pollination with Girnar 1

d. Reproductive efficiency

With a view to bridging the gap between number of flowers produced and the number of pods developed an experiment on flower load was taken up in four seasons (two kharif and two rabi-summer). The genotypes studied were Gangapuri and MH 2 (valencia), JL 24 and GG 2 (spanish), Kadiri 3 and BG 1 (virginia bunch), and Somnath and GAUG 10 (virginia runner). The pooled analysis over four seasons showed that genotype BG 1 and Somnath produced flowers on the main axis also which is otherwise a peculiarity of spanish and valencia types. The valencia genotypes recorded highest proportion of mature pods total flowers (30.4% in kharif and 18.1% in rabi-summer); and total pods/ total peg (50.4% in kharif and 63.0% in rabi-summer). Hence, Valencia types were considered reproductively most efficient. But, the total number of the flowers as such were the least in these genotypes.

D. GENETICS OF FLOWERING THROUGH GENERATION MEAN ANALYSIS

Two sets of materials, each consisting of six generations (P_1, P_2, F_1, BC_1, BC_2 and F_2) were developed for the crosses M 13 X R 33-1 and M 13 X Chico and evaluated in rabi-summer season. In both the crosses considerable heterosis was found for total flowers in F_1. F_1s were 4-5 days earlier in flower initiation than the maternal parent, M 13. For total flowers these crosses had shown presence of the interaction effects pre-dominantly of duplicate nature. For days to flower initiation the interaction effects were absent in the cross M 13 X Chico. In F_2 the mean number of flowers over the plants had shown depression in total flowers produced.

Project: Breeding for Resistance to Biotic and Abiotic Stresses in Groundnut

M.Y. Samdur, P. Manivel, R.K. Mathur, M.P. Ghewande, V. Nandagopal, A.L. Singh and P.C. Nautiyal

A. HYBRIDIZATION, MULTIPLICATION AND GENERATION ADVANCEMENT

A total of 21 crosses were made to study the inheritance of major foliar diseases (9 crosses), multiple disease resistance (6 crosses), salinity tolerance (2 crosses) and water

use efficiency (4 crosses). One hundred and fifty four breeding cultures bred for various biotic and abiotic stresses were raised during kharif season. Out of these 23 cultures were selected for use in the breeding programme.

B. SCREENING OF ADVANCED BREEDING CULTURES FOR RESISTANCE TO BIOTIC AND ABIOTIC STRESSES

1. Abiotic stresses

a. Drought tolerance

In the rabi-summer season an experiment was taken up with 18 cultures (11 spanish and 7 virginia) along with four checks entries (GG 2, JL 24, Girnar 1 and Kadiri 3) for screening for drought tolerance. Water stress was induced by withholding the irrigation from the 40th to the 65th days after sowing. The reproductive efficiency of spanish (3.92 to 20.90%) was higher than virginia (3.61 to 10.77%) cultures under both irrigated and drought conditions. The cultures PBS 11050, 19003 and 21065 were found promising as their reproductive efficiency in terms of mature pods to total number of flowers was higher under drought conditions.

b. Iron chlorosis tolerance

Twenty four advanced breeding cultures along with two checks (PBS 20100 and 20101) were screened for tolerance to iron chlorosis in rabi summer 1997. The cultures PBS11015, 11040,11050, 14017, 20027,and 21018 were found tolerant to iron chlorosis (visual chlorotic rating below 1.50). The cultures PBS 14017 has produced more number of pods per plant (18.62 g) and thus it was found to be promising for yield also.

2. Biotic stresses

a. Diseases

The advanced breeding cultures were screened for diseases like early and late leafspot and rust. The following entries were found to be resistant. Disease pressure upto 9 for LLS and 7 for rust was observed on 0-9 scale.

Resistant to ELS and LLS (score 0-3)	-	CS19
Moderately resistant to ELS (score 3-5)	-	Code 7 code 30 & PBS No's20026 21063, 24006, 29033 and 29017
Moderately resistant to LLS (score 3-5)	-	PBS No's 12029, 12032, 12038, 12063, 20142, 20147, 22030, 20026, 22028 Code 7 & 30.
Moderately resistant to rust (score 3-5)	-	PBS No's 11019, 12017, 12029, 12032, 12038, 12063, 20142, 20147, 22030, 29035 and CS 19.

b. *Insect Pests*

The cultures PBS 24003, 24001, Code 11 and Code 7 found to be moderately resistant to and thrips infestation. The genotype CS 19 recorded recorded the highest number of thrips eggs (36.50) per leaf.

c. *Genetic studies on Late leaf spot and rust resistance*

Nine F_1's with their parents were evaluated to study the genetics of Late Leaf Spot and rust resistance under field condition. The performance of F_1 with their parents is given in the Table 7.

Table 7. Disease index on F_1 and their parents for LLS and rust

Name of crosses/ parents	LLS	Rust	Disease index	
			LLS	Rust
DRV 25	S	MR	53.4	33.2
DRV 1	S	MR	46.5	30.2
PBDR 6	MR	MR	35.2	28.0
JL 24S	S	61.1	42.2	
GG 2S	S	59.1	48.7	
NCAc 343	R	R	24.0	20.4
DRV 25 X PBDR 6	S	MR	50.0	38.6
DRV 25 X DRV 1	MR	MR	34.7	33.4
DRV 25 X JL 24	S	MR	42.7	30.2
PBDR 6 X GG 2	S	MR	44.4	36.9
DRV 1 X GG 2	S	MR	45.2	37.1
GG 2 X JL 24	S	S	62.5	50.6
NCAc 343 X PBDR 6	MR	MR	30.9	26.8
NCAc 343 X DRV 1	MR	MR	29.8	25.9
NCAc 343 X JL 24	S	MR	47.8	40.0

R- Resistant with disease index (DI) below 25.00; MR-Moderate resistant with DI above 25.00 to 40.00; S- Susceptible with DI above 40.00

National Seed Project (Crops)

A. Bandyopadhyay, R.K. Mathur, P. Manivel and M.Y. Samdur

Breeder seed production was initiated in collaboration with ICRISAT during 1997-98 after a long gap. Non availability of nucleus seed was a big handicap and later heavy incidence of foliar diseases in ICRISAT towards the end of the crop season affected the yield. The details of breeder seeds produced is given here:

Variety	Quantity (q)
TG 26	18.90
TAG 24	7.75
Somnath	0.95
TG 3	0.72
TKG 19A	0.76

Genetics & Cytogenetics

Project: Embryorescue, Micropropagation and Haploid Production in Groundnut.

T. Radhakrishnan, P. Paria, S. K. Bera

I. ISOLATION AND PURIFICATION AND CULTURING OF PROTOPLASTS

Different explants from *in vitro* raised seedlings of cv.SB XI were incubated overnight in 12 combination of cellulase and pectinase (0.25% to 2% cellulase and, 1 and 2 % pectinase) in an osmoticum containing CPW salts and 9% mannitol. The enzyme combinations comprising 1% and 2% cellulase with 1 and 2% pectinase resulted in good release of protoplasts. However, the combination of 2% cellulase and 1% pectinase yielded more number of viable protoplasts and the hypocotyl explants responded better. The released protoplasts were purified by layering over 20% sucrose at 300 RPM for 5 minutes and their viability was tested using FDA staining.

As the viability of the protoplasts was lost during trnsfering the purified protoplast suspended in osmoticum to the culture medium, alternate osmoticum (MS medium + $CaCl_2$ 1440mgL^{-1} + 9% mannitol, V47 medium) were tried for isolation and suspension of protoplasts. Both hypocotyl and leaf explants were incubated in enzyme mixture containing cellulase (1%), hemicellulase (1%) and pectinase (1%) in osmoticum. The yield of protoplasts after purification by layering over 20% sucrose was 1.65×10^5 /ML from hypocotyl explants. Newly and fully opened leaf explants did not release protoplasts in the digestion mixture. In V47 medium without hormones was tried as an osmoticum with an increased concentration of hemicellulase (1.5%) in the enzyme mixture yielded 1.98×10^5 /ML protoplasts after purification by layering at higher concentration of sucrose (30%).

Both MS with 9% mannitol and V47 media, with three combination of growth hormones viz. NAA 1.5 $mg.^{-1}$ + BA 0.5 $mg.^{-1}$, NAA 1.5 $mg.^{-1}$ + 2,4-D 1 $mg.^{-1}$ + BA 0.4 $mg.^{-1}$, and NAA 3 $mg.^{-1}$ +2,4-D 1 $mg.^{-1}$ + BA 0.4 $mg.^{-1}$ were used for culturing of the protoplasts. The Protoplasts tend to show only budding in the MS based culture medium in all combinations and in V47 medium the initial protoplast division was observed in second and third combination after 7 days in culture. However, the progressive divisions were found to be arrested. Attempt are on to prolong the division leading to microcolony formation.

II. STANDARDISATION OF TRANSFORMATION PROTOCOLS

For the standardization of the transformation protocols, somatic embryos were induced in large numbers from the mature zygotic embryos of the cultivar J11 and the mature zygotic embryos of the cultivar Girnar 1. The somatic embryos were separated

from the mother explants and were first subcultured on MS basal medium. For the purpose of transformations, the biolistic as well as the *Agrobacterium* mediated methods were attempted.

Biolistics

The gene gun facility available with the NRC on Plant Biotechnology was used for this purpose. The somatic embryos subcultured on the basal medium was further arranged in 3-4 cm diametre in the center of the petriplates, packed in cooling gel. The materials were taken to the NRCPB. Plasmid DNA with GUS and Green Fluorescence Protein were prepared and coated on tungsten particles. These particles were used to bombard the somatic embryos. Tobacco leaves from axenic cultures were used as control. The somatic embryos were brought back and assayed for the expression of the GUS and GFP. The GUS gene showed transient expression in a very high frequency and the GFP did not show any transient expression (Plate 4). The somatic embryos are being maintained in culture for assay at a later stage to see the stable integration and expression in the plantlets regenerated.

Plate 4. Somatic embryos bombarded with tungsten particles coated with DNA containing GUS gene, expressing the reporter gene in GUS assay

Agrobacterium mediated

Mature somatic embryos derived from the cultivar J 11 were used for testing the transformation protocol. The embryos were treated with 1 and 3 min abrasion with Carborundum and the control was treated with distilled water without the abrasive. They were co-cultured with *Agrobacterium* containing the Osmotin gene and NPT II marker. The co-culture was extended for 24 hours and then the embryos were cleared using cephataxime. Now the embryos are put for regeneration and for further confirmation of the presence of the gene in the regenerants.

Project: Utilisation of Wild Species in the Genetic Improvement of Cultivated Groundnut

S.K. Bera, P. Paria and Radhakrishnan T.

With a view to understanding the interspecific relations, pairing behaviour of F1 hybrids and its allo-hexaploid of J 11 x *A. cardenasii* (ICG 1158) were analysed. The mean

chromosomal association and the forms of multivalents observed were given in the Tables 8 and 9.

Table 8. Mean chromosomal association in diakinesis and MI of J 11 x *A. cardenasii* and its allo-hexaploid.

Genotype	Number of PMC's observed	Mean chromosomal association I	II	III	IV	V
F_1 J 11 X *A. cardenasii* (ICG 11558)	125	3.45	10.42	1.14	0.26	0.04
Hexaploid	24	26.29	14.49	0.02	0.16	—

The frequencies of univalents, bivalents and multivalents observed were in conformity with earlier workers. The analysis of the observed forms of trivalents and quadrivalents depicts interesting information on the synthesis of *A. hypogaea*. The ring trivalent indicated the presence of at least one isochromosome in the genomes involved in the hybrid. The presence of the isochromosomes suggests selective duplication of chromosome arm followed by their inadequate differentiation in course of evolution in the genus *Arachis*.

Table 9. Forms of multivalents observed in F1 of J 11 x *A. cardenasii*

Trivalent configurations observed	Frequency of quadrivalent configurations observed	Frequency
– – –	61	12
\ /	30	6
( )	2	4
Unidentified	50	11
Total	143	33

The \ / and -O- forms of quadrivalent as observed in the PMCs are clear indication of the autosyndetic pairing and provides a scope to doubt that the basic number of the genus *Arachis* is less than 10.

Table 10. Chromosome separation at AI in J 11 x *A. cardenasii*.

Chromosome observed number	PMC's (%)	Separation
Bipolar		
14/16	20	22.20
13/17	40	44.44
15/15	7	7.77
12/18	7	7.77
11/19	3	3.33
10/20	3	3.33
Multipolar	10	11.11
Total	90	

Chromosome separations at the AI of the said cross were studied in 90 PMCs and the results are presented in Table 10.

The mean chromosome associations as observed in the PMCs at diakinesis and MI suggests irregular separation as observed in AI. The separation of 10/20 may in extreme rare cases are likely to produce balanced gametes. It is interesting to note that laggards

are not present in the PMCs at AI. This suggests that chromosomes, be it in the form of univalent, bivalent or multivalent in the PMCs of the hybrid are equally responsive to anaphasic pull.

A selfed progeny of the hexaploid J 11 x *A. cardenasii* was analysed mitotically for the chromosomal constitution in the individuals and the results are presented in Table 11.

Table 11. Aneuploids in the progeny of selfed hexaploid J 11 x *A. cardenasii*

No. of plants analysed	Frequencies of plants with chromosome number					
	62	60	59	58	56	62+fragment
121	1 (.8)	114 (94.3)	1 (.8)	1 (.8)	1 (.8)	3 (2.5)

Figures in parenthesis are percentages.

It can be seen from the table that the progeny consisted of 60 chromosome classes mostly (94.3%). The range of aneuploids varied between 56 and 62. However, a few individuals were observed to have 62 + 1 fragment. It was not known certainly about the frequencies of aneuploids in the 60 chromosome class.

With a view to produce interspecific hybrids using two cultivars viz. TAG 24 and J 11 as female 3830 pollinations were made using *A. duranensis, A. cardenasii, A. pusilla, A. paraguariensis, A. stenosperma*, ICG 8192, *A. chacoense, A. correntina* and *A. prostrata* as male parents. A total of 1213 probable hybrid pods have been collected from those pollinations and will be grown in the following crop season to isolate heterozygous interspecific hybrids.

With a view to produce monosomic and locating genes, a nullisomic line was crossed to TMV 2 NLM, golden yellow leaves, puckered leaves and variegated testa and a total of 92 probable hybrid pods have been collected.

With a view to test the association (linkage) between marker genes all possible crosses amongst TMV 2 NLM, golden yellow leaves, puckered leaves, corduroy leaves and variegated testa have been made and a total of 284 crossed pods have been collected.

Agronomy

Project: Development of Suitable Agronomic Practices in Groundnut

P.K. Ghosh and Devi Dayal

CROPPING SYSTEMS

1. Relay cropping

Saurashtra farmers plant wheat with a wider row-to-row spacing of 30 or 45 cm than the recommended 23 cm, mainly for ease in interculturing. An experiment was taken up to see whether this extra space could be used by rabi-summer groundnut as a relay crop. Wheat was sown at 30 and 45 cm row spacing. Groundnut was sown in between the rows of wheat at three stages of wheat: heading stage (19th January), grain filling stage (31st January), and 15 days before wheat harvest (10th February). In 30 cm spacing, groundnut was dibbled but in 45 cm it was sown in furrows. Pod yield as a relay crop was lesser than the sole groundnut.This was perhaps due to the fact that the standing wheat crop had the shading as well as cooling effect on the groundnut crop. Soil temperature recorded at 8.30 am and 2.30 pm during January-February showed higher temperature in sole groundnut than in the plot of standing wheat crop (Plate 5). Data analyses over two years showed that the highest pod yield (13.99 q/ha), wheat yield (33.4 q/ha), groundnut equivalent yield (34.02 q/ha), net return (Rs.48,558/ha) and B:C ratio (3.53) were recorded when groundnut was sown at grain filling stage of wheat (Table 1). The lowest pod yield obtained when sown at heading stage of wheat may be due to low soil temperature during germination and initial stage of growth (Plate 5). Interaction effects of date of

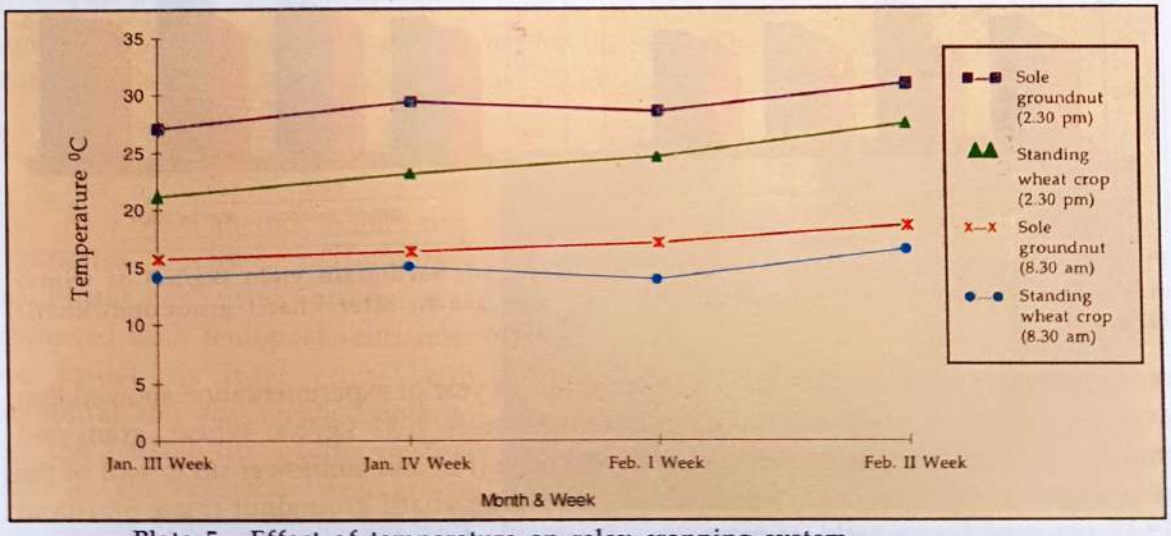


Plate 5. Effect of temperature on relay cropping system.

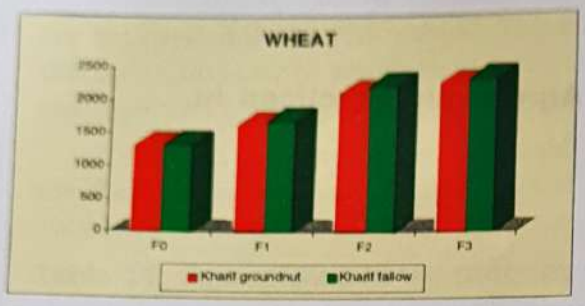


Plate 6a. Seed/grain yield (kg/ha) of winter crops grown after kharif groundnut/kharif fallow.

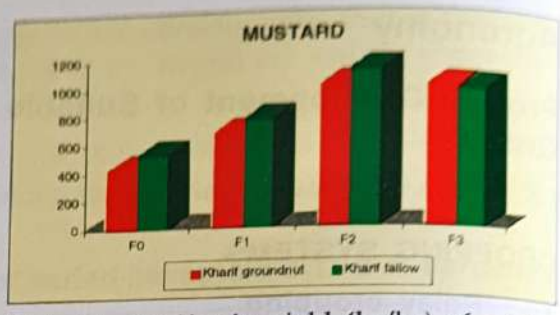


Plate 6b. Seed/grain yield (kg/ha) of winter crops grown after kharif groundnut/kharif fallow.

sowing and method of sowing on poda yield and groundnut equivalent yield was significant. Groundnut dibbled in between wheat crop spaced at 30 cm either at grain filling stage or 15 days before harvest of wheat gave significantly higher pod yield and groundnut equivalent yield as compared to 45 cm.

2. Crop sequences

a. Fertilizer response and nutrient dynamics

The fertilizer requirement of four rabi crops: wheat, gram, sunflower, and mustard were evaluated in two crop sequences either after kharif groundnut or after a kharif fallow in fixed plots. Four levels of fertilizer i.e, nil, half of recommended (HF) doses of N & P, the recommended doses (FL) and one-and-a-half times of the recommended doses(OH) were applied to each rabi crops. Kharif groundnut was grown with

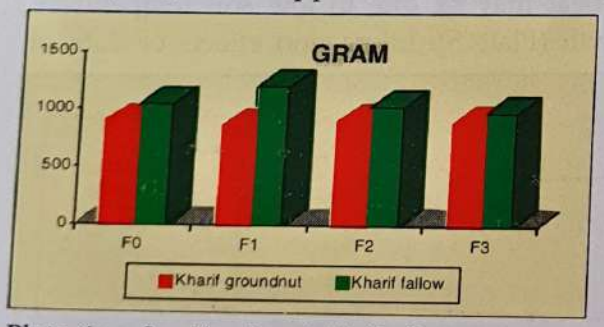


Plate 6c. Seed/grain yield (kg/ha) of winter crops grown after kharif groundnut/kharif fallow.

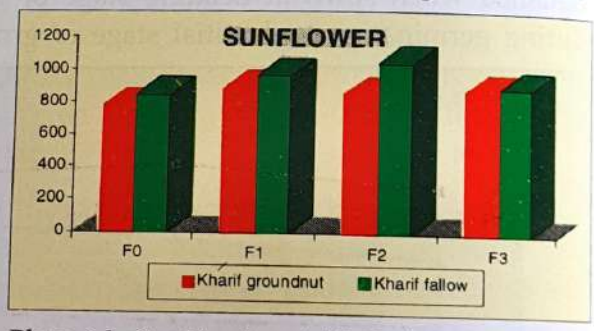


Plate 6d. Seed/grain yield (kg/ha) of winter crops grown after kharif groundnut/kharif fallow.

recommended dose of fertilizers. The result of fourth year of experimentation showed that average pod yield of kharif groundnut recorded was 1032 kg/ha. Wheat, gram and mustard responded up to the recommendation dose (FL) and sunflower up to half of the recommended (AF) doses of N & P when grown after kharif groundnut (Plate 6). About 19.17 per cent lower yield of gram was obtained when they were grown after kharif

groundnut than when grown after kharif fallow. However, not such decline in yield of wheat, mustard and sunflower was observed between two crop sequence. The causes of shunted growth of plants of gram following kharif groundnut are being investigated.

Soil analyses showed that NH_4^+ content in soil after kharif groundnut (133.2 kg/ha) and after kharif fallow (135.3 kg/ha) did not differed much but the NO_3^- content in kharif fallow 89.67 kg/ha) was higher than that after kharif groundnut(57.98 kg/ha). Variation in organic carbon content(%) of soil between kharif groundnut(0.555) and kharif fallow (0.527) was less.

3. Intercropping

a. With cereal fodders

Plate 7. Maize fodder intercropping with groundnut.

Rabi-summer groundnut is generally irrigated through border strip method with three to four lines of groundnut in each strip. With a view to utilizing the bunds/borders and produce fodder for the dry season, an experiment was conducted during rabi/summer 1996 and 1997 with different cereal fodders like maize, pearl millet and sorghum Plate 7. Three lines of groundnut were maintained in between two rows of fodder. One and two cuttings of fodder (60 and 106 days after sowing) were tried. The system gave the highest net return and B:C ratio when pearl millet was allowed for two cuttings though yield of groundnut was lower than the sole crop. The lowest Net return and B: C ratio were recorded in sole groundnut. The superiority of this system was evident in both the years. The average net returns over two years was Rs.34,766 and the B:C ratio was 2.43.

b. With short duration vegetables

Plate 8. Vegetable (fenugreek)-groundnut intercropping.

As a novel attempt to inter crop vegetables with rabi-summer groundnut, a pilot study was conducted with fenugreek, coriander and radish as inter crops with groundnut and also on the bunds to test the feasiability of the system (Plate 8). The vegetables were grown without any external inputs and were harvested at 35-40 days after sowing.

Reduction in pod yield of groundnut was the highest in association with radish but maximum net returns (Rs.61,070/ha) and B:C ratio (4.65) were recorded when radish was grown only in the inter space followed by coriander grown in the inter space Table 2). In association with groundnut all the vegetables gave fairly higher net return and B:C ratio as compared to sole groundnut. The experiment needs to be repeated in detail.

c. Interactions between genotypes of the base and the inter crops

Two sets of trials were conducted during kharif, 97 in association with plant breeders to study the compatibility of different habit groups as well as genotypes of both the base and the intercrops.

i. Groundnut x pigeonpea:

Two cultivars of each of two habit groups of pigeon pea viz; short -ICPL 87 and ICPL 88039; and tall- ICPL 87119 and BDN 2 having different maturing times and three growth habit groups of groundnut viz; spanish bunch (GG 2), virginia bunch (Kadiri-3 and virginia runner (M 13) were evaluated.

Variation in pod yield (462-959 kg/ha) due to the combinations of groundnut an pigeon pea intercropping was evident. The highest pod yield was recorded in cv. M 1 virginia runner in association with short cultivar, ICPL 87 of pigeonpea. But the highe groundnut equivalent yield was recorded when virginia runner was associated with t group of pigeonpea. The highest NO_3^- content (164.24 kg/ha) was recorded in the plo where GG 2 (VUL) were associated with cv. BDN 2 of pigeon pea (tall) but P content w the highest when cv.GG 2 of groundnut (VUL) was associated with ICPL 87 (short) pigeon pea. Available soil moisture (% volume) recorded before harvest of groundn from 0-15 cm soil depth varied from 22.7 to 26.2 ; highest being in the plot where cv. ICP 88039 and cv. BDN 2 of pigeon pea were sown. The soil moisture in 15-30 cm depth wa comparatively high and not much varied due to different genotypes.

ii. Groundnut x castor:

Two growth habit groups of castor viz.;short (Sowbhaghya & HCS-4) and tall (DC 23 & DCS 59) and three habit groups of groundnut viz; spanish bunch (GG 2), virgin bunch(Kadiri-3) and virginia runner (M 13) were evaluated.

Variation in pod yield (480-1038 kg/ha) due to the combinations of groundnut an castor intercropping was evident. The highest pod yield was recorded in cv. kadiri (HYB) in association with tall habit growth of castor (cv.DCS 59). The highest NO_3^- conte was recorded in the plots where cv. Kadiri 3 (HYB) were combined with cv. HCS 4 (sho of castor but P content was the highest in the combination of cv. M 13 of groundnut (HY and DCS 59 (tall) of castor. Organic carbon (%) in the soil ranged from 0.446 (when cv.G 2 combined with cv. HCS 4) to 0.555 (when cv.Kadiri 3 combined with cv. DCS 23). S

moisture (% volume) recorded before harvest of groundnut from 0-15 cm soil depth ranged from 23.2 to 28.0; highest being in the plot where cv. Sowbhagaya (short) was sown.

Project: Factors Affecting Yield of Groundnut Through Variation in Plant Population

P.K.Ghosh and Devi Dayal

1. TILLAGE

Effect of different tillage systems viz; T1: harrowing (once); T2: harrowing (twice); T3: harrowing (once) + MB plough; T4: MB plough + harrowing (twice) and T5: rotavator, on plant growth, yield and soil properties were evaluated during kharif'97. The number of pods(9.92) and pod weight(8.42 g/plant) were maximum in T3 which resulted in the maximum pod yield of 1195 kg/ha. The maximum seedling emergence (77.2 %) was found in T4 possibly due to low bulk density (1.32 to 1.34 g/cc) of soil. T1 gave the lowest number of pods (7.48), pod weight (6.68 g), pod yield (990 kg/ha) and seedling emergence (71.3 %) and comparatively had high bulk density (1.39 g/cc). The field prepared by rotavator (T5) had, in general, high available moisture at 0-15 cm soil depth but in deeper layer (15-30 cm), available soil moisture was not varied much among the treatments. Organic carbon (%) did not differ much among the treatments (0.449 to 0.485). The study, thus, indicated that deep ploughing could improve yield, yield attributes, seedling emergence and alter bulk density and soil moisture. The experiment needs to be repeated.

Project: Studies on Integrated Weed Management in Groundnut

P.K.Ghosh and Devi Dayal

A collaborative experiment, comprising fungicide mixture, neem, insecticide mixture, herbicide (fluchlorolin @ 1.5 kg a.i./ha + one hand weeding + one interculturing) and trap crops (pearl millet, soybean, pigeon pea, castor etc.) was tested in a large plot during rabi-summer and kharif 1997.

During rabi -summer ,maximum dry matter of weed at 30 DAS(636.4 kg/ha), 60 DAS (1328.8 kg/ha) and at harvest (1760 kg/ha) was recorded in the control (T4) plot where no weeding and spraying were done but the weed dry matter was the lowest in the farmers practice.

In kharif 1997, total dry matter of weed at 30 and 60 DAS was also the lowest in the farmers practice but at harvest it was lowest in T2. The highest dry matter was recorded in control plot (Table 12).

Table 12. Yield of groundnut and wheat and economics in relay cropping (pooled over two years), 1996 & 1997

Treatments	Pod yield (q/ha)	Grain yield of wheat (q/ha)	Groundnut equivalent yield(q/ha)	Net return (Rs./ha)	B:C ratio
Time of sowing					
Heading	9.62	31.8	28.67	40,041	2.91
Grain filling	13.99	33.4	34.02	48,558	3.53
15 days before harvest	13.78	33.2	33.70	47,557	3.46
C.D. at 5%	2.47	NS	3.48	6707.7	0.489
Sole groundnut (average of 3 date of sowings)	18.28	-	18.28	22,270	1.86
Methods of sowing					
Furrow (45 cm)	10.16	30.66	28.57	38,795	2.93
Dibbling (30 cm)	14.77	34.89	35.70	51,982	3.63
C.D.at 5%	2.03	3.25	2.84	5476.7	0.399

Price per q of wheat and groundnut = Rs. 900 and 1500, respectively.

Table 13. Yields and economics in groundnut and vegetables intercroppin

Treatments	Fresh vegetables (t/ha)	Pod yield (q/ha)	Net return (Rs./ha)	B:C ratio
Interspace	2.36	20.4	54,813	4.16
Groundnut + fenugreek				
On bund	1.77	23.9	40,775	3.11
Bund + interspace	3.51	18.7	48,443	3.65
Interspace	2.37	21.0	41,767	3.16
Groundnut + radish				
On bund	1.48 (0.81+0.23)	18.2	53,245	4.06
Bund + interspace	1.44 (0.77+0.33)	17.4	52,219	3.94
interspace	2.17 (1.16)	17.2	61,070	4.65
Groundnut + coriander				
On bund	1.17	18.9	35,914	2.74
Bund + interspace	1.49	20.3	41,681	3.16
Sole groundnut	-	24.8	26,401	2.06

Data in parenthesis are number of mature and immature radish in lakhs, respectivel
Fenugreck-Rs 9/kg, Coriander Rs.15/kg, Radish- 40 paise per mature piece, 20 paise
immature piece

Table 14. Effect of different treatments in IPM on dry matter of weed during kharif

Treatments	Dry matter (kg/ha)		
	30 DAS	60 DAS	Harvest
T1	724.1	317.0	138.3
T2	629.4	248.6	101.6
T3	542.4	363.2	115.5
T4	670.9	230.9	127.4
T5	601.9	239.9	110.6
T6	202.7	202.8	220.2
T7	894.2	560.6	1367.0

Details of the T1 to T7 are given in Entomology section report.

Plant Physiology

Project: Studies on Abiotic Stresses in Groundnut

Y. C. Joshi and P. C. Nautiyal

A. SOIL MOISTURE-DEFICIT STRESS

1. Role of potassium on pod yield and biomass production

Role of potassium to increase drought tolerance is generally known in crop and was tested on two cultivars of groundnut viz. GG 2, drought tolerant, and JL 24, drought susceptible, during two rabi-summer seasons (1996 and 1997). Two doses of potassium viz. 20 kg/ha and 40 kg/ha were applied in the soil at the time of sowing. Under normal irrigation pod yield in cv. GG 2 increased due to potassium application in both the years (Table 1). Under soil moisture-deficit stress condition both the cultivars showed some increase in yield, though not statistically significant, and which was more in 1996 than in 1997. Due to application of potassium under soil moisture deficit stress (irrigation at 50% cpe) condition leaf relative water content, photosynthesis, and accumulation of biomass was higher in cv. GG 2 as compared to JL 24. Potassium application appeared to have some positive effect though again, not statistically significant, in normal soil moisture condition (irrigation at 100% cpe) also.

2. Enhancement and synchronization of flowering by soil moisture deficit stress.

It has already been shown by us that groundnut yield increased due to imposition of transient water-deficit stress during the initial vegetative phase of the crop. During rabi-summer 1997 an experiment was conducted with four cultivars viz. AK 12-24, J 11, GG 2 and Girnar 1 (all Spanish bunch) to study the influence of this stress on flower production and flowering-behaviour. The imposition of water deficit stress at different phenophases i.e. vegetative, flowering, and pod development showed that transient stress during the vegetative phase resulted in higher pod yield (28-34%). This enhanced yield appears to be due to the combined effects of synchronised flowering, and a spurt in the growth of vegetative and reproductive parts due to stress at vegetative phase followed by irrigation five days after relief of water stress.

B. HIGH TEMPERATURE TOLERANCE

High temperatures during pod-development phase during the rabi and summer seasons in most of the groundnut growing states cause a sizable loss in pod yield as the ambient temperature during this period remains >40°C. There are reports that in part of Rajasthan due to high temperatures at pod-development phase pod formation in groundnut is severely affected. With this background following experiment was initiated.

Biomass, photosynthesis and leaf thermostablity of some selected genotypes

In NRCG (ICAR)-ICRISAT collaborative project about 100 genotypes were screened for high temperature (minimum 25°C and maximum 45°C) tolerance at Hanumangadh (Rajasthan) during the rabi-summer seasons of 1996 and 1997. Eleven genotypes viz. ICG 2738, ICG 86031, ICG 76, CSMG 84-1, Kadiri 3, TKG 19A, ICG 4226, ICG 44, TMV 2 NLM, TG 26 and TAG 24 were selected on the basis of biomass production and pod yield to study leaf thermostablity as measured by relative injury index (RI%), leaf photosynthesis, specific leaf area, total biomass and pod yield. Genotypes differed in their leaf RI% and it ranged from 39% to 86%. The genotypes ICG 4226, ICGS 44, and TAG 24 showed low RI% and higher biomass production, whereas genotype ICG 2738, Kadiri 3, ICG 86031, ICGS 76 showed higher RI% and lower biomass production at Junagadh conditions. Photosynthetic rate observed during vegetative and pod development phases at Junagadh did not show relationship with leaf thermostablity. Working out the relationship of leaf thermostablity with biomass production and photosynthesis at higher temperatures during pod development phase need detailed studies.

C. LOW TEMPERATURE TOLERANCE

In various part of the country i.e. Uttar Pradesh, Punjab, Parts of Rajasthan and North-eastern region sub-optimal temperatures (minimum 5°C and maximum 20°C) at the time of rabi season sowing is a constraint in the cultivation of groundnut. Due to low temperatures field emergence and seedling growth is delayed. Following experiments were initiated to improve field emergence and seedling growth at sub-optimal temperature.

1. Screening for low temperature tolerance: field emergence at sub-optimal temperature

(i) The same set of 100 genotypes mentioned above could be simultaneously tested at Hanumangarh for tolerance to sub-optimal temperatures during germination and early seedling growth. The genotypes viz. ICGV 86644, ICGV 86635, ICG 3217, and TKG 19 A showed higher field emergence and seedling growth.

(ii) Four hundred germplasm lines were sown at Groundnut Research Station (CSUAT), Mainpuri (UP) during the first week of January, 1998, to study the genotypic variation in field emergence, flowering, plant growth and other yield contributing traits. Minimum temperature during the sowing period remained around 6-7 °C and maximum 15-16 °C. Field emergence took about 26-36 days in different genotypes. Genotype ICG 4112 took 26 days to show more than 50% emergence whereas genotype ICG 719 took 36 days. Among the various genotype,time taken to 50 per cent flowering ranged between 79 and 102 days. Genotypic variation for number of immature pods, pegs, plant height, primary branches and secondary branches were significant. Significant genotypic variations were observed in the crop maturity period (136 to 170 days) and pod yield

Table 15. Pod yield and crop duration of the promising lines for cold tolerance at Mainpuri (U.P.) during Rabi Summer 1998.

Genotypes	Pod yield (g plant^{-1})	Maturity period (days)
ICG 4071	20.0	148
ICG 4091	14.0	150
ICG 4114	14.0	148
ICG 1086	14.0	142
ICG 2067	15.0	150
ICG 4710	12.0	148
ICG 2210	15.0	150
ICG 2036	12.0	168

(0.5 to 20 g plant-1). However pod yield in more than 50 per cent genotypes was less than 2.0 g plant-1.Based on pod yield and maturity period,the promissing genotypes were identified (Table 15). Thus clear variation in low temperature tolerance was evident but since the base temperature for groundnut is about 11 °C, therefore the crop must be sown when sub-optimal temperature remaines around 12-13 °C. This trial have to be repeated by sowing the crop in the first week of February if the practial utility of the variation has to be found.

2. Pre-sowing heat treatment to seed to increase field emergence and pod yield in rabi groundnut

Seeds of cv. GG 2 were given heat treatment at 40°C in a water bath for 2, and hours. After the treatment, seeds were sown in the field (soil temperature: minimum 15 and maximum 28°C) along with a control. Seeds treated at 40°C for 4 h showed earl flowering, higher flower production, and pod yield. However, the difference in fiel emergence could not be noticed. Detailed studies are required to explain the earl flowering and higher pod yield in the heat treated seeds.

Project: Physiology and Biochemistry of Seed Viability and Dormancy in Groundnut

P.C. Nautiyal and J. B. Misra

A. SEED VIABILITY

Loss of seed viability is a serious problem in groundnut cultivation, especially the areas where groundnut is mainly cultivated in rabi and summer seasons on Experiments conducted at NRCG showed that groundnut produced in the rabi or t summer season loses its viability rapidly after 4 months of storage. The main causes of t rapid loss of viability are high pod drying temperatures, and subsequently high humidi of the storage environment (Plate 9). Following experiment was initiated to invigorate t seeds after 4 months of storage in shell.

Plate 9. NRCG method for drying groundnut.
A. Skeleton of the structure developed with bamboo stick and coir rope
B. Groundnut pods arranged on the structure for drying.

1. Seed invigoration: effect on seed viability and seedling vigour

Various chemicals have been reported to be able to invigorate the seeds of several crop species after a period of storage. Pods obtained from rabi-summer produce of groundnut (NRCG 6919) were stored at ambient conditions and after four months of storage were soaked in different chemicals for four hours. After further eight months of storage seed germinability (77 per cent) and seedling vigour was highest in seeds treated with $CaCl_2$ (0.05M), followed by water soaking (75 per cent) and control (70 per cent), however the seed stored in shell showed 69 per cent germinability. Result of the experiment indicated that groundnut seeds can be invigorated by soaking them in $CaCl_2$ (0.05 M) solution.

B. SEED DORMANCY

1. Role of testa in fresh seed dormancy

In our earlier studies it was found that most of the Spanish bunch genotypes possessed fresh seed dormancy, though the degree of dormancy vary. Keeping this in

view seeds of 20 dormant and non dormant Spanish genotypes with varying degree of dormancy were studied to understand the role of seed testa in inducing fresh seed dormancy. Seed testa being the mother tissue the portion of dormancy governed by it would be more amenable to manipulate by breeding. Pods were harvested at different maturity period and seed germination percentage with, and without testa, in the presence, or absence of ethrel (0.5%) was tested. Fresh seed dormancy as influenced by seed testa was found to be present in all the genotypes because the seeds without testa showed initiation of germination even at as early a stage of seed development as only 25 days after anthesis. Seeds treated with ethrel showed more radicle growth and high germination percentage both with, and without testa at all the stages of seed development.

3. Trasfer of technology: Demonstration of drying and storage technology at two locations in Orissa

Loss of seed viability in rabi and summer seasons produce is a serious problem in the states like Orissa, West Bengal and North Eastern region, because in these areas groundnut is mainly cultivated during the rabi or the summer season after the cultivation of rice. A technology was developed at NRCG to prevent rapid loss of viability of seeds produced in rabi and summer seasons. This technology was demonstrated at two locations in Orissa viz. Bargarh and Bhubaneswar in collaboration with the Orissa State Seed Corporation Ltd. After five months (just in the time for rabi sowing) of storage of the summer produce, germinability of the stored seeds was found more than 80% in both the locations. Thus, the technology has the potential to help the farmers of Orissa and other adjoining states in storing their own rabi and summer groundnut produce for the seed purpose.The experiment is now being repeated in farmers fields in the Puri and Cuttak districts.

Project: Inorganic Nutrient Requirements and Their Disorders in Groundnut

A. L. Singh and Y. C.Joshi

A. NUTRITION OF BOLD SEEDED GROUNDNUT

1. Effect of macro- and micro-nutrient on pod filling and yield

A field experiment was conducted to know the effects of Ca, K, and B on pod filling and yield of groundnut, by taking a HPS (TG19A) and an ordinary (NRCG 7085-1) groundnut genotypes, during the Rabi-Summer seasons of 1997. The soil of the experimental plot was calcareous containing 21 % $CaCO_3$, 1.2 % organic carbon, 6.7 g/kg Ca, 1.19 g/kg K, 8.2 mg/kg P and 0.96 ppm B.Some improvement in the pod filling and pod and seed yield (Table 16) were noticed by application of these nutrients,but no statistical significance of difference among the treatments was present.A further repetition will be required.

Table 16. Effects of Ca,K and B on pod Yield, shelling (%) and seed-mass of groundnut genotypes.

Treatments	Pod yield (kg/ha)		Shelling (%)		100-Seed mass(g)	
	NRCG 7085-1	TG19A	NRCG 7085-1	TG19A	NRCG 7085-1	TG19A
1. Control	1944	1064	60.9	63.2	27.2	55.9
2. B_2	2172	1312	62.4	64.3	27.6	56.1
3. K_{100}	2352	1360	63.5	67.2	31.2	59.3
4. $K_{100}+B_2$	2434	1420	64.6	67.7	30.4	61.1
5. Ca_{100}	2455	1594	64.8	67.1	29.9	59.8
6. $Ca_{100}+B$	2669	1397	65.7	66.6	29.2	59.9
7. $Ca_{100}+K^2_{100}$	2745	1555	65.3	67.4	30.7	60.8
8. $Ca_{100}+K_{100}+B_2$	2814	1534	66.1	68.0	31.7	61.3
LSD (0.05)						
Treatments	256		1.95		2.45	
Genotypes	128		0.98		1.23	
Interactions	NS		NS		NS	

2. Influence of various levels of Ca and K, in nutrient solution, on the growth and yield of bold seeded groundnut genotypes

A sand culture experiment was conducted under high, and low levels of Ca and K to find out their role in the nutrition of bold seeded groundnuts. Five groundnut (four bol d seeded namely BAU 13, ICG 88398, B 95, BG 3 and a small seeded namely NRCG 6919) were used in this study. Increasing the level of Ca, 00 ppm dose reduced growth and yield. Most of the genotypes showed best growth and yield at 50 ppm K + 400 ppm Ca. The 200 ppm K + 50 ppm Ca caused adverse effect on both growth and yield. Application of K and Ca increased the seed size (8.0 to 10.2 %) and shelling percentage (1.0 to 2.0 %) and hence seed yield.Thus it is essential to apply balance dose of both K and Ca for the proper nutrition of bold seeded groundnut.

B. METHODS OF NUTRIENT APPLICATION

1. Comparision of micronutrient application through soil, foliar and drip

Looking to the water economy, particularly in the semi-arid regions, the drip system of irrigation is becoming popular. The micronutrients are generally applied on foliage in solution form instead of soil application, but due to dry weather it is not so effectively absorbed by leaves. Therefore, field experiments for two consecutive years were conducted to assess the performances of Fe, Zn and B application through drip i rigation and their comparison with soil and foliar application during the Rabi-Summer season. The soil of the experimental plot was calcareous containing 21% $CaCO_3$, 3.0 ppm Fe, 49 ppm Mn, 1.81ppm Zn and 0.9 ppm B. The micronutrient Fe, Zn and B were applied thrice at 30, 50

and 70 DAS through soil, foliar and drip. It was observed that application of these micronutrients through drip irrigation increased the yield, over their soil application (Table 17). The application of Fe, Fe+Zn, and Fe+Zn+B through drip irrigation increased the pod yield by 16.3, 22.0 and 30.0 %, respectively over control. However, their foliar application could increase 15.0, 15.9 and 17.0 % pod yield, respectively, during 1996. The soil application of these nutrients jointly could increase 11.9 % pod yield. The drip alone also increased these parameters over flood irrigation (8.6 to 8.9 % pod yield).From the two years trial it may concluded that micronutrients applied through drip irrigation increased the fertilizer use efficiency and kept the soil loose for peg penetration and pod development.

Table 17. Influence of micronutrients application through various methods on the yield of groundnut during 1996 and 1997.

Treatments	Mode of application	Pod yield (kg ha^{-1})		Shelling (%)		100-seed mass (g)	
		1996	1997	1996	1997	1996	1997
Control	—	1805	2135	67.4	65.8	34.4	30.4
Fe+Zn+B	Soil	2020	2526	68.2	67.2	34.8	30.6
H_2SO_4 (0.05%)	Foliar	1876	2422	69.4	67.1	34.8	31.1
Fe	foliar	2076	2343	69.1	67.6	35.8	31.0
Fe+Zn	Foliar	2091	2415	69.0	68.2	35.9	32.5
Fe+Zn+B	Foliar	2125	2463	69.4	68.5	36.2	31.3
water	Drip	1965	2318	69.8	67.8	38.1	32.1
H_2SO_4	Drip	1999	2639	68.9	68.4	36.9	33.0
Fe	Drip	2100	2365	68.8	67.9	37.9	32.9
Fe+Zn	Drip	2202	2618	68.9	68.0	37.7	32.7
Fe+Zn+B	Drip	2352	2835	69.1	68.6	38.3	33.4
LSD (0.05)	111	248	1.1	NS	1.9	NS	

C. STUDIES ON THE NUTRIENT-EFFICIENT GROUNDNUT GENOTYPES

1. Calcium, Fe and S nutrition in efficient and inefficient groundnut genotypes

Groundnut genotypes including germplasm and advanced breeding lines were studied in field during 1990-1995 and based on nutrient uptake,twelve nutrient- efficient (Fe,Ca and S efficient) and inefficient genotypes were identified (Table 18). It is necessary whether the efficient genotypes could grow under low supply of nutrients was investigated.Sand culture pot experiments were conducted to study the growth, pod yield and nutrient content of nutrient efficient and inefficient groundnut genotypes.These genotypes were grown with 1/4 (low) and Full (normal) concentrations of Fe, S and Ca in the Steinberg's nutrient solution. The nutrient efficient genotypes showed more chlorophyll (both Chl-a and b), and carotenoid contents than the inefficient genotypes

Clear-cut symptoms of Fe, Ca and S deficiencies were noticed in the nutrient-inefficient groundnut genotypes under low supply of these nutrients which reflected on their growth and pod yield. The nutrient efficient groundnut genotypes showed better growth and yield than the inefficient ones both at low and normal levels of these nutrients.As expected with increase in the doses the response in terms of growth and yield was more pronounced in nutrient-inefficient groundnut genotypes (Table 19).

Table 18. Nutrient efficient and inefficient groundnut genotypes.

Nutrient	Efficient	Inefficient
Fe	TG 26 and I1	NRCG 162 and VRI 3
Ca	NRCG 5513 and 7599	NRCG 6155 and 7417
S	NRCG 2588 and 1306	NRCG 3498 and 4659

Table 19. Nutrient doses and average yield (g/pot) of nutrient efficient and inefficient genotypes.

Nutrient	Low (1/4 dose)		Full dose	
	Efficient	Inefficient	efficient	Inefficient
Fe	7.6	6.4	10.3	9.2
Ca	8.5	4.6	11.5	9.5
S	8.2	6.3	11.7	9.1

D. SCREENING GROUNDNUT GENOTYPES FOR Al-TOLERANCE

An experiment was conducted in pots to study the tolerance of nine groundnut genotypes (of 4 Spanish and 5 Valencia groups) of Al (500 and 1000 uM Al provided weekly in solution form at pH 4.5) and to study the ameliorative role of Ca (200 uM $CaCl_2$). It was noticed that Al decreased the root and shoot length and number of pods and weight hence pod yield (Figure 1 and 2). Of the nine genotypes the NRCG 1308 and 7599 (both of Valencia group) showed better root and shoot growth and pod yield and hence were relatively more tolerant of Al toxicity than other genotypes. The Al at 500 and 1000 uM showed 28 and 42 % reduction in pod yield. However application of 200 uM of $CaCl_2$ caused considerable relief to the plant receiving 500 uM Al and increased growth and yield.

In another pot experiment, conducted under nutrient solution culture in sand, 5 genotypes were tested for their tolerance of Al (400 uM) and ameliorative effects of Ca (200 uM). It was observed that most of these genotypes tolerated the dose of Al till 60 DAS, but later on contrasting differences were noticed. Based on the root and shoot length, dry biomass and pod yield the genotypes NRCG 7085-1 showed better tolerance of Al and NRCG 6919 showed better ameliorative effect of CaCl2 to combat the effect of Al toxicity.

E. COLLABORATIVE EXPERIMENTS

Groundnut cultivation in North-East Hill regions

Plate 10. Groundnut farmer in NEH region.

The soils of these regions are mostly acidic containing 4.5 to 6.0 pH but are rich in organic matter. The Al and Fe toxicities and Ca and P deficiencies are major nutritional disorders occurring in groundnut grown in these regions which restrict the expansion of groundnut cultivation in these region. As we have now about 5000 germplasm lines and more than 100 groundnut varieties, our first and foremost effort would be to select the suitable groundnut genotypes for these regions through screening and understanding the behaviour of various genotypes so that integrated nutrient management practices could be formulated later. Looking to these problems, a preliminary survey was made during 1996 cropping season and based on the problems and possible solutions, five collaborative pilot experiments were suggested for ICAR Research Complexes in the North-Eastern Hill regions (Plate 10). During Kharif 1997 three experiments, with the following objectives, were successfully conducted at Barapani, Imphal and Tripura:

To find out the suitable groundnut cultivars for their cultivation in North-Eastern Hill Regions.

To screen groundnut germplasm for their tolerance of acid soils, Al, Fe and Mn toxicities and P deficiency.

To understand the role of nutrients for growing groundnut in those areas.

In the first experiment ten recently developed promising groundnut genotypes (five each of spreading and bunch habit groups) were grown to identify a suitable groundnut genotype for the region for immediate cultivation. In the second experiment 100 germplasm lines were screened for identifying acid and Al toxicity tolerant groundnut genotypes. The experiment conducted at Tripura at pH 5.0 had shown that based on the overall relative root and shoot growth and pod yield, the genotypes with ICG No 1026, 1045, 1062, 3606 and 7077 showed better tolerance of Al toxicity in acid soil. In the third experiment the integrated approach of testing phosphorus and Ca along with *Bradyrhizobium* and phosphorus solubilizing microbes were made.

At Tura the experiment has been planted in November. The data of these experiments are being processed at respective places and plant and soil samples being analysed and hence the detail reports of these experiments.

Microbiology

Project: Biological Nitrogen Fixation and Phosphate Solubilization in Groundnut

K.K. Pal and Rinku Dey

A. BIOFERTILIZERS

1. Bradyrhizobium

In order to develop nitrate tolerant bradyrhizobia suitable for groundnut-cereal intercropping and conditions of high dose of N-fertilizer application,thirty three strains were isolated from pot grown groundnut nodules amended with 180 kg ha^{-1} KNO_3 and 300 Kg ha^{-1} $(NH_4)_2 SO_2$. Efficiency testing of these strains to fix atmospheric nitrogen at different levels of nitrate is underway. For the development of efficient strains of *Bradyrhizobium* suitable for rice fallows and acidic conditions, strains were isolated from nodules of groundnut grown in rice fallows. *In vitro* testing of these strains is underway.

2. Phosphate Solubilizing Microorganisms

Newly isolated rhizobacteria were quantified for tri-calcium phosphate solubilization *in vitro*. Out of twenty isolates tested, two fungal isolates *viz.*, PSM 1 and BHU1, solubilized 57.3 mg. 100 mL^{-1} and 74.34 mg. 100 mL^{-1} medium respectively, after ten days of incubation. Among the rhizobacterial isolates, PSM 4, BHU 1, BHU 4 and isolate 311 solubilized 50.70, 48.52, 67.06 and 74.30 mg. 100 mL^{-1}, respectively after ten days of incubation. The efficiency and competence of these isolates for phosphate solubilization and plant growth will be tested in pot and field experiments.

B. PLANT GROWTH PROMOTING OR DELETERIOUS RHIZOBACTERIA (PGPR/DRB)

Crop specific PGPR have been isolated for various crops. PGPR influence the crop growth either by producing plant growth promoting substances or by eliminating/ inhibiting deleterious/pathogenic rhizospheric microorganisms. Four hundred and twenty three different physiological groups of rhizobacterial isolates were obtained from the rhizotic zones of groundnut and tested for different PGP/DRB attributes like production of IAA and HCN, phosphate solubilization and antifungal activity against *Sclerotium rolfsii* and *Aspergillus niger*. Isolate 180 and 188 exhibited potent antifungal activity against *Sclerotium rolfsii* (Plate 11) and *Aspergillus niger*, respectively. Mostly fluorescent pseudomonads were found to produce cyanide. Among these, nine cyanogenic and six non-cyanogenic isolates were characterized (table 20). Out of these fourteen isolates, isolate 363 (11.56 mg. L^{-1}), 397(8.95 mg.L^{-1}), 359 (4.56 mg. L^{-1}) and 185 (3.6 mg. L^{-1}) produced appreciable amounts of IAA like substances *in vitro*. Seedling bioassay (table 21) with

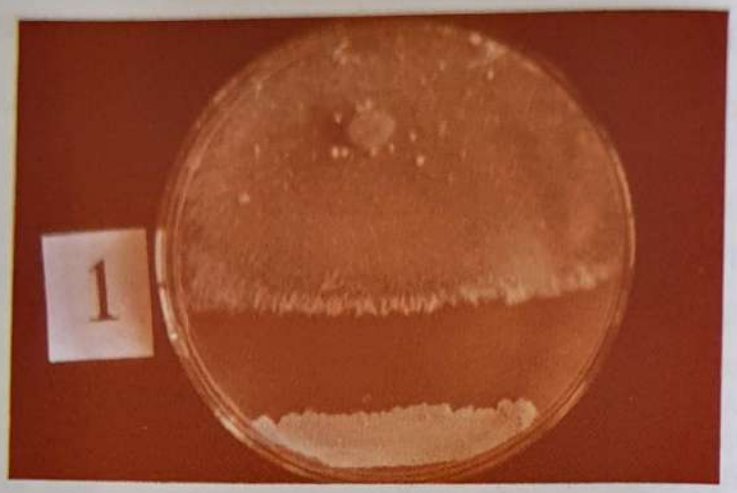


Plate 11a. Inhibition of *Sclerotium rolfsii* by Bacillus spp. Isolate 180 (inhibition zone after 5 days of growth at 28 ±1°C

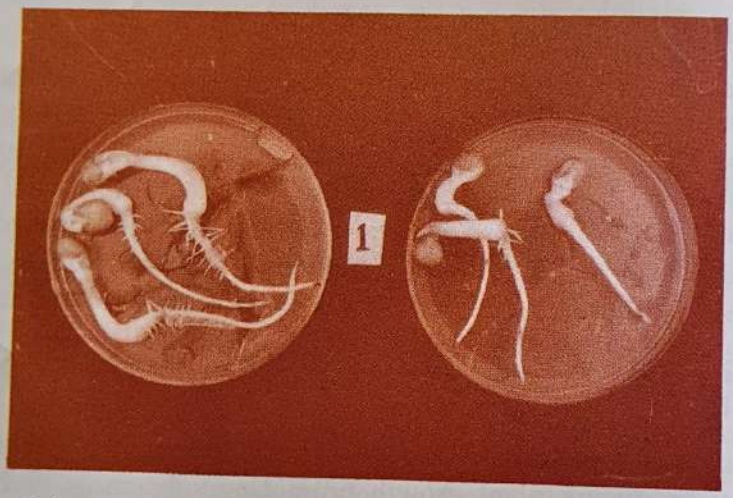


Plate 11b. Enhancement of seedling growth of CV. JL 24 by a fluorescent psuedomonad isolate (left).
Left: Control **Right: C185**

these cyanogenic and non-cyanogenic isolates exhibited significantly reduced root grow with potent cyanide producers like C220, C63, C103 etc., whereas significantly enhanc root growth was obtained with a non-cyanogenic isolate C185 (plate 11). The effect these isolates on growth and yield of groundnut will be further ascertained in pot a field trials and possible reason(s) for growth promoting/retardation will b determined.

Table 20. Detection and/or quantification of plant growth promoting/ deleterious attributes of bacterial isolates.

Isolates	TCP Solubilization (mg.100 mL^{-1})	IAA Production (mg.L^{-1})	HCN
C220	-	++	++
2	13.8	3.47	++
379	-	1.63	+++
85	-	1.77	+++
29	-	1.67	+
C42	-	1.00	+
C103	-	-	++
C63	-	-	-
C185	16.6	3.6	+++
C285	-	-	-
387	-	-	-
363	21.9	11.56	-
359	-	4.56	-
397	-	8.95	

Table 21. Effect of cyanogenic/non-cyanogenic microorganisms on root growth of groundnut cv. JL 24

Treatments	Root length after 7 days (cm)
Control	3.82[a]
C185	5.56
C103	0.51
359	1.39
85	1.94
C63	0.74
2	2.44
C220	1.13
C285	2.42
C42	1.75
363	1.94
387	1.71
29	0.64
397	1.71
379	1.93
CD (0.05)	1.73

a: Average of three replications

Biochemistry

Project: Biochemical Aspects of Groundnut Quality and Composition

J.B. Misra

A. NEW ESTIMATION PROTOCOLS

A1. Calibration of NIR for determination of oil content in groundnut seeds

Oil content of seeds of 56 breeding lines supplied by Plant Breeding section was analyzed by Soxhlet method which ranged from 47.3 to 54.9 per cent. These samples were used for testing the calibration of NIR and also for refining the calibration equation developed earlier. However, no improvement could be brought about in the predictability (r^2 = 81 per cent) of NIR by incorporation of additional samples. Differences of > ±2 per cent remained the predicted values and Soxhlet values, especially for the samples having oil content outside the range of 48 to 51 per cent.

A2. Determination of seed protein content by biuret method

The conventional Kjeldahl-N method of determination of protein entails handling of large volumes of highly corrosive chemicals (conc. sulfuric acid and caustic soda) and also the tedium of carrying out digestion and distillation. Biuret method is one of the simplest procedures for determination of protein in animal extracts. However, due to presence of several interfering substances, e.g. pigments in testa, and oil and certain other substances in cotyledons, the biuret method can not be applied directly on groundnut seeds. Experiments were conducted to adapt biuret method for determination of protein in groundnut seeds. The procedure thus developed involves physical removal of testa from seeds followed by grinding in a pestle with mortar to obtain a fine meal. Extraction of meal for removal of oil by suspending in hexane for 10 hours, followed by extraction of defatted residue by suspending in 80 per cent methanol for 10 hours for removal of small molecular weight substances. The residue thus obtained bcomes free from interfering substances and after its solubilization in sodium hydroxide (1 N) can be used directly for determination of protein by following the standard biuret protocol. The results obtained by this method were highly reproducible.

B. EVALUATION OF QUALITY CHARACTERISTICS, THE INCLUDING ORGANOLEPTIC ONES FOR THE CULTIVARS RELEASED IN THE LAST TEN YEARS (1987- 96)- THRUST AREA 5, MM-I

Seeds of 23 grown in Kharif-96 were analyzed for oil and protein contents (Table 22). The oil content ranged from 46.8 (CSMG 84-1) to 53.9 per cent (Girnar 1) and protein from 20.8 (ICGS 11) to 28.2 per cent (CSMG 84-1). The average values were 50.8 per cent and 23.5 per cent for oil and protein contents, respectively. Seeds of the varieties ALR 1,

Table 22. Oil and protein contents of some groundnut varieties

Sr. No.	Variety	Oil (%)	Protein(%)
1.	ALR 1	52.9	25.1
2.	B 95	50.0	21.7
3.	BAU 13	50.1	23.3
4.	CSMG 84-1	46.8	28.2
5.	GG 3	49.0	20.9
6.	GIRNAR 1	53.9	21.3
7.	ICGS 1	52.8	23.7
8.	ICGS 5	49.5	22.1
9.	ICGS 11	52.9	20.8
10.	ICGS 44	48.6	23.6
11.	ICGS 76	49.7	26.3
12.	ICGV 86325	49.8	27.3
13.	ICGV 86590	53.6	21.1
14.	K 134	51.4	22.7
15.	M 335	48.6	24.2
16.	RS 1	50.6	21.7
17.	RG 141	50.5	24.6
18.	RS 138	50.2	24.3
19.	SG 84	50.7	25.3
20.	Somnath	52.5	23.8
21.	TAG 24	53.3	21.2
22.	TG 26	48.2	24.3
23.	TKG 19-A	52.5	23.2
	Minimum	46.8	20.8
	Maximum	53.9	28.2
	Mean	50.8	23.5

Girnar 1, ICGS 1, ICGS 11, ICGV 86590, Somnath, TAG 24, and TKG 19-A the oil content of of 52 per cent or more. Seeds of ALR 1, CSMG 84-1, ICGS 76, ICGV 86325, and SG 84 the protein content of 25 per cent or more. Though a significant inverse relationship was observed between seed oil and protein contents (r = - 0.497*, N = 23), seeds of the variety ALR 1 were identified as *high oil-high protein* type and those of GG 3 as *moderate oil-low protein* type. Seeds of varieties ICGS 11 and CSMG 84-1 were identified as *high oil- low protein* and *low oil-high protein* types, respectively.

C. SERVICES PROVIDED TO OTHER SECTIONS/AGENCIES:

Seed samples, received from various sections of the NRCG project coordination, were analyzed for various biochemical attributes. Oil, protein, total sugars, reducing sugars, sucrose, and free amino acid contents were determined in 1370, 272, 98, 98, 42, and 98 samples, respectively.

Entomology

Project: Integrated Pest Management In Groundnut

V. Nandagopal, M.P. Ghewande and P.K. Ghosh

A. IPM

Farmers in general do not follow IPM as such and apply the commercially available pesticides indiscriminately leading to many undesirable problems in the environment apart from inadequate control of the target pests. Components of the IPM, which are feasible, simple to use, available locally in large quantities and adaptable by the farming communities have been tried under field conditions.

Four seasons (1994-1997) experimentation in both Rabi and Kharif season have revealed certain components of the IPM efficient in the management of pests and increased the pod yields.

The components that may go as part of IPM were considered for experimentations

1. Seed treatment with Carbendazim @ 2 g/kg of seeds
2. Weedicide application (Basalin @ 1.5 Kg a.i./ha)
3. Soil application of carbofuran @ 25 kg/ha.
4. Trap/barrier crops (Red gram (BDN 1), S'bean (Gujarat 1), castor (GAUCH 1), Baj (MH 169)
5. Pesticides mixtures (0.025% Dithane M 45+ 0.05% Bavistin + 2% crude nee oilinteepol+0.04%endosulfan+0.02%phosphamidon) + culture filtrates of *P.islandicu*
6. Pheromone traps (leaf miner + *Spodoptera* + *Helicoverpa*)
7. Intercultural operations

Treatments

T1. Seed treatment with carbandazim @ 2 g/kg seed + Trap crops (soybean: one middl row after each 4 rows of groundnut; one row of bajra surrounding the groundnu + pheromones (leaf miner+*Spodoptera*+ *Helicoverpa*) + insecticides mixture (2%crude neem oil + 0.04% endosulfan or 0.02% phosphamidon+0.025% dithane M 45 + 0.05% carbandazim) + weedicide: pre-emergence Fluchloralin @ 1.5 kg a.i./ha + one hand weeding + one interculturing.

T2. Seed treatment with carbendazim @ 2 g/kg seed + Trap crops one middle row o soybean+pheromones(leaf miner+*Spodoptera*+ *Helicoverpa*) + insecticides mixtur (2%crude neem oil+0.04% endosulfan or 0.02% phosphamidon + 0.025 % dithane M 45+0.05% carbandazim) + Weedicide:pre-emergence Fluchloralin @ 1.5kg a.i./h + one hand weeding + one interculturing.

T3. Farmer's practice: application of insecticides, fungicides, one hand weeding and one interculturing.

T4. Control (only groundnut, no weeding and no spray).

In the summer, there was in adequate pest load in the experimental plots. The aphid, thrips, jassids and other defoliators were below the pest status. The disease such as aflaroot,collar rot and BND were below the level to create disease, while stem rot incidence was highest in the first treatment (13.1%) compared to even farmers practice (6.03%) and control (5.3%) (Table 23). The weeds intensity was not significant at 30 DAS and 60 DAS, while there significant difference in the weed flora (dry matter kg/ha) with 1760 kg/ha dry matter in control plots compared to only 484 kg/ha in the treatment where all the feasible components are used at harvest (Table 24).

Table 23. Diseases pressure in the IPM experiment during summer,1997

Treatment root	Aflaroot (%)	Collar rot (%)	BND (%)	Stem rot (%)
1	0.156	0.32	1.06	13.1
2	0.13	0.33	1.06	6.37
3	0.22	0.12	1.02	6.04
4	0.33	0.13	0.67	5.33
CD= 0.093**	NS	NS	5.38*	
-p=0.05%				

**= Significant at 1 %; *=Significant at 5 %

Table 24. Weed intensity in the IPM experiment during summer,1997

Treatment	Weeds (dry matter kg/ha) over period		
	30 DAS	60 DAS	At harvest
T1	343.32	754.86	484.60
T2	452.28	769.74	635.06
T3	269.90	637.30	376.72
T4	636.44	1228.80	1760.74
C.D. (0.05%)	NS	NS	258.35**

In the summer 1997, excluding trap crops such as soybean, bajra (Plate 12) and use of other components such as seed treament with Bavistin, soil application of carbofuran @ 25 kg/ha, spray of insecticides mixture (insecticides mixture i.e., 2% crude neem oil + 0.04% endosulfan +0.02% phosphamidon, pheromones (leaf miner + *Spodoptera*+ *Helicoverpa*) and application of weedicide:pre-emergence Fluchloralin @ 1.5 kga.i./ha + one hand weeding + one interculturing has resulted the highest pod yield of 1691 kg/ha with a gross monetary return of Rs. 21167/ha compared to other treatments. The farmers practice gave only 858kg/ha with Rs10985/ha (Table 25).

Plate 12. A trap crop of bajra as a component of IPM.

Table 25. Yields and economics of main crop and the trap/barrier crops in IPM (Summer-97).

Treatment	Groundnut	kg/ha -value (Rs)		Gross return (Rs.)
		soybean	bajra	
T1	1250.13	3.32	110.67	
	847.59			
	(16951.8)	(16.60)	(1106.70)	18075
T2	1373.28	—	96.91	
	911.86			
	(18237.2)	—	(969.10)	19206
T3	1690.68	—	—	
	1058.37			
	(21167.40)	—	—	21167
T4	858.25	—	—	
	549.28			
	(10985.60)	—	—	10986

CD (p=0.05%): 309.92 **; **: Significant at 1%

B. MONITORING OF MAJOR INSECTS IN GROUNDNUT

Monitoring of the major insects were continuing from October 1993. Thrips and jassids were monitored using sweepnet in the micro-plots raised 5th of every month. The aphid was monitored using drum trap and the leaf miner was monitored using pheromone traps.

The results indicated that the aphid population trapped the maximum in January and February (1475/week/trap and 696/week/trap respectively), while in March the population declined to 44/week/trap. In the case of leafminer, unlike 1996 summer, 1997 summer registered population ranging 1to 4/trap/month, but never appeared in pest status.

The stepwise correlation of the aphid and leaf miner catches resulted that the temparatures maximum, minimum and the average have significantly negative relation with the aphid (total) and non-significant with aphid *Hysteroneura setaria* and again significant negative relation with *Aphis craccivora*.

The correlation of the independent factors such as temperature (max,min,avg), humidity (morning, evening, average), soil temperature (10cm, 20cm), rainfall, rainy days, sunshine, vapour pressure with the aphid catch in the drum trap over four years have resulted that the temparature, humidity, soil temparature and vapour pressure played a mjor role in the population density of the aphid.

The stepwise regression worked out between weather factors and the aphid catch were as follws:

Temparature	Vs	aphid in sticky trap	= y =711.99 + (-24.06) x (Average)
Temparature	Vs	aphid in water trap	= y =16.2 + 0.29 x (minimum)
Temparature	Vs	aphid in drum trap	= y =1839.57 + (-60.65) x (Average)

Plant Pathology

Project: Studies on Economically Important Fungal and Viral Diseases of Groundnut

M.P. Ghewanmde and S. Desai

A. DISEASE RESISTANCE

(I) Early leaf spot, late leaf spot and rust

Sixty five genotypes alongwith the susceptible check (GG 2) were evaluated agains major foliar fungal diseases (ELS, LLS & Rust) under Uniform Disease Nursery durin kharif 1997. Out of these, eight genotypes, viz., ICG 7881, NCAc 343, ICGV 86020, NCA 927 (Germplasm lines), PBS 105, 27(7), PBS 22028 and IR 14 (NRCG breeding lines) wer found to possess multiple disease resistance (ELS, LLS & Rust) with a disease score rang of 1.33 to 4.00 (Table 26). Seven other genotypes, viz., PBDR 48, PBDR 7, IR 16 B (NRC breeding lines), NCAc 17090, ICGV 87280, ICGV 78991 and ICGV 86694 showed resistan reaction against rust.

Table 26. Genotypes found to be resistant against foliar fungal diseases (ELS, LLS & Rust) during kharif 1997 at the NRCG, Junagadh.

Genotypes	Mean Disease Score (1-9 scale)			
	ELS	LLS	Rust	Pod Yield (g/plant)
ICGV 86020	2.66	3.00	2.00	5.35
PBS 105	3.50	3.83	2.33	4.75
27(7)	3.50	4.00	2.33	4.37
NCAc 343	3.66	4.00	3.00	7.50
ICG 7881	2.66	2.50	1.33	3.60
PBS 22028	3.17	3.50	2.33	7.81
IR 14	4.00	4.00	2.33	6.09
NCAc 927	3.33	3.66	1.83	1.66
PBDR 48	4.33	7.00	2.83	7.36
PBDR 7	6.50	8.00	2.66	6.90
ICGV 87280	5.17	6.17	2.00	5.94
ICGV 78991	4.83	6.50	2.33	5.11
IR 16 B	4.17	5.33	2.17	5.53
ICGV 86694	3.83	5.50	2.00	5.61
NCAc 17090	4.83	7.33	3.00	2.33
GG 2	6.17	7.83	6.00	4.75

Among the multiple disease resistant lines, PBS 22028 recorded highest pod yield of 7.81 g/plant followed by NCAc 343 (7.5 g/plant) and IR 14 (6.1 g/plant). (ii) PBND and stem rot *(Sclerotium rolfsii).*

During summer 1997, seventy genotypes were evaluated against aflaroot, collar rot, stem rot and PBND under field condition. The incidence of aflaroot and collar rot was very low. However, the incidence of stem rot (34%) and PBND (16%) was considerable. Out of 70 genotypes, 2 breeding lines, CY 9 and DRV 12 B of NRCG were found to be free from PBND infection. Four other genotypes viz., CY 5 and PBDR 32 (NRCG breeding lines), ICGV 86652 and ICG 239 (germplasm lines had below two per cent incidence of PBND.

No incidence of stem rot was found in the germplasm lines, NCAc 927 and ICGV 86594 and the NRCG breeding lines, IR 14, CY 7 and PBDR 48. Eight genotypes, CY 14, DRV 1, PPS 1, PPS 1-1, 27(7), PBS 145, PBS 22017 (NRCG breeding lines) and ICGV 86280 had below 2 per cent incidence of stem rot.

Fifteen genotypes were also screened for resistance against stem rot (S.rolfsii) under sick plot and 27 were tested in artificially inoculated laboratory conditions (Plate 13).

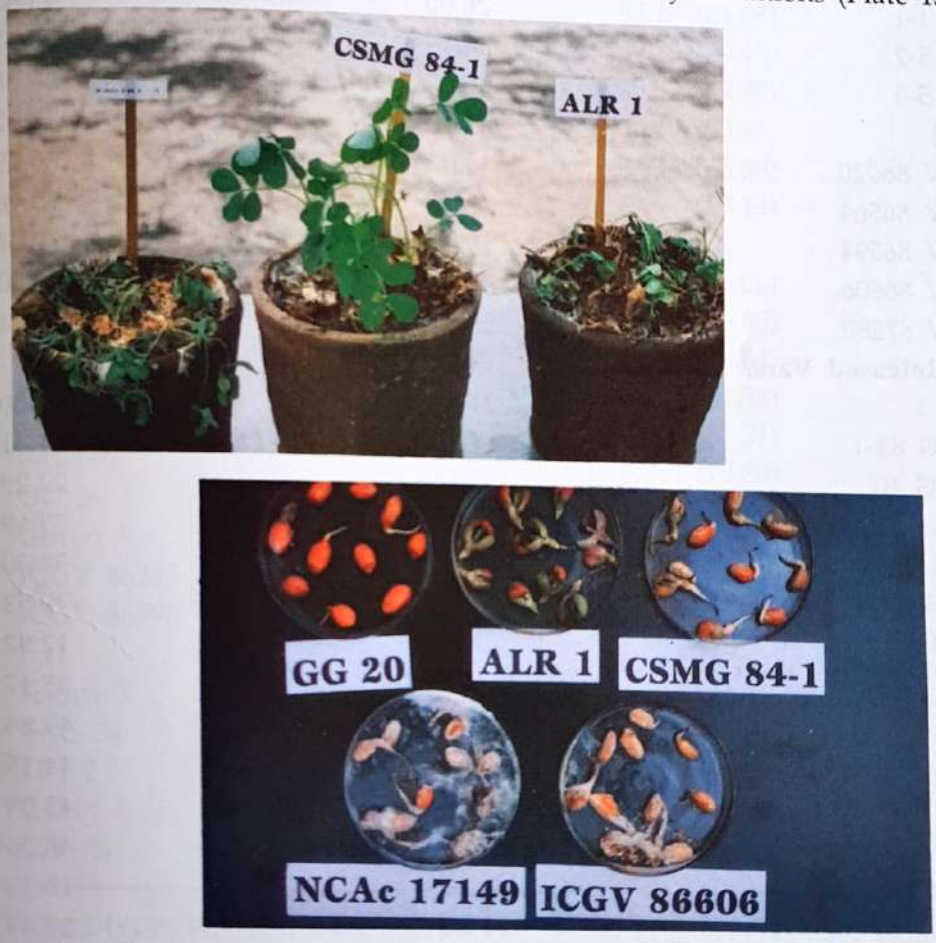


Plate 13. Screening of released cultivars of groundnut against *Sclerotium rolfsii*

Out of 27 genotypes, two released cultivars, CSMG 84-1 and GG 20 showed dry seed resistance to *S. rolfsii* (Table 27). However, all the 27 genotypes tested under laboratory condition were found susceptible to stem rot at seedling stage (Table 28).

Table 27. Screening of some groundnut genotypes for dry seed resistance to stem rot *(S.rolfsii)* under laboratory condition.

Genotype	Mean seed infection (%)	Mean seed colonization (%)
I. Germplasm		
NCAc 343	34.18	25.31
NCAc 17149	41.95	40.11
NCAc 341879	39.23	29.690
II. Breeding Lines		
PPS 1	63.85	45.00
PPS 1-1	26.90	25.45
PPS 5-2	38.19	35.17
PPS 5-3	50.82	38.86
27(7)	63.10	48.93
ICGV 86020	36.07	30.29
ICGV 86564	32.76	33.16
ICGV 86594	45.99	32.01
ICGV 86606	38.55	32.90
ICGV 87280	55.85	48.84
III. Released Vars.		
ALR 1	24.05	22.60
CSMG 84-1	14.76	4.31
GAUG 10	29.93	22.29
GG 2	47.83	39.69
GG 4	45.06	33.00
GG 11	37.09	29.53
GG 20	10.45	12.92
Girnar 1	34.93	35.17
ICGV 86325	62.79	49.86
ICGV 86590	57.12	44.15
J 11	50.79	43.09
Kadiri 3	52.84	46.26
TAG 24	26.14	15.38
TPT 2	61.26	37.89
C.D (=0.05)	13.41	10.79
C.V.%	27.89	27.88

Table 28. Screening of some groundnut genotypes for resistance to stem rot *(S. rolfsii)* at seedling stage under laboratory condition.

Genotype	Mean seedling mortality (%)
1. Germplasm Lines	
NCAc 343	56.93 (70.22)
NCAc 17149	62.11 (78.11)
NCAc 314879	59.51 (74.28)
II. Breeding Lines	
PPS 1	63.07 (79.79)
PPS 1-1	53.86 (65.24)
PPS 5-2	29.04 (23.59)
PPS 5-3	51.93 (61.95)
27(7)	53.16 (64.05)
ICGV 86020	32.89 (29.45)
ICGV 86564	49.82 (58.34)
ICGV 86594	45.19 (50.45)
ICGV 86606	41.44 (43.80)
ICGV 87280	47.97 (55.19)
III. Released Varieties	
ALR 1	60.00 (75.00)
CSMG 84-1	43.08 (46.65)
GAUG 10	51.14 (60.64)
GG 2	50.39 (54.38)
GG 4	51.54 (61.31)
GG 11	57.29 (70.80)
GG 20	39.61 (40.66)
Girnar 1	25.97 (19.18)
ICGV 86325	64.03 (80.81)
ICGV 86590	50.00 (58.69)
J 11	42.68 (45.92)
Kadiri 3	53.46 (64.55)
TAG 24	47.11 (53.69)
TPT 2	38.62 (38.93)
C.D. (=0.05)	14.85
C.V. %	37.47

Out of 15 genotypes tested during kharif 1996-97 and R/S 1997 against stem rot under sick plot, ICGV 86020 recorded the lowest incidence (8.11 per cent) of stem rot as against 35 per cent in NCAc 341879 and 22.14 per cent in GG 2 (Table 29).

Table 29. Evaluation of some groundnut genotypes for resistance to stem rot *(S. rolfsii)* under sick plot condition during kharif 1996-1997 and R/S 1997.

Genotype	Disease Incidence (%)	Pod Yield (g/10 plant)
NCAc 343	25.52	42.71
NCAc 17149	32.09	29.19
NCAc 341879	34.75	35.11
PPS 1	22.70	70.56
PPS 1-1	26.22	38.50
PPS 5-2	18.42	48.01
PPS 5-3	16.97	50.05
27-7	23.01	46.16
ICGV 86020	8.11	31.68
ICGV 86564	22.16	35.86
ICGV 86594	18.42	37.85
ICGV 86606	16.30	22.83
ICGV 87280	23.57	72.60
J 11	17.67	44.43
GG 2	22.14	46.62
C.D. (=0.05)	5.58	6.86
C.V. %	38.55	23.83

B. DISEASE MANAGEMENT

1. Role of intercropping a component of integrated management of major foliar fungal diseases.

Field experiments for the management of early leaf spot (ELS), late leaf spot (LLS) and rust diseases through intercropping were conducted in the kharif season of the years 1995 to 1997. Four crops viz., sunflower (cv. Morden), pigeonpea (cv. T 21), Pearlmillet (cv. GMB 32) and sorghum (local) were evaluated as intercrops, each in a ratio of 3:1 (Gnut: intercrop) in RBD with four replications and a plot size of 5 m x 3.9 m. GG 2 was used as the test cultivar.

Pooled data showed that the severity of ELS, LLS and rust diseases varied significantly among crop combinations. Groundnut + pearlmillet intercropping significantly reduced the severity of ELS by 39 per cent, LLS by 54 per cent and rust by 49 per cent over sole crop. The next best crop combination for disease management was groundnut + pigeonpea which reduced the intensity of ELS by 50 per cent, LLS by 44 per cent and rust by 21 per cent (Table 30A & 30B).

Table 30A. Effect of crop combinations on foliar disease development and yield of groundnut (kharif 1995-1997).

Crop combinations	Disease Intensity (Pooled Mean %)		Groundnut Yield(kg/ha)	
ELS	LLS	Rust		
G'nut + Sunflower	18.32	48.30	33.9	495.48
G'nut + Pigeonpea	12.00	39.72	37.5	593.83
G'nut + Pearlmillet	14.73	32.58	24.4	462.55
G'nut + Sorghum	20.48	51.51	36.1	488.48
G'nut sole crop	24.18	71.02	47.4	858.65
C.D. (0.05)	3.39**	3.44**	7.78	116.40**
C.V. %	23.37	13.32	13.0	34.40

Table 30B. Yield levels in different crop combinations and disease situation G'nut.

Crop combination	Disease Reduction (%)			Mean Pod/Grain Yield (kg/ha)		Mean Fodder Yield (kg/ha)	
	ELS	LLS	Rust	G'nut	Intercrop	G'nut	Intercrop
G'nut+Sunflower	24	32	29	496	203	729	760
G'nut+Pigeonpea	50	44	21	594	1436	722	920
G'nut+Pearlmillet	39	54	49	463	214	906	2701
G'nut+Sorghum	15	27	24	489	-	738	4337
G'nut (sole crop)	-	-	-	859	-	1224	-

The maximum average pod/grain yield was realized under Gnut + pigeonpea intercropping (Gnut 594 kg/ha, pigeonpea 1436 kg/ha). Thus crop combination of Gnut + pearlmillet (3:1) and/or Gnut + pigeonpea were found suitable for managing the major foliar fungal diseases and could form a major component of IDM programme in groundnut.

2. Management of stem rot (*S. rolfsii*) of groundnut

Experiments on the integrated management of stem rot of groundnut were conducted during the rainy seasons of the year 1996-97 and post-rainy season of the year 1997 in sick soil in concrete block condition involving components like seeed treatment with carbendazim (2g/kg seed), seed treatment with Trichoderma viride (commercial preparation, monitor w.p. @ 4 g/kg seed), soil application of *T. viride* (monitor-s) @ 62.5 kg/ha) and organic soil amendment with castor cake and neem cake each @ 1000 kg/ha.

Pooled data (Table 31) indicated that though the incidence of stem rot and yield did not vary significantly among the treatments, all the treatments had lower incidence of stem rot and higher pod yields than the control. The soil application of *T. viride* (monitor S @ 62.5 kg/ha) gave maximum control (48 per cent) of stem rot followed by seed treatment with T.viride (monitor w.p. 4g/kg seed) and combination of these two treatments.

Table 31. Management of stem rot (S.rolfsii) of groundnut G'nut sole crop under sick plot condition during kharif 1996-97and R/S 1997.

Treatment	Pooled mean of 3 seasons		Pod Yield
	Disease Incidence (%)	Disease Reduction (%)	
T_1 Seed Treatment with Carbendazim (2g/kg seed)	31.28	6.43	0.104
T_2 Seed Treatment with Monitor-WP (Trichoderma Viride) (4g/kgseed)	23.83	28.72	0.147
T_2 Soil Application of Monitor-S *(T. viride)* (62.5 kg/ha)	17.37	48.04	0.133
T_4T_2 + T3	24.40	27.01	0.138
T_5 Soil Amendment with castor (1000 kg/ha)	27.07 cake	19.02	0.159
T_6 Soil Amendment with Neem cake (1000 kg/ha)	26.28	21.39	0.106
T_7 control	33.43	-	0.069

Soil application of castor cake @ 1000 kg/ha gave maximum pod yield (1060 kg/ha) followed by seed treatment with *T. viride* and combination of seed treatment and soil application of *T. viride.*

C. DETECTION OF PSTV IN G'NUT SEED MATERIAL

In all, 15912 seed samples received from various scientific sections of the NRCG, Project Coordinator (G'nut) and Main Oilseeds Research Station, GAU, Junagadh were indexed for PStV through ELISA. Out of these, 13, 054 samples were ELISA negative for PStV.

Project: Studies on seed pathological aspects with special reference to seed health and aflatoxin in groundnut.

M.P. Ghewande, J.B. Misra and S. Desai

A field trial was conducted during both the summer and kharif seasons of 1997 for evaluating resistance to pre- harvest aflatoxin contamination under field conditions. Twenty bold-seeded genotypes, along with the cultivar M 13 as the susceptible check and the cultivar J 11 as the resistant check. After the harvest, observations on pod infection, seed infection and seed colonization by Aspergillus flavus were recorded.

There was no pod infection during summer 1997 in any of the genotypes tested. However, seed infection and seed colonization by A.flavus ranged from zero to 2.0 per cent and zero to 4.33 per cent respectively. No seed infection and seed colonization were recorded in J 11 and the germplasm like NRCG 5850. NRCG 7276 had 0.33 per cent seed infection but no seed colonization by *A. flavus*.

During kharif 1997, no pod infection, seed infection and seed colonization by *A. flavus* were found in J 11. Pod infection of 0.66 per cent to 1.33 per cent was recorded only in six genotypes viz., NRCG 839, 2746, 8939, 7276, B 95 and B 99-1. The seed infection ranged from zero to 2.33 per cent. No seed infection was recorded in NRCG 734 and J 11. The seed colonization ranged from zero to 3.33 per cent. The minimum seed colonization of 0.33 per cent was recorded in M 13 and NRCG 912. No seed colonization was recorded in J 11.

The highest pod yield of 2297 kg/ha was recorded in B 99-1 followed by NRCG 7276 and PPS 1 during summer, 1997.

B. EVALUATION OF BOLD SEEDED GENOTYPES FOR SEED INFECTION AND COLONIZATION (*IN VITRO*) AND AFLATOXIN CONTAMINATION.

Six bold-seeded genotypes viz., ICHNG 88448, BAU 13, JSP (HPS) 24, JSSP (HPS)8, JSP (HPS)19 being tested in the HPS varietal trial of the AICRPG were tested in vitro for resistance to seed infection and seed colonization by *A. flavus*. M 13 was the susceptible check and J 11 the resistant check. Seed infection and seed colonization ranged from 10 per cent to 100 per cent and 13.33 to 100 per cent respectively. All the genotypes tested, except J 11 were found to be susceptible to A.flavus seed infection and seed colonization. J 11 showed resistance to both the seed infection and seed colonization by *A. flavus*.

Transfer of Technology

Project: Technology Assessment and Refinement Through Institutional Village Linkage Programme (TAR-IVLP)

The TAR-IVLP project is operative at the Centre and is helping the farmers to adopt technologies for overall development of the four adopted villages viz. Vadhavi, Nandarkhi, Zhanzarda, and Umatwada around Junagadh.

The team is headed by Dr. M.P. Ghewande, Sr. Scientist (Plant Pathology) and the members of the team are Dr. V. Nandagopal, Scientist (Entomology), Dr. P.K. Ghosh, Scientist (Agronomy), and Dr. R.K. Mathur, Scientist (Plant Breeding). In addition, the team also consists of sceintists from Gujarat Agricultural University, Junagadh Campus and technicians from NRCG for effective implementation of the programme. The activities and the results there of for the year 1997-98 are presented below.

GROUNDNUT PIGEONPEA INTER-CROPPING

In the groundnut + pigeonpea intercropping system, groundnut was grown as a rainfed crop but in pigeonpea partial irrigation (one or two) was given by all the farmers. The gross monetary returns were higher in all the replacement series (Rs. 47552 to Rs.48595) than the sole groundnut crop, a farmers practice (Rs. 21915).

IMPROVEMENT OF YIELDS OF WHEAT THROUGH CROP MANAGEMENT

Farmers who adopted the recommended spacing of 23 cm between rows in wheat programme, realised a higher yield of 6292 kg/ha than those adopted wider spacing (45 cm) who obtained yield of 5309 kg/ha. There was an increase in yield by 803 kg/ha in the recommended practice over farmers practice. Thus, there was an increase in gross monetary return of Rs. 8037/ha/farm family.

IMPROVEMENT OF SUMMER GROUNDNUT YIELD THROUGH MANAGEMENT PRACTICES

The improvement of rabi/summer groundnut yield through management practices was taken up by four farm families in Umatwada village. The combination of criss-cross sowing of groundnut and application of wheat straw @ 5 tone/ha realized increase in pod yield by 154 per cent and an extra gross income of Rs.20,970/ha was recorded over farmers practice.

INTEGRATED MANAGEMENT OF DIAMOND BACK MOTH OF CABBAGE

Among the vegetable crops grown on a limitted scale in Umatwada village, cabbage is the main crop grown in winter season. The crop is severly attacked by the diamand back moth. The integrated management with Cartab @ 1 kg a.i./ha and susequent

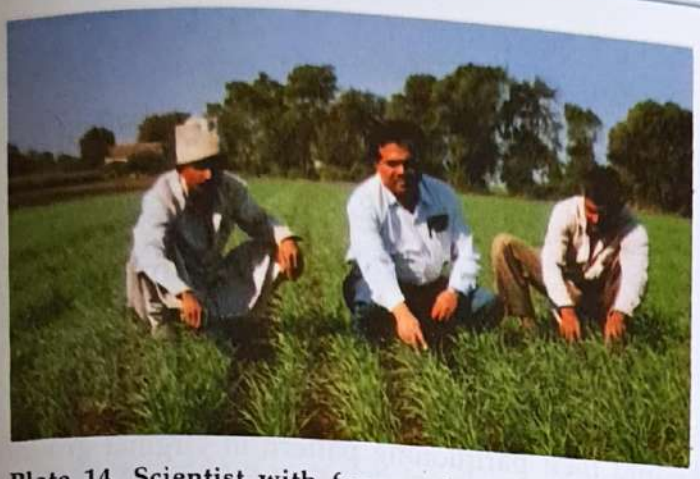


Plate 14. Scientist with farmers in IVLP village.

application of BT toxin @ 300 g/ha was adopted. The results indicated that the field with IPM resulted with 200 kgs more cabbage/ ha compared to farmers practice. The fly parasite recorded in the diamand back larvae is beaing processed for identification.

INTEGRATED MANAGEMENT OF STEM ROT/COLLAR ROT IN GROUNDNUT

Farmers have been following monocropping of groundnut in medium black soil either in the set furrow system or in changing furrows but in the same plot year after year. As a result the stem and collar rot problems are in the ascendance very fast. Farmers do not adopt any control measures against stem rot. Integrated disease management using seed treatment and soil application through biocontrol agent, Trichoderma viridi (monitor S and monitor WP) and soil ammendment with castor cake resulted in reduction of the stem rot ranging from 48 to 60 % over farmers practice.

Plate 15. Groundnut produce after harvest in IVLP village.

Publications

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C. CHAPTERS IN BOOK/REVIEWS

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D. PRESENTED IN WORKSHOPS/SEMINARS/SYMPOSIA

Bandyopadhyay, A., Desai, S., Radhakrishnan,T., Misra, J.B. And Pal, K.k. 1997. Status of biotechnological research in groundnut. Paper presented at the Biotechnological approaches fro crop improvement in groundnut and Pigeonpea, 8-9 March, 1997 held at Institute of Public Enterprise, Osmania University Campus, Hyderabad.

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E. TECHNICAL BULLETIN

Rajgopal K. and Bandyopadhyay, A. Elite Groundnut Germplasm -A Ready Reference (In press).

Other Information

ADMINISTRATIVE AND FINANCIAL

A. TOTAL STAFF IN NRCG WITH NAME AND THE NUMBER OF SC, ST AND OBC's EMPLOYEES AS ON 31.04.98.

	SANCTIONED POSTS	FILLED UP	SC	ST	OBC
Scientific Staff	39	20	5	-	-
Technical Staff	38	37	5	-	1
Administrative Staff	18	18	4	6	-
Supporting Staff	21	20	3	3	7
Total	116	95	17	10	8

B. EXPENDITURE STATEMENT FOR 1997-98 (RUPEES IN LAKHS) AS ON 31.04.98.

		RE		EXPENDITURE	
		Non-Plan	Plan	Non-Plan	Plan
1.	Estt. charges including LSP & PF.	95.25	5.60	95.11	5.55
2.	T.A.	2.00	3.50	2.00	3.50
3.	Other charges including equipment	2.00	65.70	2.00	65.67
4.	Works	-	17.70	-	17.65
5.	Other Contingencies	-	-	-	-
	Total	99.25	92.50	99.11	92.37

LIST OF RESEARCH PROJECTS AND SUB-PROJECTS AT THE NRCG AS APPROVED BY RAC HELD IN 1998, JUNAGADH, FOR THE YEARS 1998-2003

Programme I: Low-inputs, low risk efficient sustainable production packages for traditional rain-dependent areas

Project 01: Studies on crop improvement for resistance to biotic and abiotic stress
Project Leader: Dr. R.K. Mathur
Sub-project: Biotic stress
Sub-project: Abiotic stress

Project 02: IPM for groundnut based production system
Project Leader: Dr. M.P. Ghewande
Sub-project: Integrated insect-pest management of thrips and defoliators in Groundnut using non-synthetic pesticides, biocontrol, pheromone in CDR production system.
Sub-project: Integrated management of major diseases (ELS, LLS, Rust, Collar rot, Stem rot) of groundnut.

Project 03: Management of post harvest problems in Groundnut
Project Leader: Dr. P.C. Nautiyal
Sub-project: Seed viability and dormancy
Sub-project: Storage pests

Project 04: Nutrient management in groundnut
Project Leader: Dr. K.K. Pal
Sub-project: Biofertilizer
Sub-project: Mineral disorders of groundnut

Project 05: Studies on groundnut based cropping system
Project Leader: Dr. Devi Dayal
Sub-project: Studies on input management in intercropping system
Sub-project: Studies on sequential cropping system

Programme II: Cropping system for traditional rabi-summer and spring irrigated situations

Project 06: Cropping system for traditional rabi/summer and spring irrigated situations
Project Leader: Mr. Y.C. Joshi
Sub-project: Physiological studies on abiotic stresses
Sub-project: Development of cropping system

Programme III:	**Sustainable cropping systems for non-traditional areas with special emphasis on eastern and north-eastern parts of India.**
Project 07:	Development of suitable cropping system for non-traditional areas with special reference on eastern and north eaastern parts of India
Project Leader:	Dr. A.L. Singh
Sub-project:	Studies on impact of agro-ecology and agr-economy
Sub-project:	Development of suitable cropping system
Sub-project:	Breeding to develop cultivars tolerant to Al toxicity
Sub-project:	Organic farming
Programme IV:	**Understand and overcome the nature of barriers to enhance the genetic yield potential of cultivars by conventional and modern methods.**
Project 08:	Germplasm management of cultivated groundnut and its wild relatives.
Project Leader:	Dr. K. Rajgopal
Sub-project:	Collection, evaluation, documentation and distribution of cultivated groundnut and related Arachis species
Sub-project:	In vitro- and Cryo- conservation of groundnut germplasm
Sub-project:	Enhancing the recombination frequency in groundnut
Project 09:	Biotechnological approach to characterization and genetic enhancement of groundnut.
Project Leader:	Dr. T. Radhakrishnan
Sub-project:	Characterization, enhancement and molecular screening of Arachis gene pool
Sub-project:	Developing and utilizing transformation protocols for groundnut to produce insect and virus resistant transgenics.
Programme V:	**Cropping system based on groundnut for diversified and value added products**
Project 10:	Assessment and enhancement of quality in groundnut and its value added products
Project Leader:	Dr. J.B. Misra
Sub-project:	Assessment of quality in germplasm collection, breeding material and produce of other experiments.
Sub-project:	Breeding for HPS and confectionary cultivars
Sub-project:	Genetic engineering for enhancement of quality
Sub-project:	Microbial recycling of groundnut shell into useful products
Project 11:	Prevention and management of aflatoxins and other mycotoxins in groundnut
Project Leader:	Dr. S. Desai

INSTITUTIONAL ACTIVITIES

I. INSTITUTE SEMINARS

Date	Topic	Speaker
5-7-97	Simulation of model for drought resistance breeding in groundnut (A Report on Visit to Australia 13 March to 7 April 1997.	Dr. M.S. Basu
16-7-97	Modalities for consultancy and contract research in ICAR.	Dr. K.K. Pal
15-10-97	Plant nutrition for sustainable food production and environment.	Dr. A.L. Singh
17-1-98	Molecular Farming	Dr. K.K. Pal

Research Advisory Committee Meetings

II. MEETING OF THE RAC (24-27 APRIL, 1997)

The meeting was called to order by the chairman, Dr. S.S. Rajan, and the following members participated in the meeting Dr. P.S Reddy, Director, DOR, Hyderabad; Dr. V.J. Patel, Ex. Director of Campus, GAU, Junagadh; Dr. S.N. Nigam, Pricipal Groundnut Breeder, ICRISAT, Patancheru; Shri S.M. Asif, Chief Editor, *In Dinon*, Patna; Dr. S.N. Puri, Director, NCIPM, New Delhi; Dr. M.V. Kanjaria, Director, SVRTI, Mandavi; Dr. N.B. Singh, ADG (OP), ICAR, New Delhi; Dr. M.P. Ghewande, Director (Actng.), NRCG, Junagadh; and Sh. Y.C. Joshi, Senior Scientist, NRCG, Junagadh. Dr. Anupam Verma, Jt. Director (Edn.), IARI, New Delhi and Ms. Meena Thakur, President, Mahila Youth Congress, Upleta, Distt. Rajkot could not attend the meeting due to some unavoidable preoccupations. The chairman expressed his happiness over the inclusion of public men/women as non-technical members of RAC. He urged all the participants to freely express their views as the role of RAC was more of advisory nature than a fault finding one. Dr. Ghewande welcomed the participants and then gave a brief account of the Centre including major accomplishments since its inception. This followed presentations by the Heads of scientific sections about their research activities. The members of RAC offered suggestions for improving the research programmes and also provided guidance for conducting some special type of research issues such as DNA finger printing for characterization of germplasm, research on monosomics and male sterility, basic agronomic issues, HPS groundnut and value addition, low input technology for resource-poor farmers, soil salinity, and white grubs.

The evolution of the groundnut variety Girnar1, conceptualization of ideal ideotype for groundnut breeders, the advocation of paired-rows planting of groundnut as an improved production practice for some areas of Gujarat, the design and formulation of easy and quick method of oil estimation were commended by the RAC.

The committee recommended for laying out of a well defined and articulated mandate for the NRCG. Since, the demarcation between basic and applied work can not be sharply defined in agricultural research research may be conducted on basic aspects which have imemdiate applications. Filling up of vacant posts, lack of incentives to the scientists for working in a remote area and lack of infrastructure such as green houses, glass house and crossing block and insectry have been viewd as major constraints.

The members of RAC also took a round of experimental fields and laboratories of various sections in the morning of 24.04.97. The members of RAC were unanimous in appreciating the efforts vis-a-vis accomplishments of the scientists of the centre. The chairman concluded the meeting with the hope that the scientist at the NRCG would take the suggestions of RAC in the spirit they were made.

III. MEETING OF THE RAC (30-31 MARCH, 1998)

The meeting was chaired by Dr. P.S. Reddy in absence of Dr. S.S. Rajan due to his indisposition. The following members of the RAC participated in the meeting.

Dr. V.J. Patel, Director of Campus, GAU, Junagadh
Dr. M.V. Kanzaria, Director, SVRTI, Mandavi
Dr. Anupam Verma, Dean, IARI, New Delhi
Dr. S.N. Puri, Director, NRC for IPM, New Delhi
Dr. A. Bandyopadhyay, Director, NRCG, and
Dr. M.P. Ghewande, Sr. Scientist (Plant Pathology), NRCG

Dr. N.B. Singh, ADG(OP), ICAR, New Delhi, Dr. S.N. Nigam, Principal Groundnut Breeder, ICRISAT, Patancheru, Shri S.M. Asif, Chief Editor, In Dinon, Patna and Ms. Meena Thakur, President, Mahila Youth Congress, Upleta, Distt. Rajkot could not attend the meeting due to their pre-occupation.

Dr. A. Bandyopadhyay, Director, NRCG, presented the Action taken report on the proceedings of the first RAC meeting. Dr. Bandyopadhyay then presented a brief report on the research work done during 1997.

The salient suggestions and recommendations were:

To rename the facility at Bhubaneshwar as " NRCG Out-reach station".

To develop linkages with IASRI, New Delhi for plot size and field design for experiment on groundnut.

The ICAR may take necessary steps to fill scientific positions and PStV related problems.

The projects were discussed threadbare and several suggestions were offered by the Committee for improvement of the work plans.

ICRISAT and NBPGR facilities may be fully availed of for obtaining specific germplasm material.

No material may be destroyed for the fear of PStV but be grown in proper containment and healthy seeds and plants may be recovered by ELISA testing and employing technique of meristem culture, if required. Some basic work may be taken up on groundnut viruses.

Greater emphasis on epidemiology of rust

More emphasis on basic research work related to groundnut based cropping system.

Exploratory research on organic farming on groundnut

The Scientists of NRCG may be associated with some of the PG and Ph.D programmes in specific areas

The NRCG should have atleast one position of Principal Scientist each in the areas of crop Improvement, Crop Production, Crop Protection and basic sciences units

Reviving the publication Groundnut News

Finally the committee expressed its happiness over the general performance of the Scientists and their future plants of work.

IV. **IMC (8.9.97)**

Under the chairmanship of the Director, NRCG the metting was attended by the Sh. S.M. Asif, Editor-in-Chief, In Dinon, Patna; Dr. D.D. Malaviya, Principal, GAU, Junagadh; Dr. R. Laxminarayan, Project Coordinator (Tobacco), GAU, Anand; Dr. K.K.Solanki, Principal Sci. & I/c, CIFT Res. Stn., Veraval; and Dr. P.K. Joshi, Sr. Sci. Microbiology, CSSRI, Karnal.

The regularisation of 30 temporary status casual workers and the proposed posts of group 'D' to be created were discussed. Write off of the equipments, outdated and not in use were also discussed.

V. **IMC (21.7.98)**

The Director, NRCG called to order the fifth meeting of the Institute management commettee. The meeting was attended by the following members.

Sh. S.M. Asif, Chief Editor, In Dinon, Patna, Bihar
Dr. D.D. Malaviya, Principal, GAU, Junagadh
Dr. R. Laxminarayan, Project Coordinator (Tobacco), GAU, Anand
Dr. K.K.Solanki, Principal Sci. & I/c, CIFT Res. Stn., Veraval
Dr. L.B. Rakholia, Dy. Director (Agri. Extn), GAU, Junagadh
Sh. G.C. Prasad, Finance and Account Officer, NRCG, JNG
Dr. P.C. Nautiyal, Scientist(SS), Admn. Officer, I/c co-opted member secretary

The need for revamp of lighting facilities in the field and NRCG campus affected by the cyclone in the in the area was considered by the IMC to be taken up on priority basis. The committee recommended grant of temporary status to additional casual workers who have completed the requisite no. of days subsequent to 1993.

VI. IN-HOUSE REVIEW MEETINGS

Kharif in-house group meeting was convened on 8 and 9 May, 1997 to discuss the results of the previous kharif trials and the experiments proposed for the ensuing kharif season. As the regular Director was not in a position to attend the meeting, the proceedings were conducted by Dr. M.P. Ghewande, Director (Actg.) The meeting was attended by Dr. G.B. Manna and D.R.C. Bakhetia, ICAR nominees as subject matter specialists. The work done reports of the ongoing projects were presented. The proposal work included rejuvenation of germplasm, testing of advanced breeding material for BNF activity in acid soils, basic studies to enhance recombination, frequency, induction of functional male sterility, pairing behaviour in interspecific hybrids, extent of outcrossing in groundnut, protocol development for transformation of groundnut through non-conventional breeding techniques, fertilizer requirements in groundnut-based cropping systems, genotypic interactions in groundnut-based intercropping systems, high input groundnut-agriculture for HPS types, tolerance of soil salinity, cold tolerance, indicator for soil-moisture, deficit stress, further characterisation of high-and low SLA lines, biochemical basis of seed viability, dormancy and storage, mineral nutrition of groundnut trials for NEH region, bioconversion of groundnut shell for more efficient use of biomass, phosphate solubilisation, refining the simple techniques developed to assess quality of groundnut, management of stem rot including host resistance, integrated pest management, and management of aflatoxin contamination.

It was reemphasized that all efforts should be taken to monitor and eliminate PStV infected material to avoid further spread of the disease. The Secretary SRC mentioned that the vacant positions at the centre may be filled up on priority basis so that the programme could be implemented in its earnest spirit.

The rabi-summer in-house review meeting was held on 6.1.98 to discuss the results of the trials conducted during rabi-summer 1997 and the technical programme for rabi-summer 1998. The project leaders were requested to present the results of the experiments conducted by them. The Chairman requested the concerned scientists to concentrate on the following issues with a special emphasis apart from their regular technical programme.

1. screening of the genetic stocks under artificially simulated conditions of various biotic and abiotic stresses
2. maintaining a set of wild species at NRCG Outreach Centre, Bhubaneswar
3. fresh seed dormancy in spanish types

4. physiological studies to explain the behaviour of companion crops in intercropping system
5. prepare a monograph on deficiency and toxicity symptoms for the mineral nutrition disorders
6. intensify work in NEH region and
7. management of stem rot

VII. DEPARTMENTAL PROMOTION COMMITTEE MEETINGS

Two DPC meetings were held on 21.10.98 and 7.11.98 during the year of report to clear various cases pertaining to clearing of probation, promotion and efficiency bar clearing.

VIII. SUPERANNUATION

Two senior scientists of this Centre retired from their active service. Dr. Neelakant R. Bhagat, Sr. Scientist & Head, Genetics Resources Section had joined this Centre in 1983. Dr. Bhagat was instrumental in setting up a working collection of groundnut at this Centre and has published numerous catalogues containing precious information on characterisation of germplasm accessions.

Dr. Amalendu Shome has spent much of his career at CRIJAF, Barrackpore before joining at NRCG. Dr. Shome had joined NRCG in 1994 and after a brief stay at the main Centre he was shifted to NRCG Out-reach Centre, Bhubaneswar for establishing the facilities for germplasm manitenance and rejuvenation.

The Director and staff of the NRCG wish both Dr. N.R. Bhagat and Dr. Shome a peaceful retired life.

TRAINING & VISITS

A. TRAINING

Dr. Radhakrishnan T. attended the training programme on Novell Netware 4.1 and MS Office organised by M/s HCL-HP at Central Institute for Research on Cotton Technology, Bombay (26 Aug. to 5 Sep. 1997).

Dr. S. Desai attended a Special International Training programme on detection and estimation of aflatoxins in groundnut based products as a nominee of ICAR at ICRISAT, A.P., Patancheru, from 24.11.97 to 06.12.97 for a hands-on experience on determination of aflatoxins in groundnut and extractions through ELISA methods.

Dr. S. Desai participated in a two-days training programme on Application of biotechnology in biofertilizers and biopesticides organized by IIT, New Delhi from 13-14 October 1997.

Mr. M.A. Khan attended the training programme on Novell Netware 4.1 and MS Office organised by M/s HCL-HP at Central Institute for Research on Cotton Technology, Bombay, (26 Aug. to 5 September. 1997).

Shri G.C. Prasad attended a Foundation Training Programme at NAARM From 17 May to 7 June, 1997.

Shri Rajiv Lal attended a Foundation Training Programme at NAARM From 17 May to 7 June, 1997.

Kumari K.A. Vasani, Smt. Santha Venugopalam and Smt. M.N. Vaghasia attended a Training for Administrative & Accounts Staff from 19-8-97 to 23-8-97 at CIRCOT, Mumbai.

Shri.Rajiv Lal attended a training programme "Record Management" at ISPM New Delhi from 3 November 97 to 7 November 97.

Shri.Ranvir Singh and Shri.R.S.Karia attended "Introductory Course on Windows 95" at NAARM from 3 November 97 to 13 November 97.

Shri.Rajiv Lal attended a training programme on "Administration Vigilance" at ISYM New Delhi from 19 January 98 to 30 January 98.

B. VISITS

Within the Country

Dr. A. Bandyopadhyay

16th meeting of ICAR Regional Committee No. VI at Bikaner from 24.1.97 to 26.1.97.

Social Audit Meeting at ICAR from 25.5.97 28.5.97.

Micro-Mission meeting hald at IARI, New Delhi from 5.8.97 to 6.8.97.

	Discussed about formulation of Collaborative Programme with ICRISAT from 11.9.97 to 17.9.97.
	National consultation of Phyto Sanitation Standards meeting at IARI, New Delhi from 21.10.97 to 22.10.97.
	A Collaborative programme formulation discussion at ICRISAT to be funded by CRSP involving NRCG, ICRISAT & NDDB from 3.12.97 to 6.12.97.
	IX plan meeting at CRIJAF, Barrackpore from 25.12.97 to 5.3.98.
	Director's Conference at NBPGR, New Delhi from 4.3.98 to 5.3.98.
	The workshop on Biotechnological options for the Crop Improvement of G'nut and Pigeonpea held at Biotechnology Unit of the Instt. of Public Enterprises, Hyderabad.
Dr. P. Manivel	Annual Workshop of NSP (Crops) held at GAU, Anand campus from 19.05.97 to 22.05.98.
Dr. R.K. Mathur	HPKV, Palampur from 15.4.97 to 22.4.97 to attend the group meeting of Zone-I and Zone VI under TAR-IVLP; and attended WUE Methodology Workshop held from 25.6.97 to 2.7.97 at ICRISAT.
Dr. S. Desai	TCDC international workshop on application of biotechnology in biofertilizers and biopesticides, October 15-18, IIT, New Delhi, India.
	International conference on integrated plant disease management for sustainable agriculture, November 10-15, IARI, New Delhi, India.
	Biotechnological approaches for crop improvement in groundnut and Pigeonpea, 8-9 March, 1997, Institute of Public Enterprise, Osmania University Campus, Hyderabad.

PERSONNEL

i. NRCG

Dr. A. Bandyopadhyay	Director

PLANT GENETIC RESOURCES

1. Dr. K. Rajgopal	Scientist (SS)
2. Sh. K. Chandran	Scientist (on study leave)

PLANT BREEDING

1. Dr. R.K. Mathur	Scientist
2. Dr. P. Manivel	Scientist
3. Dr. M.Y. Samdur	Scientist

CYTOGENETICS

1. Dr. P. Paria	Senior Scientist
2. Dr. T. Radhakrishnan	Scientist(SS)

PLANT PHYSIOLOGY

1. Sh. Y.C. Joshi	Senior Scientist
2. Dr. P.C. Nautiyal	Scientist (SS)
3. Dr. A.L. Singh	Scientist (SS)
4. Sh. V.G. Koradia	Technical Officer

BIOCHEMISTRY

Dr. J.B. Mishra	Senior Scientist

AGRONOMY

1. Dr. Devi Dayal	Scientist (SS)
2. Dr. P.K. Ghosh	Scientist

MICROBIOLOGY

1. Dr. K.K. Pal	Scientist
2. Dr. Rinku Dey	Scientist
3. Sh. D.M. Bhatt	Technical Officer
4. Ku. S.M. Chauhan	Technical Officer

PATHOLOGY

1. Dr. M.P. Ghewande	Senior Scientist
2. Dr. S. Desai	Scientist (SS)
3. Dr. H.M. Hingrajia	Technical Officer

ENTOMOLOGY

1. Dr. V. Nandagopal	Scientist

FARM SECTION

1.	Dr. R.S. Tomar	Farm Superintendent
2.	Sh. H.B. Lalwani	Technicl Officer
3.	Sh. V.K. Sojitra	- do-
4.	Sh. C.P. Singh	- do-

LIBRARY

1.	Sh. N. Karthikeyan	IDO
2.	Sh. M.A. Khan	Information & Documentation Officer I/c

ADMINISTRATION

1.	Sh. Rajeev Lal	Administrative Officer
2.	Sh. G.C. Prasad	Finance & Accounts Officer

ii. NRCG Outreach Centre, Bhubaneswar

1.	Dr. S.K. Bera	Scientist and Officer-in-charge
2.	Sh. M.M. Dash	Technical Officer

iii. AICRPG

1.	Dr. M.S. Basu	Project Coordinator
2.	Sh. A.L. Rathna Kumar	Scientist (on study leave)
3.	Dr. Chuni Lal	Scientist
4.	Sh. D.L. Parmar	TechnicalOfficer (onstudy leave)
5.	Sh. Prem Narayan	Tehnical Officer

FARM

I. AGROFORESTRY

Farm Superintendent was deputed to attend the short course on "Recent Advances in Agroforestry and its role in conservation of soil, water and Biodiversity" sponsored by the ICAR and organised by the National Research Centre for Agroforestry, Jhansi in between 4 to 13 June, 1997. In response to the short course following improved material viz., Sapota (*Achras sapota*) - 50; Gauva (*Psidium guajava*) - 50; Lemon (*Citrus* sps.) - 25; Jamun (*Schyzigium cumini*) - 25; Aonla (*Emblica officinalis*) - 10; and Pomegranate (*Punica granatum*) - 10; have been planted in J-3 and J-8 plots i.e. either side of pond No.1. Moreover, plants like Borsaily (25), Goras Imali (20), Gulmohar (10) and Pendula (10) were planted on boundary side to impart beauty to farm section.

Besides, 375 saplings of jojoba (*Simmondsia chinensis*) saplings were procured from the Central Salt and Marine Chemicals Research Institute, Bhavnagar and planted in J-1 plot.

II. ERADICATION OF PStV

All self-sown groundnut plants were uprooted under the supervision of the Farm Superintendent to eradicate the PStV.

III. FISHERIES

For the first time, the seeds of variety Cutla fry fish (No.4875 and 15mm to 20 mm size) were procured from Fish Farmers Development Agency, Gujarat Govt., Junagadh and was stocked in pond No.1 on 25th July, 1997. These seeds survived well in the pond and achieved the very good growth. The weight of fish was observed between 800 gms to 950 gms at the time of its disposal amongst the staff members @ Rs.25/ kg in the first week of January, 1998. A revenue of Rs.3500/- was earned by selling the fresh fish var. Cutla.

IV. CONSTRUCTION

A new barbed-wire fencing was erected on the road side towards Ivnagar village as proposed in the plan at the time of allowing construction of road inside our farm by the Jilla Panchayat, Junagadh.

V. LAND UTILIZATION

Under the land utilization programme, residual resources were utilised for cultivating maize and jowar for green fodder in an area of 2.4 and 7.75 ha of land, respectively, and crops were auctioned before harvesting for an amount of Rs.19,425/- and 35,800/- ,respectively. During kharif 1997, an amount of Rs.59,000/- were remitted from the auction of grasses and 1.5 ha of maize crop is in the field.

The certified seed production programme of hybrid castor var. GCH-4 from Gujarat State Seed Corporation was undertaken in about 3.75 ha whereas general castor var. GCH-4 were grown in an area of 3.75 ha. The crops are nearing maturity. The wheat var. LOK 1, Foundation stage was grown in about 1.25 ha of land and nearer to harvesting.

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