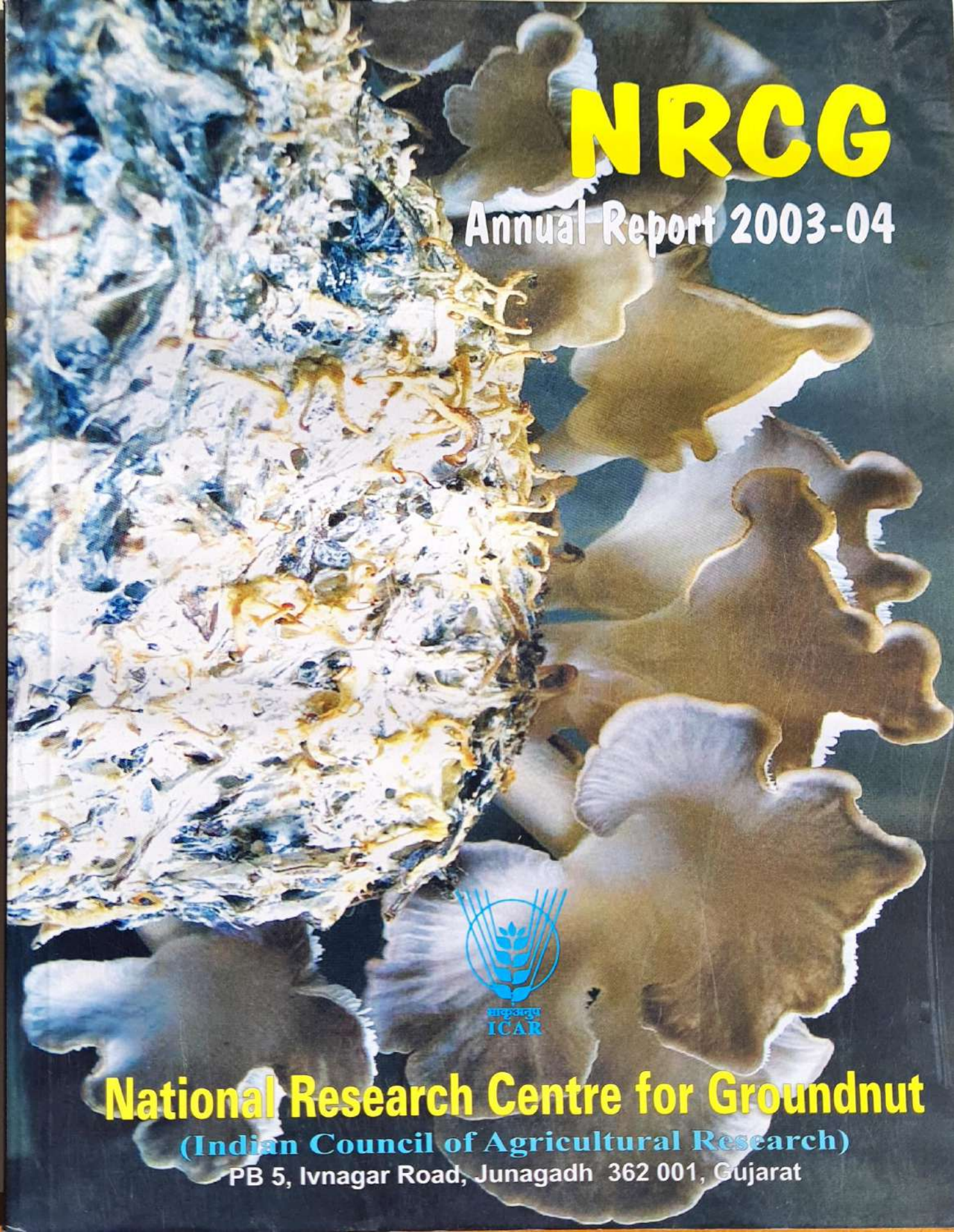

NRCG

Annual Report 2003-04

भाकृअनुप
ICAR

National Research Centre for Groundnut

(Indian Council of Agricultural Research)

PB 5, Ivnagar Road, Junagadh 362 001, Gujarat

ANNUAL REPORT

2003-04

National Research Centre for Groundnut
(Indian Council of Agricultural Research)
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PREFACE

The National Research Centre for Groundnut was established in 1979 to conduct basic and strategic research for enhancing groundnut production in India. Since inception, the Centre has grown in expected line and has acquired high degree of scientific competence and established excellent research facilities. Although considerable progress has been made in the past to increase groundnut productivity and production through special thrust given under Technology Mission on Oilseeds and Pulses (TMOP), there is an urgent need to break the yield barrier. There is also an emerging need to diversify the use of groundnut and its byproducts to make the groundnut farming profitable and competitive under WTO regime. This annual report summarizes the major activities of the Centre during 2003-04 and aimed to highlight the Centre's research thrust and technologies developed in different fronts.

During the period a number of fresh crosses were effected and selections were made from segregating populations. Many Spanish and Virginia entries were found promising and one of the entries tested under AICRP-G'nut, PBS 24030, has been proposed for identification. Besides, a number of advanced breeding lines have showed resistance to soil-borne and foliar diseases. On germplasm management, a total of 1255 accessions have been assembled, 584 accessions characterized and 449 accessions have been deposited to National Genebank at NBPGR, New Delhi. A new isolate of *Trichoderma harzianum* (T-170) showed promising antagonistic effect against soil-borne fungal pathogens. Forewarning models have been developed for *Spodoptera litura* by collecting and analyzing the historical data on weather, and incidence/intensity of target insect pests for the last ten years in five lead centres. Evaluation of economics in IPM trial indicated castor as mixed crop as the best. In *in situ* moisture conservation trial, optimization of plant density and fertility levels revealed that when ET exceeded rainfall, increase in plant density had adverse effect on available soil moisture. A laboratory based method to measure the leaf cell membrane thermostability (LCMT) has been developed which would be useful for screening a large number of germplasm accessions and breeding lines for high temperature tolerance. A number of genotypes have been identified for Ca- and P-efficiency. Protocols for transformation have been standardized for developing transgenics in respect of *Bt*, coat proteins, and osmotins. Technologies have been developed for producing cellulase and amylase enzymes from groundnut shell and de-oiled groundnut cake, respectively through microbial processes. Besides, attempts have been made to utilize groundnut shell and haulm for producing oyster and milky mushrooms. Under IVLP, the technologies developed at NRCG have been validated in adopted villages of Junagadh district. Interventions have improved the profitability of the groundnut farm enterprises. Training for farm women on "Preparation of groundnut based bakery items" was organized under IVLP programme.

Human resource development has been quite satisfying in the sense that a number of scientists visited abroad, a number of DPCs held for promotion and a number of young scientists joined in different disciplines. A number of externally funded projects, both national and international, have also been made operational and significant advancement has been made with new recruitments.

I sincerely thank all the concerned for helping in the publication of this annual report.

(M S Basu)
Director

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1. जैविक (12) और अजैविक (59) तनाव सहनशीलता / प्रतिरोधकता के समावेश के लिए और बीज का आकार (3) बढ़ाने के लिए नये संकर के प्रयास किए गए। इसके अतिरिक्त, चारे के लिए जैवद्रव्य के लिए हैटेरोसिस उपयोग में लेने हेतु छह जंगली संकर, J 11 और छह जंगली प्रजातियों को सम्मिलित करते हुए प्रयास किए गए।

2. विभिन्न वियोजित वंशों में चयनों को प्रभावित किया गया और पिछले वर्ष किए गये चयन क्रमानुसार अगले संतानीय वंशों में अग्रसारित किए गए। खरीफ 2003 में कुल 230 और ग्रीष्म 2004 में 258 उन्नत प्रजनन लाइनों का आगे अनुरक्षण और उपयोग के लिए बहुगुणन किया गया।

3. स्पैनिश कल्चर्स में तीन प्रविष्टियां, नामतः PBS 12160, PBS 30044, और PBS 30073 निरिक्षण सूचक प्रजातियों (Check varieties) से अधिक फली और दानों के उत्पादन के लिए पंजीकृत की गई (दो वर्ष से)। वर्जीनिया कल्चर्स में, PBS 24004 का खरीफ 2003 मे सराहनीय उत्पादन हुआ।

4. बडे दानों वाली उन्नत प्रजनन लाइनो मे., PBS 21063 और 29058 फली व दानों के उत्पादन के लिए GG 20 के समतुल्य पाई गई और PBS 29058 में उच्च 100- बीज द्रव्यमान दर्ज किया गया। PBS 29062 में निमम्न तैल प्रतिशतता (42.7%) और उच्चतम प्रोटीन की मात्रा (25.5%) दर्ज की गई।

5. छह उन्नत प्रजनक लाइने (PBS Nos. 21031, 11066, 30076, 11029, 28008 और 11019) खरीफ 2004 में शीघ्र पकने वाली पाई गई। PBS 21031 ग्रीष्म 2004 में भी शीघ्र पकने वाली पाई गई।

6. जीन प्ररूप JUN 7, JUN 9 और JUN 37 सभी छद्मरुपीव (simulated) सूखे तरीके (जल्दी, मध्य और देर-ऋतु में उत्तम निरिक्षण सूचक प्रजाति (check variety), ICGS 76 से महत्वपूर्ण उच्च उत्पादन देने वाले पावे गये। JUN 8, JUN 37, JUN 38 और JUN 39 जल्दी और देर-ऋतु सूखे के लिए promising पाए गए।

7. पाँच नये कल्चर JUN 21, JUN 27, PBS 12160, PBS 30073 का मूँगफली की अखिल भारतीय समन्वित अनुसंधान परियोजना परीक्षण में जांच के लिए अभिनिरर्धारण किया गया जबकि जोन I में एक जाँच प्रविष्टि, PBS 24030 को जांच के अंतिम स्तर तक बढा दिया गया। नो मुँगफली की अखिल भारतीय समन्वित अनुसंधान परियोजना केंन्द्रों को F3 से F6 वंशों में वियोजीत सामग्री भेजी गयी जो कि जैविक/अजैविक दबाव के लिए प्रतिरोधक/सहनशील थी।

8. प्रोन्नत किस्म के जिन 548 एक्सेशनों का कैरेक्टराइजेशन किया गया उनमें से NRCG 685,4802, 13094, 13108 एवं 13137 को उपज हेतु चिन्हित किया गया। जिन 352 एक्सेशनों का तेल हेतु विश्लेषण किया गया उनमें से NRCG 12713 एवं 12975 में 53% तेल की मात्रा पायी गयी। यु.ए.एस. बैंगलोर की सहभगिता मे 167 एक्सेशनों के एक संग्रह का $\Delta^{13}C$ के लिए विश्लेषण किया गया।

9. ICAR - NBPGR एवं ICRISAT के एक संयुक्त कार्यक्रम के अन्तर्गत 1457 एकसेशनो का बहुगुणन किया गया। दीर्यकालिक भण्डारण हेतु NBPGR नई दिल्ली मे 449 एक्सशनों की पर्याप्त मात्रा जमा की गयी। फील्ड जीन बैंक में जंगली प्रजातियों के 89 एक्सेशनों का परिक्षण किया गया। सभी जनन द्रव्यों से प्राप्त आकड़ों को फोक्स बेस कार्यक्रम का उपयोग करके उनका अभिलेख तैयार किया गया।

10. तीन जीन प्रारुप PBS 11067, JAL 05, JUN 33 नें प्रयोगशाला परिस्थिति में एस्पर्जिलस के प्रति सूखा बीज प्रतिरोधकता दर्शायी। इसके अतिरिक्त जीन प्रारुप JUN 33 और JAL 05 ने अगेती पर्ण धब्बा के प्रति सहनशीलता दर्शायी। प्रक्षेत्र अवस्था में, PBS 30104 और 30158 रस्ट के प्रति प्रतिरोधक पायी गयी और JUN 13 अगेती पर्ण धब्बा के प्रति प्रतिरोधक और रस्ट के प्रति औसत रुप से प्रतिरोधक पायी गयी, जब कि JUN 15 अगेती पर्ण धब्बा के प्रति औसत रुप से प्रतिरोधक पायी गयी।

11. खरीफ 2002 और 2003 में तना सड़न का न्यूनतम आपतन CS 19 और उसके बाद ICGV 86590 में दर्ज किया गया और शीर्ष प्ररुपों ICGV 86590, CODE 1-1 और CS 19 ने खरीफ 2003 में कृत्रिम संरोपित अवस्था में न्यूनतम आपतन दर्शाया ।

12. प्रक्षेत्र अवस्था में खरीफ 2003 में पीबीएनडी (PBND) का न्यूनतम आपतन TG45 और उसके बाद UF 70 - 103 व CODE 7 में दर्ज किया गया ।

13. दस जीन प्ररुपों CODE 1, CS 115, CS 117, CS 132, PBS 11067, JAL 05, JUN 33, CS 53, CS 65 और CS 81 ने प्रयोगशाला परिस्थिति में एस्पर्जिलस नाईजर के प्रति प्रतिरोधक प्रतिक्रिया दिखायी और PBS 18062 उद्गमन के 30 दिन बाद तना सड़न के प्रति औसत स्तर की प्रतिरोधकता दर्शायी ।

14. बुवाई के समय मृदा में तत्व सल्फर या जंगली उचार की ताजा पत्तियां से तना सड़न का आपतन काफी हद तक कम हुआ ।

15. इन-विट्रो अवस्था में ट्राईकोडर्मा हार्जियेनम (टी-170) के एक विलुक्त ने इन विट्रो परिस्थिति में तना सड़न और परिवर्तन सड़न के पेथोजन के प्रति होनहार प्रतिकुल क्षमता दिखायी ।

16. एकीकृत बीमारी प्रबंधन (IDM) में, 45, 55 और 70 दिवस बुवाई के बाद फफुंद नाशक मिश्रण (कार्बेन्डेजिम + मेन्कोजेब) के तीन पर्ण छिड़काव से अगेती पर्ण धब्बा 43.9 % तक, पछेती पर्ण धब्बा 41.7 % तक और रस्ट 69.8 तक कम हुआ । तना सड़न के आपतन को सबसे ज्यादा कमी ट्राईकोडर्मा विरिडी से बीजोपचार + अरंडी की खली का मृदा में प्रयोग + मूँगफली का बाजरे के साथ 1:3 अनुपात में अंतर्शस्य से हुई ।

17. मृदा और जल लवणता का पर्ण बिमारियो के विकास और गंभीरता के अध्ययन से मालूम हुआ कि लवणता बढ़ने से अधिकतर पर्ण बिमारियाँ घटती है ।

18. थ्रिप्स और जेसिड के विरुद्ध परखी गयी 16 स्थापित लाइनों में से, PBS 12137, 21046, 21018 और 30006 प्रतिरोधक पायी गयी जिन्होने न्यूनतम जेसिड को आकर्षित किया । थ्रिप्स के बारेमें, PBS 21018 पायी गयी ।

19. एकीकृत कीट प्रबंधन परीक्षण में सभी उपचारों में मूँगफली में पर्णहीनता बहुत कम थी, लेकिन बुवाई के 60 दिन बाद मिश्रित फसलों जैसे चंवला, उड़द में देखने लायक हानि थी, जिन्होनें ट्रेप फसलों का काम किया ।

20. मूँगफली आधारित मिश्रित फसल प्रणाली में एकीकृत कीट प्रबंधन प्रयोग में उपज अर्थशास्त्र में बताया कि मिश्रित फसल के रुप में विवेचित (Rs. 11,547 प्रति हेक्टेयर) की तुलना में सर्वोच्च आय अरंडी (Rs. 21,335 प्रतिहेक्टेयर) और उसके बाद मूँग (Rs. 20,208 प्रति हेक्टेयर) के साथ हुई ।

21. पाँच केंन्द्रो में पिछले दस सालों के मौसम पर ऐतिहासिक आंकड़े, कीट-पेस्ट का आपतन / तीव्रता और एकत्र कर और उनका विश्लेषण कर स्पोडोप्टेरा लिटुरा के लिए पहले से ही चेतावनी देने वाला मोडल विकसित किये गये यथा जलगाँव ($\hat{Y}$ = - 706 + 0.23 X3 - 0243 X7 where X3 = Tmax ; X7 = RHe), धारवाड़ ($\hat{Y}$ = - 208.1 + 19.47 X3 - 10.06 X5 where X3 = Tmax ; X5 = Tmax), कादिरि ($\hat{Y}$ = 240.75 - 6.42 X2 where X2 = Tmx), वृद्धाचलम ($\hat{Y}$ = 140.8 - 3.4 X3 where X3 = Tmx) और जूनागढ़ ($\hat{Y}$ = 87.68 + 4.3 X3 - 6.88 X4 - 0.35 X14 whre X3 = Tmx ; X4 = Tmin ; X14 = Rhe) ।

22. एकीकृत कीट प्रबंधन परिक्षण में स्पोडोप्टेरा लिटुरा से हानि मृदा तापसे धनात्मक और वाष्प दबाव से ऋणात्मक रुप से सबंद्ध थी । फफुंदी पर्ण धब्बों का आपतन मृदा ताप व धूप से धनात्मक और ताप (न्युनतम) व वाष्प दबाव से ऋणात्मक रुप से सबंद्ध थी । रस्ट आपतन, हवा के वेग, वर्षा, चमकीली धुप व वाष्प दबाव से धनात्मक रुप से और ताप (न्युनतम) व अपेक्षित आर्द्रता (सायं) से ऋणात्मक रुप से सबंद्ध थी ।

23. पाँच मुख्य मूँगफली आधारित फसल प्रणालियो मे से खरीफ में अधिकतम फली उत्पादन मूँगफली + गेहुँ + मूँग फसल प्रणाली मे प्राप्त किया गया ।

24. एकल मूँगफली की तुलना में मूँगफली + गेहुँ + मूँग क्रम ने मृदा में ज्यादा उपलब्ध नाईट्रोजन (41.26 pmm) रखी ।

25. मूँगफली + अरहर अंतर्शस्य प्रणाली में पी.एस. एम. (PSM) की क्रिया ज्यादा थी जब कि फ्लुरोसेंट सुडोमोनाज (Fluroscent pseudomonas) और कुल जीवाणु की क्रिया मूँगफली + गेहुँ और मूँगफली + गेहुँ + मूँग क्रम में अधिकतम थी ।

26. इन - सीटू नमी संरक्षण के अंतर्गत पौध घनत्व और उर्वरकता स्तर के अनुकूलमता के अध्ययन से प्रदर्शित हुआ कि जब वाष्पोत्सर्जन (ET) वर्षा से ज्यादा होता है ; बढती हुई पौध घनत्वता, उपलब्ध मृदा नमी के उपर प्रतिकूल प्रभाव डालती है ।

27. उर्वरक स्तर और पौध घनत्व के साथ मूँगफली के फली उत्पादन में विभिन्नता पायी गयी, जब कि सिफारिस की गयी पौध घनत्वता के 75 % तक अनुक्रिया वर्गात्मक (quadratic) पायी गयी ।

28. मूँगफली आधारित फसल प्रणालियों में, बाजरा ने 9.92 kg/ha/mm जल-उपयोग सक्षमता के साथ उच्चतम अनाज उत्पादन (2198kg/ha) और उसके बाद मूँगफली (2082 kg/ha फली और 8.08 kg/ha/mm) ने दर्ज कराई ।

29. वर्षा परिस्थिति में जल उपयोग सक्षमता 221.4mm (बाजरा) से 353 mm (अरंडी) तक थी । तिल में जल उपयोग सक्षमता अधिकत्म और उसके बाद मूँगफली +अरहर में थी ।

30. प्रक्षेत्र क्षमता की जल कमी की 70% पुनः पूरकता पर, जुड़ी हुई वाष्पोत्सर्जनता के साथ अधिकत्म जल उपयोग सक्षमता अरहर और मूँगफली +अरहर अंतर्शस्य प्रणाली में क्रमानुसार 5.45 और 3.33 kg/ha/mm थी । एकल अरंडी और मूँगफली + अरंडी भी 4.71 और 3.11kg/ha/mm जल उपयोग सक्षमता के साथ इसके नजदीक थी ।

31. पत्ती की कोशिका झिल्ली की ताप स्थिरता (LCMT) नापने के लिए एक प्रयोगशाला विधि विकासित की गयी, जो कि बहुत संख्या में जर्मप्लाज्म अक्सेसन और प्रजनक लाइनों में उच्च ताप सहनशीलता के लिए छंटनी में उपयोग में ली जा सकती है ।

32. प्रकीर्णन (RAU) और जल उपयोग सक्षमता (WUE), फसल वितान संरचना पर महत्वपूर्ण रुप से निर्भर करता है । कम आपेक्षिक पत्ती क्षेत्र (SLA) के जीन प्रारुपों में उच्च जल उपयोग सक्षमता (WUE) और प्रकीर्णन (RAU) पायी गयी ।

33. सीमित जल परिस्थितियो में जड़ वृद्धि में महत्वपूर्ण विभिन्नता पायी गयी और सूखा सहनशील जीन प्ररुपों ने कम मृदा गहराई में संवेदनशील की तुलना में ज्यादा सक्षम जड़ वृद्धि दर्शायी ।

34. मूँगफली फली पोषण में फली संरचना, विशेष रुप से आकार का महत्वपूर्ण योगदान रहता है । उपयुक्त फली-भरण के लिए फोस्फोरस और केल्सियम महत्वपूर्ण पोषक है और उचित बीज व फली आकार के लिए उनका प्रयोग जरुरी है ।

35. केल्सियम क्लोराइड व केल्सियम नाईट्रेट के प्रयोग से अधिकतम फली उत्पादन प्राप्त किया गया । जिप्सम, चूना व टाइज (Ties) का प्रभाव भी समतुल्य था और इनमे से टाइज व चूना, केल्सियम के उत्तम स्त्रोत थे ।

36. फोस्फोरस और केल्सियम सक्षमता के लिए छांटे गये 103 जीन प्रारुपों में से, GG 5, GG 20, NRCG 3498, ICGV 86590 और SP 250 A, फोस्फोरस सक्षम थे, जब कि GG 5, GG 7, GG 20, ICGV 886448 और B 95 केल्सियम सक्षम थे ।

37. बोरोन और जस्ता के स्तर को बढ़ाने पर मूँगफली की प्रजातियों (GG 2, JL 24, ICGS 76, GG 20) में उत्पादन में रखीय बढ़त देखी गयी । JL 24 और ICGS 76 ने 0.6 ppm जिंक तक और GG 20 व GG 2 ने 0.8 ppm तक प्रतिक्रिया दिखायी । सभी कल्टीवर्स ने बोरोन के 1 ppm तक प्रतिक्रिया दिखायी ।

38. कम पी.एच. (PH) के अंतर्गत जीन प्रारूपों की एंटनी के तहत NRCG 5513, 6820, 4659 और 3498 एल्युमीनियम विषैलापन व अम्लीय मृदा के प्रति सहनशील पायी गयी ।

39. जब कार्बनिक व अकार्बनिक पोषक तत्व और जैव उर्वरको के प्रभाव की तुलना अम्लीय मृदा में की गयी, बेहीराइजोबियम और पी.एस.एम. (PMS) का फोरफोरस और कैल्सियम के साथ उत्कृष्ट परिणाम पाया गया ।

40. उत्तर-पूर्व क्षेत्र (NEH) में रबरगोश रस्सरी, अरंडी की खली, नीम खली और खेती की बन विधि का प्रयोग समतुल्य था और होलहास कार्बनिक खेती की विधि है ।

41. जूनागढ़ जिले के चार गाँवों वथावी, उमटवाड़ा, जादरखी और झांझरड़ा में दस तकनीकियों का मूल्यांकन किया गया ।

42. पौधे कि वृध्दि बढ़ाने वाले राइजो बेक्टीरीया (PGPR) के साथ सिफारिस की गयी नाइट्रोजन, फोस्फोरस व पोटेशियम (NPK) के प्रयोग से फली उत्पादन 18% तक और सकल धन आय 18% तक नकद लाभ अनुपात (CBR) 1:4 के साथ किसान विधि (1:4.08) की तुलना में बढ़ा ।

43. सिफारिस की गयी बीज दर और आवश्यकता आधारित नीम तैल का पर्ण प्रयोग @ 2% बुवाई के 35, 50 और 65 दिन बाद + फेरोमोज ट्रेप @ 10/ हेक्टेयर ने मुख्य बीमारियों व कीट के आपतन को घटाया और किसान के तरीके की तुलना में फली उत्पादन 27% बढ़ा ।

44. होलिस्टिक एकीकृत कीट प्रबंधन में, मुँगफली आधारित अंतशस्य (अरहर) के अपरिष्कृत नीम के तैल का पर्णीय प्रयोग और अरंडी की खली @ 500kg/ha ने मुख्य बीमारियों और कीट के आपतन को काफी हद तक घटाया और किसान के तरीके की तुलना में फली उत्पादन 26.3% बढ़ाया । एकीकृत कीट प्रबंधन में सकल धन आय कपास + तिल में उच्चतम थी ।

45. बेकिंग विद्यालय, जूनागढ कृषि विश्वविद्यालय पर उपलब्ध सुविधाओं का उपयोग कर, प्रक्षेत्र महिलाओं (20) के लिए ''मूँगफली आधारित बेकरी वस्तुएँ'' नामक एक प्रशिक्षण आयोजित किया गया । मवेशी प्रजनन फार्म, जूनागढ़ कृषि विश्वविद्यालय में एक निदर्शन आयोजित किया गया जिसमें दस किसानों ने भाग लिया ।

SUMMARY

- Fresh crosses were attempted to incorporate tolerance/resistance to biotic (12) and abiotic (59) stresses, and to enhance seed size (3). In addition, six wild crosses involving J 11 and six wild species were also attempted to utilize the heterosis for biomass for fodder purposes.
- Selections were effected in different segregating generations and the selections made during previous year were advanced to the next respective filial generations. A total of 230 advanced breeding lines in kharif 2003 and 258 in summer 2004 were multiplied for further maintenance and use.
- Three entries, namely PBS 12160, PBS 30044 and PBS 30073 among the Spanish cultures registered higher pod and kernel yields over the check varieties (for two years). Among the Virginia cultures, PBS 24004, registered appreciable yield in *kharif* 2003.
- Among the large-seeded advanced breeding lines, PBS 21063 and 29058 were at par with GG 20 for pod and kernel yields, and PBS 29058 recorded high 100-seed mass. PBS 29062 recorded lowest oil content (42.7%) and highest protein content (25.5%).
- Six advanced breeding lines (PBS Nos. 21031, 11066, 30076, 11029, 28008 and 11019) were found to be early in maturity during kharif 2003. PBS 21031 was found early in summer 2004 also.
- The genotypes JUN 7, JUN 9 and JUN 37 were found to yield significantly higher over the best check variety, ICGS 76, under all the simulated drought patterns (early-, mid- and late-season). JUN 8, JUN 37, JUN 38 and JUN 39 were found promising for early as well as for late season droughts.
- Five new cultures *viz*., JUN 21, JUN 27, PBS 12160, PBS 30044 and PBS 30073 have been identified for testing under AICRP-G trials, while one test entry, PBS 24030, has been promoted to final stage of testing in Zone I. Segregating material in F_3 to F_6 generations bred for resistance/tolerance of different biotic and abiotic stresses were supplied to nine AICRP-G centres.
- Among the 548 accessions characterized, promising accessions identified for yield are NRCG's 685, 4802, 13094, 13108 and 13137. A core collection representing 167 accessions were analysed for $\Delta\ ^{13}C$ in collaboration with U.A.S., Bangalore. An oil content of 53.0% was recorded in NRCG 12713 and 12975 out of 352 accessions analyzed.
- Eighty nine accessions of wild *Arachis* are mianitained in field gene bank. Sufficient quantity of seeds of 449 accessions was deposited in NGB, New Delhi for long term storage. 1457 accessions were multiplied under joint repatriation programme of ICAR-NBPGR and ICRISAT. The data generated on all germplasm are documented using the fox base programme.
- Three genotypes *viz*., PBS 11067, JAL 05, JUN 33 showed dry seed resistance against *Aspergillus niger* under lab conditions. In addition, the genotypes JUN 33 and JAL 05 exhibited tolerance to ELS. Under field conditions, PBS 30104 and 30158 were found to be resistant against rust, and JUN 13 was found to be resistant to ELS and moderately resistant to rust, whereas JUN 15 was found to be moderately resistant to ELS.
- Lowest incidence of stem rot was recorded in CS 19 followed by ICGV 86590 during rainy seasons of 2002 and 2003, and three genotypes *viz*., ICGV 86590, CODE 1-1 and CS 19 showed lowest incidence during summer 2003 in artificially inoculated condition.
- The minimum incidence of PBND was recorded in TG 45 followed by UF 70-103 and Code 7 under field conditions during summer 2003. PBS 11058 was found tolerant.
- Ten genotypes *viz*., Code 1, CS 115, CS 117, CS 132, PBS 11067, JAL 05, JUN 33, CS 53, CS 65 and CS 81, showed resistant reaction against *A. niger* under laboratory condition and PBS 18062 showed moderate level of resistance to stem rot at 30 days after emergence.

- Soil application of elemental sulphur at the time of sowing or fresh leaves of wild sorghum or fresh leaves of neem reduced the incidence of stem rot considerably.
- An isolate of *Trichoderma harzianum* (T-170) showed promising antagonistic potential against both stem rot and collar rot pathogens under *in vitro* conditions.
- Under IDM, three foliar sprays of fungicide mixture (Carbendazim + Mancozeb) at 45, 55 and 70 DAS reduced the intensity of ELS by 43.9%, LLS by 41.7% and rust by 69.8%. Maximum reduction of stem rot incidence was realized in seed treatment with *Trichoderma viride* + soil application of castor cake + groundnut intercropped with pearl millet at 1:3 ratio.
- Experiments to study the effect of soil and water salinity on development and severity of foliar diseases revealed that increase in salinity led to decrease in the severity of major foliar fungal diseases.
- Out of 16 stabilized lines screened against thrips and jassids, PBS 12137, 21046, 21018 and 30006 were found to be resistant attracting minimum jassid population. In the case of thrips, PBS 21018 was found to be resistant.
- In IPM trials the defoliation on groundnut was very low in all the treatments, but at 60 DAS there was very spectacular damage on mixed crops like cowpea and black gram, which acted as trap crops.
- Yield economics of IPM experiments in groundnut based mixed cropping system has shown that castor as mixed crop gave the highest income (Rs. 21,335/ha) followed by green gram (Rs. 20,208/ha) compared to the control (Rs. 11,547/ha). The CBR was highest (1:2.00) in green gram mixed cropping system.
- Forewarning models were developed for *Spodoptera litura* by collecting and analyzing the historical data on weather, and incidence/intensity of target insect-pests for the last ten years in five centers viz., Jalgaon ($\hat{Y}$ = -706 + 0.23X3 - 0.243X7 where X3 = Tmax; X7 = RHe), Dharwad ($\hat{Y}$ = -208.1 + 19.49X3 - 10.06X5 where X3= Tmax X5= Tavg), Kadiri ($\hat{Y}$ = 240.75 - 6.42X2 where X2 = Tmax), Vriddhachalam ($\hat{Y}$ = 140.8 - 3.4 X3 where X3 = Tmax) and Junagadh ($\hat{Y}$ = 87.68 + 4.3 X3 - 6.88 X4 - 0.35 X14 where X3 = Tmax ; X4 = Tmin; X14 = Rhe).
- In IPM trials damage due to *S. litura* was positively correlated with soil temperature and negatively correlated with vapour pressure. The incidence of LLS was positively correlated with soil temperature and bright sunshine hours (BSS) and negatively correlated with temperature (min) and vapour pressure. Rust incidence was positively correlated with wind velocity, rainfall, BSS and vapor pressure and negatively correlated with temperature (min) and RH (eve).
- Among the five major groundnut based cropping systems [mono cropping, two intercropping systems (with pearl millet and pigeon pea) and two sequential cropping systems (groundnut-wheat and groundnut-wheat-green gram)] maximum pod yield of kharif groundnut was obtained in groundnut-wheat-green gram cropping system.
- Groundnut-wheat-green gram sequence maintained higher available nitrogen in the soil (41.26 ppm) as compared to sole groundnut (38.22 kg/ha)
- The activities of PSM were higher in groundnut+ pigeon pea intercropping whereas the activities of fluroscent pseudomonads and total microbes were the maximum in groundnut-wheat and groundnut-wheat-green gram sequences.
- Studies on optimization of plant density and fertility levels under *in situ* moisture conservation revealed that when ET exceeded the rainfall, increasing plant density had adverse effect on available soil moisture. Fertility levels had favourable effect on available soil moisture and increasing fertility levels conserved more soil moisture.

- Response of groundnut to fertility level on pod yield differed with plant density. While response was quadratic up to 75% of recommended plant density, at increased density, response was almost linear indicating that under sufficient soil moisture increased plant density and fertility levels would yield better.
- In groundnut based cropping systems, pearl millet recorded the highest grain yield (2198 kg/ha) with 9.92 kg/ha/mm of water-use efficiency (WUE) followed by groundnut (2082 kg/ha pod and 8.08 kg/ha/mm).
- Water use ranged from 221.4 mm (pearl millet) to 353 mm (castor) under rainfed condition. WUE was the maximum in sesame (5.17 kg/ha/mm) followed by groundnut + pigeon pea (4.37 kg/ha/mm).
- Maximum WUE with added ET were 5.45 and 3.33 kg/ha/mm in pigeon pea and groundnut + pigeon pea intercrop, respectively at 70% replenishment of water deficit of field capacity. Castor sole and groundnut + castor intercropping closely followed it with WUE of 4.71 and 3.11 kg/ha/mm.
- A laboratory based method to measure the leaf cell membrane thermostability (LCMT) was developed, which could be utilized to screen large number of germplasm accessions and breeding lines for high temperature tolerance.
- Crop canopy architecture has an important bearing on both the radiation (RAU) and water (WUE) use efficiency. The genotypes with low SLA seem to possess high WUE as well as RAU.
- Under water limited conditions root growth varied significantly and drought tolerant genotype showed more efficient root growth in the lower soil depths compared to the susceptible one.
- Pod morphology, particularly size played important role in the pod nutrition in groundnut. Phosphorus and Ca are important nutrients for proper pod-filling and their application is essential for maintaining the proper seed and pod size.
- Maximum pod yield was obtained with application of Calcium chloride and Calcium ammonium nitrate. The responses of gypsum, lime and ties were at par, and of these ties and lime were the cheaper sources of Ca.
- Out of 103 genotypes screened for P and Ca efficiency, GG 5, GG 20, NRCG 3498, ICGV 86590 and SP 250A were P-efficient, while GG 5, GG 7, GG 20, ICGV 88648 and B 95 were Ca-efficient.
- With increase in the level of B and Zn a linear increase in yield of groundnut varieties (GG 2, JL 24, ICGS 76, GG 20) was observed. JL 24 and ICGS 76 responded upto 0.6 ppm of Zn, and GG 20 and GG 2 upto 0.8 ppm. All the cultivars responded upto 1 ppm of B.
- Screening of genotypes under low pH identified NRCG 5513, 6820, 4659 and 3498 as tolerant to Al toxicity and acid soils. Under sand culture, the genotypes ICG 11882, NRCG 7599, 1038, 3498 and 6919 were found tolerant of Al-toxicity, while GG 4, GG 5, Tirupati 4 and Punjab1 were sensitive.
- An excellent response of *Bradyrhizobium* and PSM was obtained with P and Ca, when effects of organic and inorganic nutrients and biofertilizers were compared in acid soils.
- In the NEH region application of rabbit slurry, caster cake, neem cake and farmer practice of Bun method farming were at par and are promising organic farming approaches.
- Ten technology interventions were evaluated in four villages, namely Vadhavi, Umatwada, Nandarkhi and Zanjarda of Junagadh District.
- Application of recommended NPK along with the plant growth promoting rhizobacteria (PGPR) increased the pod yield by 18% and gross monetary return by 18.5% with CBR of 1:4.7 as against farmers' practice (1:4.08).
- The use of recommended seed rate and need based foliar application of neem oil @ 2% at 35, 50 and 65 DAS + pheromone traps @ 10/ha reduced the incidence of major diseases and insects, and increased the pod yield by 27% over the farmers' practice.

- In Holistic IPM of groundnut based intercropping (pigeon pea), the foliar application of crude neem oil and castor cake @ 500 kg/ha reduced the incidence of major diseases and insects considerably and increased the pod yield by 26.3% over the farmers' practice. Gross monetary return was the highest in IPM module with cotton + sesame intercropping.
- Training for farm women (20) on "Preparation of groundnut based bakery items" was organized utilizing the facility at the School of Baking, JAU, Junagadh. A demonstration on "Silage making" was organized at Cattle Breeding Farm, JAU in which 10 farmers participated.

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.
- Establishment of relevant institutional linkages, offer consultancy and training.
- 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 four units *viz.* Crop Iimprovement, Crop Protection, Crop Production and Basic Sciences. The Crop Improvement unit comprises of Genetic Resources, Plant Breeding, Genetic and Cytogenetics, the Crop Protection unit includes Plant Pathology and Entomology, the Crop Production unit with Agronomy and Soil sciences; and the Basic Science unit comprises of Biochemistry, 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, ARIS Cell, 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 railway line to Ahmedabad which is 376 km away. The nearby airports are Rajkot and Jamnagar which are 110 and 160 km away respectively. The Centre lies on 70.36°E longitude and 21.31°N latitude at an altitude of 60 m above mean sea level. The land scale of the area 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 meager 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.

Weather Data

	Temp °C Min	Temp °C Max	Temp °C Ave	r.H. % Ave	soil hum cbar Ave	Temp °C Ave	Solar130 W/qm	wind vel m/s Ave	wind dir ° Ave	rain0.2 l/qm /d Sum	Tdp °C Ave
2003, April	22.97	39.10	30.26	37.47	200.00	36.16	5.88	1.84	263.35	0.03	1.36
2003, May	25.76	38.29	31.00	49.12	200.00	37.80	5.93	2.56	271.75	0.00	9.96
2003, June	27.53	35.23	30.73	66.57	137.18	35.43	4.69	2.91	243.37	4.44	20.09
2003, July	25.86	31.00	27.90	93.80	48.67	29.43	3.61	1.83	219.38	15.61	26.57
2003, Aug.	24.99	30.00	26.92	94.67	65.17	28.55	3.03	1.16	252.16	12.22	25.84
2003, Sep.	23.90	31.81	27.10	84.59	78.12	30.30	3.99	0.98	244.03	1.66	23.24
2003, Oct.	20.98	33.545	26.73	64.47	104.415	29.85	4.79	0.97	134.945	0	13.275
2003, Nov.	17.88	34.36	26.06	29.12	190.94	30.85	4.15	0.74	142.63	0.00	-4.96
2003, Dec.	12.26	30.36	21.51	24.22	200.00	26.67	3.71	0.90	144.02	0.00	-11.27
2004, Jan.	11.80	29.22	21.06	27.90	200.00	26.58	3.81	0.94	119.39	0.00	-9.16
2004, Feb	14.31	32.86	23.91	19.97	200.00	29.66	4.53	1.24	171.55	0.00	-12.73
2004,Mar.	19.55	38.92	29.13	16.85	200.00	34.55	4.93	1.33	194.94	0.00	-12.49

PROJECT 01 : BREEDING AND GENETIC STUDIES ON BIOTIC AND ABIOTIC STRESSES IN GROUNDNUT

(Chuni Lal, A. L. Rathnakumar, K. Hariprasanna, M.P Ghewande, V. Nandagopal, P. C. Nautiyal and A.L. Singh)

Sub project 01: Breeding and genetic studies on biotic stresses in groundnut

1 Hybridization

Twelve new crosses involving cultivated parents and resistant donors of various biotic stresses were effected. One back cross between the F_2s of the cross, JL 24 x J 11 and F1 s of the cross J 11 x *A.cardinasii* was also effected. The probable hybrid pods were harvested cross-wise separately and preserved for further sowing during kharif 2004.

In addition, six wild crosses involving J 11 and six wild species viz; *A.rigoni* (2 accessions 11795, 12032) and *A.kretschmeri* (12029) of section *Procumbentes*, *A.magna* (12039), and *A.cardinasii* of section *Arachis* and *A.glabrata* (11818) were also attempted to utilize the heterosis for biomass for fodder purposes. The hybrids will be raised during Kharif 2004.

2 Generation advancement

Generation advancement of eight crosses to F_2; 18 crosses to F_3; four crosses to F_4; nine crosses to F_5 and one cross to F_6 were made and the selected progenies were harvested cross-wise and bulked separately for further advancement to their respective filial generations/yield evaluation.

3 Screening of genotypes

3.1 In Disease Nursery under field conditions

Seventeen advanced breeding lines of the Spanish botanical group and 25 of the Virginia group were tested for their disease reaction under field conditions in the Disease Nursery. In addition three Virginia genotypes, PBS 29017, 29031 and 24030 were also screened for their reaction to soil borne diseases.

The screening results indicated that the genotypes PBS 11058, 29058, 21063, 29020 and 29060 were found to be resistant to LLS (disease score <3.0) as against a disease score of 8.5 in the susceptible genotypes. The genotypes PBS 29058, 21063 and 29060 had also exhibited moderate levels of resistance to rust.

Interestingly, the genotype PBS 24030 which recorded a disease score of 3.33 for LLS also found to be resistant to rust and LLS at Aliyarnagar, a hotspot for rust and LLS during kharif 2002. Similarly, at Jalgaon, the same genotype recorded 3.43% of thrips damage as against 21% in JL 220 during kharif 2002.

At Kadiri, this genotype recorded lowest thrips damage (12%) as against 43% in JL 24. In addition, this genotype was also found to be promising against thrips at Dharwad.

For stem rot, two genotypes, PBS 12032 and 30016, were found to be promising as they recorded very low levels of incidence (~10%) as against 85% incidence in the susceptible genotypes. These two genotypes were also found to exhibit moderate levels of resistance to LLS. In addition three genotypes, PBS 30158, 11038 and 11024 were found to be tolerant of stem rot which exhibited ~15% incidence.

Three genotypes, PBS 11067, JAL 05 and JUN 33, showed dry seed resistance against *Aspergillus niger* under lab conditions. In addition, the genotypes JUN 33 and JAL 05 exhibited tolerance of ELS (recorded a disease score of <5.0 as against 8.5 in susceptible cutivars).

3.2 Screening of genotypes under different yield evaluation trials (natural incidence)

In different evaluation trials, under field condition there was an epidemic for rust and ELS. The disease score recorded in the susceptible genotypes was 9.0 for rust and 8.67 for ELS. However, incidence of LLS was negligible.

In the trial meant for early maturity, three genotypes, PBS 12038, 28008 and 30076 were found to be resistant to rust (disease score <3.0) and six genotypes were moderately resistant to rust.

In the large seeded varietal trial, the genotype, PBS 22008 was found to be resistant to rust and seven genotypes were found to be moderately resistant to ELS.

Under preliminary yield evaluation trial, five genotypes, PBS 29080, 30053, 30086, 30112 and 30051 were found to be resistant to rust. In addition, three genotypes exhibited moderate levels of resistance for ELS and to genotypes to rust.

Under Spanish bunch trial, PBS 30104 and 30158 were found to be resistant against rust. While in Virginia trial none were found to be resistant. However, nine genotypes registered moderate levels of resistance.

In the evaluation of WUE genotypes, JUN 13 was found to resistant to ELS and moderately resistant to rust, whereas the genotype, JUN 15 was found to be moderately resistant to ELS.

Sub project 02: Breeding and genetic studies on abiotic stresses in groundnut

1 Hybridization

A total of 59 fresh crosses were attempted for different breeding objectives during *kharif* 2003. During the season 10096 buds were pollinated and 3065 probable hybrid pods were obtained with a success rate of 30.12 % (Table 1).

Table 1: Details of fresh crosses attempted in *kharif* 2003

Purpose of cross	No. of crosses	F_1 pods harvested	Success of pod setting (%)
Diallel for drought tolerance	30	1942	29.53
High shelling percent	2	86	23.37
High harvest index	1	34	25.00
Early maturity to deal with end- season drought	4	298	34.37
Cold tolerance to advance the summer sowing	4	262	35.60
Genetics of seed coat colour	6	252	43.83
Linkage studies on stem, flower and testa colour	2	31	41.89
Inheritance of white flower colour	2	26	29.89
Mapping population for $\Delta^{13}C$	4	96	23.02
Mapping population for $\Delta^{18}O$	4	38	
Total	**59**	**3065**	**30.12**

Table 2: Details of selections effected in the segregating generations in *kharif* 2003

Gen.	Purpose	Crosses sown	Selections made
F_2	Pod characteristics	5	8
	Shelling percent	2	2
	Cold tolerance	2	2
	Genetics of Fresh Seed Dormancy	4	4
F_3	Drought tolerance	8	41
	Genetics of pod smoothness	1	1
	Drought and Fe resistance	7	9
	Resistance to Lime induced iron deficiency chlorosis	9	9
F_4	Use of SLA for increasing water use efficiency	5	3
	Genetic improvement for fresh seed dormancy	3	26
	Resistance to Lime induced iron deficiency chlorosis	6	4
F_5	Yielding ability	2	3
	Short duration in Virginia	9	11
	HMT	1	5
F_6	High reproductive efficiency	1	9*
	Biological N Fixation	1	3*
	High yield and earliness in Virginia groundnut	2	2*
	Fresh seed dormancy	7	35*

*Selected as non-segregating advance lines

2 Selections and generation advancements

Two three-way crosses attempted during *kharif* 2002 using the pollen of F1s between J 11 x *A. kretchmeri* and J 11 x *A. cardenasii* and GG 2 as female parent were raised in *kharif* 2003 and advanced further. Thirty crosses attempted for drought tolerance/high water use efficiency were raised in summer 2004 and true hybrids were identified to advance them to next generation. Similarly, eight crosses attempted in *kharif* 2003, four each between the extremes of $\Delta^{13}C$ and $\Delta^{18}O$ were raised to advance them further. The selections made during *kharif* 2003 in segregating generation and generation advancements are tabulated generation wise (Table 2).

3 Multiplication and maintenance of advance-breeding lines

Two hundred thirty advance breeding lines in *kharif* 2003 and 258 in summer 2004 were multiplied for their further maintenance and use either in hybridization programmes for evaluation in yield evaluation trials to identify the potential genotypes for entering into all India testing.

4 In-station trials for yield evaluation

Three different yield evaluation trials under the nomenclature of Preliminary Yield Evaluation Trial (PYET), Spanish Bunch Yield Evaluation Trial (SBYET) and Virginia Yield Evaluation Trial (VYET) were conducted in *kharif* 2003. The advanced breeding lines developed with different breeding objectives were evaluated in these trials. In all the trials observations on days to flower initiation (FI) and 50% flowering (F50), plant height (PH) in cm, number of primary (PBN) and secondary branches (SBN), plant height (PH in cm) hundred kernel weight (HKW), sound mature kernels (SMK), shelling percent (SP), specific leaf area (SLA), SPAD chlorophyll meter reading (SCMR), pod yield (PY) and kernel yield (KY) in kg/ha were recorded and analyzed statistically. The results of station trials for yield evaluation are given trial wise hereunder:

4.1 Preliminary Yield Evaluation Trial (PYET)

Twenty-two test entries comprising 13 Spanish and nine Virginia types were evaluated along with two checks, one each of Spanish and Virginia type, in a preliminary yield evaluation trial. When the test entries were compared irrespective of the habit group, none could surpass the best check variety (in most of the cases GG 20) for almost all the traits studied.

4.2 Spanish Bunch Yield Evaluation Trial (SBYET)

In this trial a total of 33 genotypes including four checks were evaluated in a RBD with three replications. Of the 29 test entries evaluated under this trial, 16 were developed by the Plant Breeding Section through hybridization and 12 through mutation breeding (mutants of Girnar 1). One entry (ICGV 00414) was selected from the International Trials supplied by the ICRISAT in the past.

The lines included 17 advance breeding lines which completed two years of testing. Based on two years results three entries, namely PBS 12160, PBS 30044 and PBS 30073 registered significantly higher pod and kernel yields over the check varieties. PBS 12160 also had significantly lower plant height and higher number of secondary branches and oil content. Besides, this genotype possessed significantly low SLA and high SCMR, and hence, likely to possess high transpiration efficiency. Therefore, this genotype holds immense promise for rain-fed *kharif* groundnut production system.

Table 3: Top performing Spanish advance breeding lines over two seasons (*kharif* 2002 and 2003)

Genotype	PY	KY	SP	SLA	SCMR	FI	F50	PH	PBN	SBN	Oil%
PBS 12160	2770*	2021*	73	192.81*	41.37*	25.67	28.00	29.47*	4.87	6.87*	49.16*
PBS 30073	2694	1960	73	218.77	32.97	22.33	25.67	43.00	4.27	0.07	49.16*
PBS 30044	2623	1870	71	230.07	33.70	23.33	26.33	36.60	4.20	1.60	47.83*
JL 24 (NC)	2333	1784	77	218.43	36.37	23.00	26.00	46.73	4.73	0.87	45.83
SB XI (ZC)	1580	1212	76	239.27	32.27	22.33	25.67	63.27	4.60	0.60	45.50
GG 2 (LC)	1922	1477	77	227.08	37.80	22.67	26.33	46.60	4.87	3.80	46.00
SE±	153.8	116.1	2.2	7.32	0.89	0.74	0.64	3.11	0.18	0.61	0.69
CD at 5%	433.2	327.0	6.3	20.96	2.55	2.12	1.83	8.89	0.54	1.77	0.67

4.3 Virginia Yield Evaluation Trial (VYET)

In this trial a total of 24 genotypes including four checks (GG 20, Kaushal, M 335 and Somnath) were evaluated in a RBD with three replications during *kharif* 2003.

Of the 20 test entries evaluated under this trial 18 were developed by the Plant Breeding Section through hybridization and two entries (ICGV 00394 and ICGV 98103) were selected from the International Trials supplied by the ICRISAT in the past.

Among the four check varieties, Kaushal registered the highest pod and kernel yields. Compared to this check one test entry, PBS 24004 recorded significantly higher pod as well as kernel yield (Table 4). Among the check varieties, GG 20 was adjudged to be the best check for shelling percent, days to flower initiation and 50% flowering, number of primary branches and nodes; Kaushal for pod yield, kernel yield, shorter plant height and number of secondary branches; M 335 for SLA, and Somnath for SCMR and number of primary branches.

Two test entries, PBS 21020 and ICGV 00394, were significantly early in flower initiation as compared to the best check. In addition, ICGV 00394 was early in days to 50% flowering. Three test entries, namely PBS 13020, PBS 22039 and PBS 24084, were significantly shorter in plant height as compared to the best check. Similarly, one test entry, PBS 13020, was found to possess significantly shorter primary branches. No test entry was found statistically superior to its respective best checks for SP, SLA and SCMR.

Table 4: Top performing Virginia bunch advance breeding line PBS 24004 in *kharif* 2003

Genotype	PY/ha	KY/ha	SP	SLA	SCMR	Oil%
PBS 24004	2192*	1413*	64	230	37	46
GG 20	1079	780	72	232	41	49
Kaushal	1689	1156	68	206	41	46
M 335	1500	959	64	240	38	48
Somnath	1227	778	63	217	41	49
CD (0.05)	86	354	5	29	3	0.36

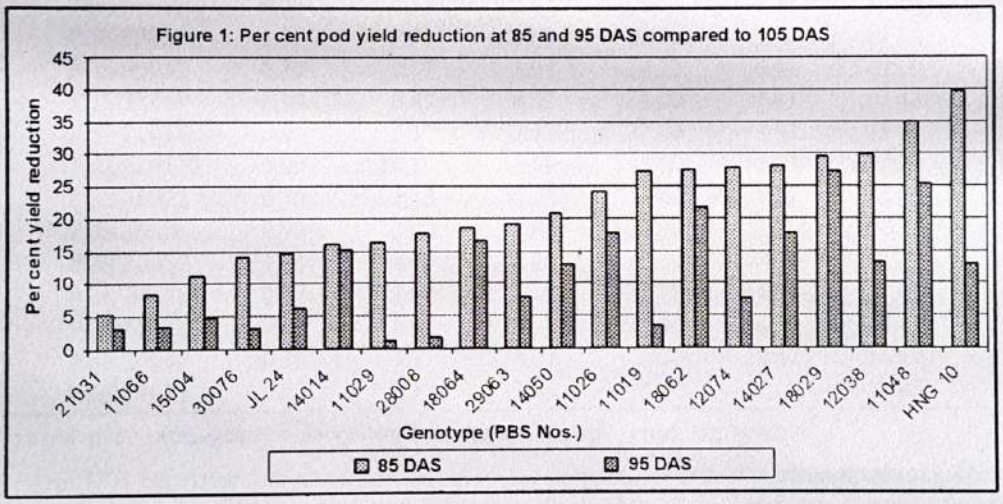
5 Evaluation for early maturity

5.1 Evaluation of advanced breeding lines for early maturity in *kharif* 2003 season

Eighteen advanced breeding lines (15 Spanish and 3 Virginia types) were evaluated in a randomized block design along with one Spanish (JL 24) and one Virginia (HNG 10) check variety during *kharif* 2003. Single row was harvested at 85, 95 and 105 days after sowing (DAS), and observations were recorded on pod and kernel yields, shelling percent and proportion of mature pods and kernels. Relative yield reduction at 85 and 95 DAS harvest was taken as index of maturity.

Variance due to genotypes and dates of harvest were significant for all the traits studied. Shelling percent showed significant differences due to interactions between genotypes and the dates of harvest.

The percent reduction at 85 and 95 DAS harvest compared to 105 DAS is depicted in Fig.1.The genotypes, PBS Nos. 21031, 11066, 30076, 11029, 28008 and 11019 have shown least reduction in pod yield when harvested at 95 DAS as compared to their yields at 105 DAS, and hence, were early in maturity. These entries need to be further tested for early maturity.



5.2 Evaluation of advanced breeding lines for early maturity in summer 2004 season

The early maturity evaluation trial of kharif 2003 was also repeated in summer 2004. Same materials and methods were adopted. Reduction in pod yield ranged from 39 to 70% on 85 DAS and -1 to 60% on 95 DAS over the yield obtained on 105 DAS. Similarly, for kernel yield it ranged from 60 to 92% on 85 DAS and 8 to 73% on 95 DAS. The Spanish genotype PBS 21031 was found to mature in 95 days.

6 Evaluation for high WUE and drought tolerance

Forty-eight advance breeding lines along with two check varieties known to possess tolerance of drought were raised in two replications in a split plot design, where four drought patterns (regularly irrigated, early-season drought, mid-season drought and end-season drought) were main-treatment and genotypes as sub-treatment. Observations were recorded on pod and kernel yields on plot basis.

Analysis of variance revealed significant differences due to genotypes, drought patterns and interaction of drought patterns x genotypes were significant for pod and kernel yield. However, for shelling percent, only variance due to genotypes was significant. When analysis of variance was performed on individual drought pattern basis and mean values were compared, the check variety ICGS 76 was found to be the best check in all the managed drought patterns.

Genotypes JUN 7, JUN 9 and JUN 37 were found to yield significantly higher over the best check variety ICGS 76 under all the simulated drought patterns (early-, mid- and late-season drought). JUN 8, JUN 37, JUN 38 and JUN 39 were found promising for early as well as for managed late season droughts.

7 Supply of segregating material to AICRP G centres

In response to the request and the MTA received from nine AICRP-G centres, segregating materials (F_3 - F_6 generation) bred for different breeding objectives were supplied to these centres.

8 Entries under All India Testing

One test entry, PBS 24030, was prompted to AVT in Zone I. Two advance lines, JUN 21 and JUN 27, were identified for testing under Initial Drought Variety Trials, and three Spanish entries (PBS Nos. 12160, 30044 and 30073) for Spanish bunch varietal trials of AICRP-G.

PROJECT 02: INTEGRATED PEST MANAGEMENT (IPM) IN GROUNDNUT BASED PRODUCTION SYSTEM

(V. NANDAGOPAL, M.P. GHEWANDE, S. DESAI, T.V. PRASAD AND VINOD KUMAR)

Sub project 01: Integrated insects and non-insect pest management in Complex, Diverse and Risk-prone (CDR) groundnut based production system

(V. Nandagopal and T.V.Prasad)

1 Screening of various genotypes against jassids and thrips

Sixteen stabilized cultures from Plant Breeding section were screened against the sucking insects such as thrips and jassids for the second year. The population of the jassids through sweep net over five time during the crop growth period for the last two seasons indicated that during 2002 summer it was only 0 to 2 per 5 sweep and during 2003 summer it was 2 to 10 jassids. Based on the population oriented towards the lines, the lines PBS 12137, 21046 21018 and 30006 was found to be resistant attracting lowest jassids population (Table 1).In the case of thrips, the line PBS 21018 recorded lowest population in both the seasons and found to be resistant .

Table1: Screening of various genotypes against jassids and thrips

Genotype	Jassids / 5 sweeps			Thrips / 5 sweeps		
	2002	2003	Mean	2002	2003	Mean
PBS 12137	0.70	1.67	1.19	10.00	7.00	8.50
PBS 30018	2.30	2.83	2.57	9.70	7.33	8.52
NRCG 1840	0.70	5.67	3.19	12.70	6.83	9.77
PBS 21046	0.70	3.33	2.02	5.00	11.67	8.34
TG 26	0.70	4.17	2.44	6.70	7.83	7.27
PBS 29026	1.70	5.50	3.60	23.70	2.67	13.19
PBS 30052	0.70	7.17	3.94	14.70	6.67	10.69
PBS 21011	1.30	6.83	4.07	9.00	5.83	7.42
PBS 21018	0.00	2.33	1.17	2.70	3.67	3.19
NRCG 9573	1.00	10.17	5.59	13.00	12.17	12.59
PBS 30022	0.70	5.33	3.02	7.00	4.00	5.50
PBS 30006	0.70	3.00	1.85	6.30	2.33	4.32
PBS 30057	1.30	11.17	6.24	15.00	10.33	12.67
PBS 14030	0.30	12.67	6.49	11.00	15.33	13.17
PBS 11003	1.30	6.83	4.07	11.00	18.67	14.84
PBS 20094	0.30	9.17	4.74	8.70	19.67	14.19
PBS 18031	0.70	7.17	3.94	5.70	2.00	3.85

2 Integrated pest management in groundnut based mixed cropping system

An IPM experiment in groundnut based mixed cropping system was taken up during *kharif* 2003 with groundnut variety GG-20 and mixed crops *viz*., Bajra (Mh 179), Sorghum (local), Maize (local), Castor (GAUCH-1), Pigeon pea (BDN-2), Cowpea (local), Green gram (local), Black gram (local) and Sesamum (local) were used in the ratio of 9:1 with three replications. The plot size was 10 rows of 10 meter length with 45 cm spacing between rows.

The mixed crop green gram found to be good in reducing the jassid population as throughout the period of crop growth the population was less (Table 2). The mixed crops like sesamum and maize also shown promise in reducing the population of jassid. The castor and pigeon pea as mixed crop increased the thrips population while green gram, sesamum and maize reduced the thrips population (Table 3).

Table 2 : Jassid populations in IPM (*kharif* 2003)

Treatment	40 DAS	50 DAS	60 DAS	75 DAS	90 DAS
Groundnut + Bajra	0.33	2.33	21.00	38.67	5.33
Groundnut + Sorghum	0.67	0.33	18.00	33.67	5.33
Groundnut + Maize	0.33	1.33	15.67	25.33	2.33
Groundnut + Sesamum	0.00	3.33	9.00	14.33	4.33
Groundnut + Castor	0.33	2.67	13.33	44.67	7.00
Groundnut + Pigeon pea	0.67	2.00	17.00	30.00	6.33
Groundnut + Cowpea	0.00	2.67	27.00	21.33	4.33
Groundnut + Green gram	0.00	1.00	12.67	10.67	4.00
Groundnut + Black gram	0.00	1.67	18.33	22.00	3.67
Groundnut alone	0.33	3.33	18.33	22.33	5.33
CD	NS	NS	NS	NS	NS

Table 3 : Thrips per 5 sweeps/5m length row of groundnut in IPM (*kharif* 2003)

Treatment	40 DAS	50 DAS	60 DAS	75 DAS	90 DAS
Groundnut + Bajra	0.33	2.00	8.33	4.33	4.00
Groundnut + Sorghum	0.67	2.00	5.00	6.00	2.00
Groundnut + Maize	0.00	4.00	4.67	3.33	1.33
Groundnut + Sesamum	0.00	2.33	3.67	5.00	1.67
Groundnut + Castor	0.67	1.00	7.00	9.00	6.67
Groundnut + Pigeon pea	0.33	4.67	6.67	4.00	8.33
Groundnut + Cowpea	0.00	4.00	7.67	5.67	3.33
Groundnut + Green gram	1.00	3.67	1.67	2.00	1.67
Groundnut + Black gram	1.00	5.67	6.33	2.00	1.33
Groundnut alone	0.00	3.33	5.33	6.33	4.00
CD	NS	NS	NS	NS	NS

Table 4 : Per cent defoliator damage on groundnut in IPM (*kharif* 2003)

Treatment	40 DAS	50 DAS	60 DAS	75 DAS	90 DAS
Groundnut + Bajra	0.92	2.57	2.85	6.92	3.85
Groundnut + Sorghum	0.70	3.92	3.48	3.98	5.37
Groundnut + Maize	0.77	4.27	2.72	5.88	3.87
Groundnut + Sesamum	0.87	2.48	4.20	7.55	6.12
Groundnut + Castor	0.87	2.48	1.82	3.73	5.22
Groundnut + Pigeon pea	1.08	3.60	1.67	4.22	7.13
Groundnut + Cowpea	1.18	2.48	2.28	4.23	4.17
Groundnut + Green gram	0.90	4.45	3.17	4.58	5.00
Groundnut + Black gram	0.95	2.83	4.02	5.58	6.47
Groundnut alone	0.92	2.25	3.40	5.23	4.87
CD	NS	NS	NS	NS	NS

The defoliation in general was very low and there was no significant difference in the damage levels in different mixed cropping system on groundnut (Table 4). In the case of damage to mixed crops, the damage was very low in mixed crops like pigeon pea and cowpea. It was very spectacular damage on black gram (Table 5).

Table 5 : Per cent defoliator damage on mixed crop in IPM *(kharif* 2003)

Treatment	50 DAS	60 DAS	75 DAS	90 DAS
Groundnut + Bajra	----	----	----	----
Groundnut + Sorghum	----	----	----	----
Groundnut + Maize	----	----	----	----
Groundnut + Sesame	----	----	----	----
Groundnut + Castor	----	----	----	----
Groundnut + Pigeon pea	1.38	6.67	4.07	2.50
Groundnut + Cowpea	1.18	10.40	4.00	3.25
Groundnut + Green gram	3.15	4.48	9.72	8.72
Groundnut + Black gram	3.40	37.93	6.90	7.67

Based on the cost of cultivation and the yields of groundnut and the mixed crop, the CBR was worked out. In green gram mixed cropping system CBR was 1:2.00. The yield economics worked out has shown that mixed crop with castor gave the highest income of about Rs.21,335 followed by green gram (Rs.20,208) compared to the control which gave Rs. 11,547/ha (Table 6).

Table 6 : Groundnut yield (kg/ha) in IPM (*kharif* 2003)

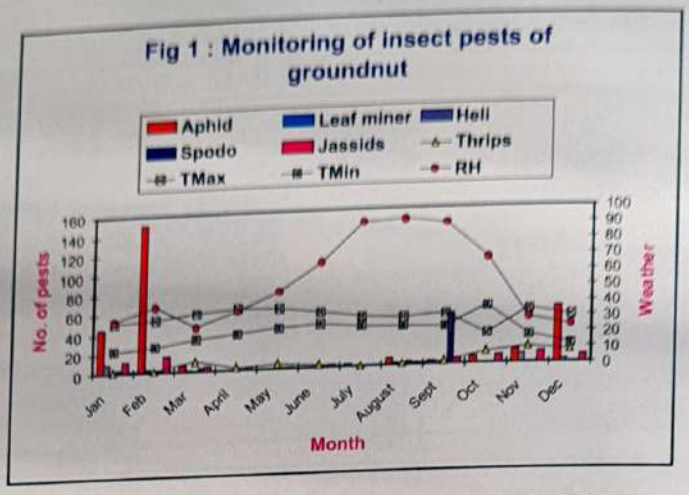
Treatment	Pod yield of Groundnut/ha	Yield of mixed crop/ha	Cost of cultivation/ha	Gross Monitory return/ha	Net return/CBR
Groundnut + Bajra	1288.76	*	9310	18119.8	1:1.95
Groundnut + Sorghum	1229.51	*	9310	17213.2	1:1.85
Groundnut + Maize	1236.91	*	9310	17217.6	1:1.85
Groundnut + Sesame	1244.32	*	10100	17072.0	1:1.69
Groundnut + Castor	1325.79	189.98	11200	21335.8	1:1.90
Groundnut + Pigeon pea	1207.29	187.50	11200	17956.2	1:1.60
Groundnut + Cowpea	1125.81	141.47	10100	17986.5	1:1.78
Groundnut + Green gram	1392.45	26.89	10100	20208.7	1:2.00
Groundnut + Black gram	762.89	53.48	10100	11001.6	1:1.09
Groundnut alone	829.55	-	8200	11547.4	1:1.41
CD	NS				

Basic cost of cultivation Rs. 8200/ha

* No yield could be recorded due to damage by birds

3 Monitoring of the major insects pests of groundnut

The population of major insect pests of groundnut under monitoring programme was under taken in monthly sown crops using cylindrical trap for aphids, sweep nets for jassids and thrips and pheromone lures for leaf miner, *Spodoptera litura* and *Helicoverpa armigera*. The aphid population was highest (151) during February. Jassids and thrips population started building up in August and continued to be raising up to November. The leaf miners continue to present in low numbers, probably in the alternate host plants. *Helicoverpa* moth catches were nil, whereas maximum *Spodoptera litura* population (51.5) was observed during September (Fig. 1).



Sub project 02: Integrated management of major diseases (ELS, LLS, rust, collar rot, stem rot, PBND) of groundnut

(M. P. Ghewande, S. Desai and Vinod Kumar)

1 Disease resistance

A total of 172 genotypes along with susceptible checks (GG 2 & GG 20) were evaluated against ELS, LLS, rust and stem rot diseases under field condition during the rainy season of 2003. In case of stem rot, each genotype was artificially inoculated with *Sclerotium rolfsii* pathogen at 30 days of emergence. Observations on foliar fungal diseases were recorded by adopting 1-9 modified scale, while in the case of stem rot, the percentage of incidence was recorded before and after harvest. Observations on pod yield (g/3m row length) were also recorded.

Promising genotypes are listed in Table 1a. The results showed that ELS intensity ranged from 3.83 to 8.5 grade while that of LLS ranged from 2.00 to 6.83 grade. The disease pressure of rust was low even in susceptible checks. Therefore, meaningful conclusion could not be drawn in this regard. The incidence of stem rot ranged from 4.17 to 76.67%. The results revealed that out of 172 genotypes, three genotypes viz. CS 86, PBS 29058 and CS 19 showed resistance to ELS. Thirteen genotypes viz; CS 185, PBS 29017, ICGV 98103, PBS 12169, ICGV 00414, PBS 29058, CS 19, CS 86, CS 160, CS 77, CS 132, PBS 29020 and CS 168 recorded below 3.0 grade of LLS as against 7.0 grade in GG 2 and GG 20 indicating their promise against LLS. The lowest incidence of stem rot (4.17%) was recorded in CS 168 followed by CS 151 (6.94%), CS 25 (7.69%), CS 19 (8.12%) and CS 157 (9.09%) as against 76.67% in PBS 24030, 58.33% in GG 2 and 29% in GG 20. This indicated that genotypes CS 168, CS 151, CS 25, CS 19 and CS 157 showed resistant reaction against stem rot. As regards yield, highest pod yield of 255 g/3m row was recorded in CS 19 as against 98 g/ 3m row in GG 2 and 83 g/3m row in GG 20. Results need confirmation during the rainy season of 2004.

Eleven groundnut genotypes were also tested against *S. rolfsii* in concrete block in artificially inoculated condition during the rainy seasons of 2002 and 2003. Observations on plant mortality were recorded at weekly intervals up to the maturity of crop and after harvest as well. The results are given in Table 1b.

The data of two years revealed out of 11 genotypes tested, none was found to be completely free from *S. rolfsii* infection. The pooled data of two years showed that the lowest disease incidence of stem rot (7.85%) was recorded in CS 19 followed by ICGV 86590 (14.75%), a resistant check as against 55.59% incidence in GG 20, a susceptible check.

A total of 29 genotypes including released varieties (12), advanced breeding lines (9) and germplasm lines (8) were evaluated against stem rot pathogen (*S. rolfsii*) under artificially inoculated concrete block condition during summer, 2003. The incidence of stem rot ranged from 8.27 to 100%. The minimum incidence of stem rot (8.27%) was recorded in ICGV 86590 a released variety of ICRISAT and resistant check followed by CODE 1-1 (16.39%) and CS 19 (17.44%) both advanced breeding lines of NRCG as against 100% in Kadiri 3, 97.79% in GG 2 and 73% in GG 20 the susceptible checks(Table 1c). Thus, based on three seasons data it is concluded that CS 19 (TMV 2 x *A. chacoense*), an advanced breeding line of NRCG can be used in stem rot resistance breeding programme for crop improvement.

A total of 33 genotypes including 10 released varieties, 21 advanced breeding lines and two germplasm lines were evaluated against peanut bud necrosis disease vis-a- vis yield of groundnut during summer 2003 under field condition. The results are presented in Table 2.

The results in Table 2 indicated that the incidence of PBND ranged from 1.11 to 16.2%. The minimum incidence of PBND (1.11%) with 440 g/5m pod yield of 5m row length was recorded in TG 45 followed by UF-70-103 (1.98%) with pod yield of 365 g/ 5m row and Code 7 (2.23%) with pod yield of 475 g/5m row length (next highest). Other genotypes viz; PBS 12032, PBS 11006 and ALR 2 recorded below 3% incidence of PBND with pod yield of 300-365 g/5m row as against 16.20% incidence in TG 49 with pod yield of 210 g/5m row. It was interesting to note that an advanced breeding line PBS 11058, although recorded 13.57% incidence of PBND (next highest) gave maximum pod yield of 530 g/5m row indicating its tolerance to PBND under field condition.

Also, a total of 150 genotypes including susceptible (GG 2) and resistant check (J 11) were evaluated against collar rot pathogen (*Aspergillus niger*) under laboratory condition by adopting dry seed resistance technique. Out of 150 genotypes, 10 genotypes namely Code 1, CS 115, CS 117, CS 132, PBS 11067, JAL 05, JUN 33, CS 53, CS 65 and CS 81 showed resistant reaction against *A. niger* (Table 3).

Similarly, 19 genotypes including GG 20 as susceptible check were evaluated against stem rot pathogen (*S. rolfsii*) at seedling stage under laboratory condition. One genotype, PBS 18062, showed moderate level of resistance at 30 days after emergence (Table 4).

2 Management of stem rot (*Sclerotium rolfsii*) through organic soil amendment

A field trial in as RBD with three replications and a susceptible variety GG 20, was conducted during the rainy season of 2003 to study the effect of soil application of fresh leaves of karanj (*Pongamia pinnata*), neem (*Azadirachta indica*) and wild Sorghum (*Sorghum halopens*) @ 100, 250 and 500 kg/ha each in furrow at the time of sowing for the management of stem rot. Also, the effect of application of elemental sulphur @ 20 kg/ha was studied for the management of stem rot. Results are given in Table 5.

Results in Table 5 indicated that the incidence of stem rot and pod yield varied significantly among treatments. The incidence of stem rot ranged from 10.27 to 30.75%. he lowest incidence of stem rot (10.27%) was recorded in the treatment of soil application of fresh leaves of wild Sorghum @ 500 kg/ha followed by fresh neem leaves @ 100 kg/ha (11.54%) and soil application of elemental sulphur @ 20 kg/ha (12.74%) as against 26% incidence in control. The highest pod yield of 2090 kg/ha was realized in the treatment of soil application of elemental sulphur @ 20 kg/ha followed by fresh leaves of karanj @ 100 kg/ha (2030 kg/ha), fresh leaves of neem @ 100 kg/ha (1976kg/ha) and fresh leaves of wild Sorghum @ 500 kg/ha (1945 kg/ha) as against 1670 kg/ha in control treatment. Based on the results it can be concluded that soil application of elemental sulphur @ 20 kg/ ha in furrow at the time of sowing or fresh leaves of wild Sorghum @ 500 kg/ha or fresh neem leaves @ 100 kg/ha should be applied for the management of stem rot.

3 Biological control of collar rot and stem rot pathogens

Antagonistic activity of 20 isolates of Trichoderma belonging to eight species was studied under in *vitro* conditions (dual culture) against collar rot (*Aspergillus niger*) and stem rot (*Sclerotium rolfsii*) pathogens of groundnut. The maximum inhibition (51.26%) of growth of A. *niger* was by the isolate T 170 (*Trichoderma harzianum*) and T 115 (*T. viride*), followed by T 390 (*T. harzianum*), T [illegible] (*T. aureoviride*) and T 28 (*Trichoderma spp*). Isolates T 170 and T 04 (T. viride) showed maximu[illegible] followed by T 00 (64.09%), T [illegible]