वार्षिक प्रतिवेदन
ANNUAL REPORT
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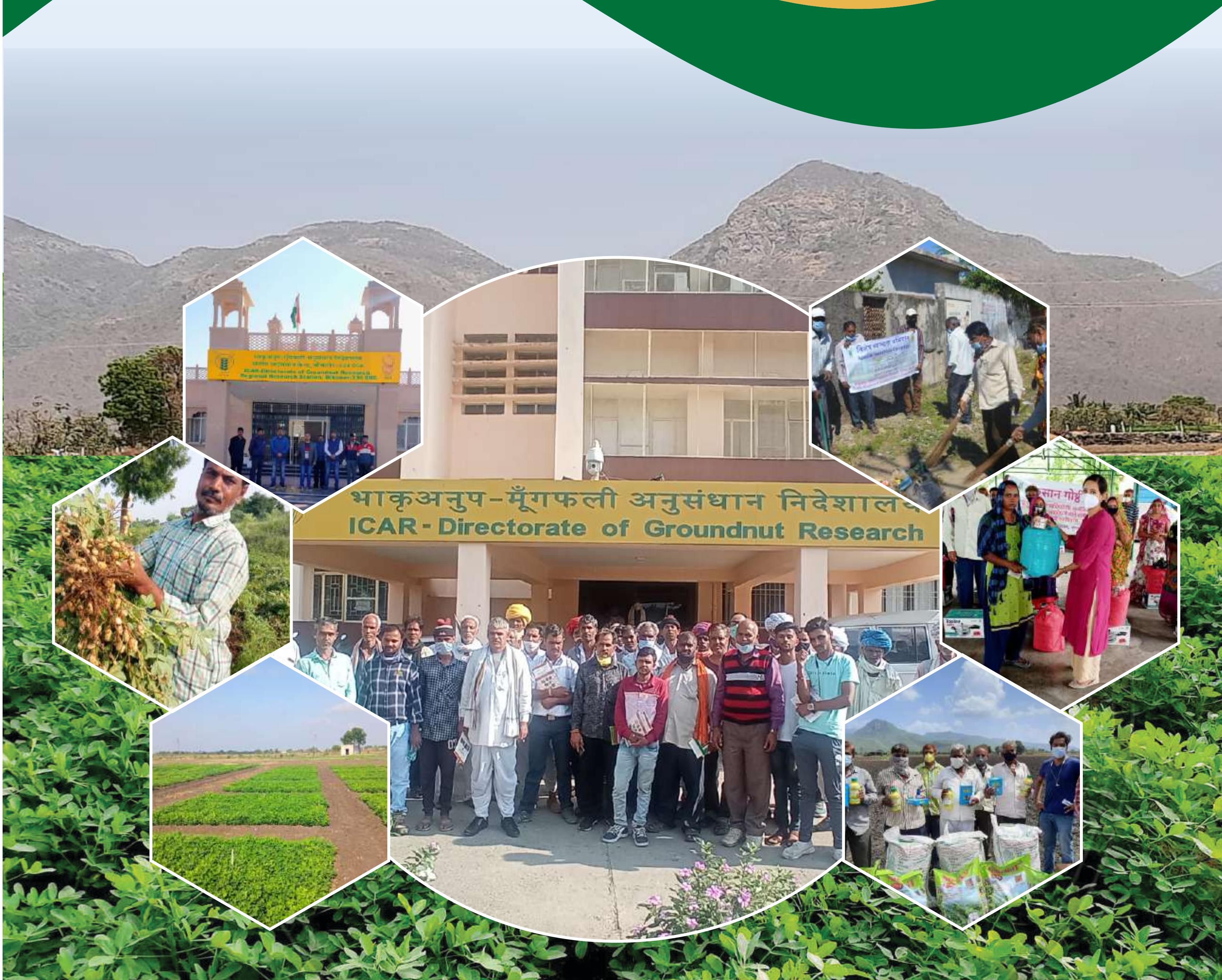

भाकृअनुप–मूँगफली अनुसंधान निदेशालय
(आई.एस.ओ 9001 : 2015 प्रमाणित संस्थान)
इवनगर रोड, पोस्ट बॉक्स नं. 5, जूनागढ 362 001, गुजरात, भारत

ICAR-Directorate of Groundnut Research
(An ISO 9001 : 2015 Certified Institute)
Ivnagar Road, Post Box No. 5, Junagadh-362 001, Gujarat, India

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डीजीआर
DGR

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Contents

अनुदेश

- मूँगफली में उत्पादकता तथा गुणवत्ता सुधार के लिए आधारीय, नीतिगत तथा अनुकूल अनुसंधान।
- उपयुक्त किस्मों तथा प्रौद्योगिकियों के विकासार्थ जानकारियों ज्ञान तथा आनुवंशिक सामग्री को उपलब्ध करवाना।
- स्थान विशिष्ट किस्मों तथा तकनीकियों के विकास हेतु अनुप्रयुक्त अनुसंधान का समन्वयन।
- प्रौद्योगिकियों का प्रचार-प्रसार तथा क्षमता निर्माण।

Mandate

- Basic, strategic and adaptive research on groundnut to improve productivity and quality
- Provide access to information, knowledge and genetic material to develop suitable varieties and technologies
- Coordination of applied research to develop location specific varieties and technologies
- Dissemination of technology and capacity building

परिकल्पना

खाद्य तेल उत्पादन, पोषण और आजीविका सुरक्षा में आत्मनिर्भरता प्राप्त करने के लिए मूँगफली की उत्पादकता और गुणवत्ता में वृद्धि करना।

Vision

Enhancing the productivity and quality of Groundnut for attaining self-sufficiency in edible oil production, nutritional and livelihood security

Preface

It is a matter of great pleasure to present the *Annual Report 2021* of ICAR-Directorate of Groundnut Research, Junagadh. This Institute is continuously striving hard to bring out the best in terms of new knowledge and technology for the cause of groundnut farmers in the country. The thrust being given to the oilseed sector in agriculture, for increasing self-sufficiency in edible oils, is an important step forward for taking groundnut cultivation to new heights. The contribution of groundnut to total oilseeds and edible oil produced in the country is immense and quantified to the tune of 27% and 16%, respectively. Moreover, groundnut has been considered as one of the most important oilseed/cash crops because of the fact that it has greater food value as it contributes to nutritional security of farm families through consumption of energy and protein rich groundnut kernels and provides nutritious food (oilcakes and fodder/haulms) to livestock. Groundnut is also being increasingly used for table purpose, a shift from its use as a source of edible oil. Being nutritionally rich, groundnut and its value-added products and confectionery items have great demand in national and international markets.

Presently, the crop is grown in about 5-6 million hectares in India producing around 10 million tonnes (MT) which has been a history in groundnut production consecutively for two years (10.10 MT in 2019-20 and 10.21 MT in 2020-21) in India. The importance of the crop is further highlighted from the fact that this unique institute and the first NRC (*National Research Center for Groundnut*, NRCG) of the Indian Council of Agricultural Research was established during 1979 and has subsequently been renamed as the *ICAR-Directorate of Groundnut Research* (ICAR-DGR) in 2009. Later, the mandate of the Directorate was reoriented to provide basic and strategic research support backstopping to the National Agricultural Research System (NARS) on groundnut. The research activities of the Directorate are carried out by five units viz., Crop Improvement, Crop Production, Crop Protection, Basic Science and Social Science. The Crop Improvement unit comprises of Genetic Resources, Plant Breeding, Genetics and Cytogenetics, and Plant Biotechnology, while the Crop Production unit includes Agronomy and Soil Science. The Crop Protection unit comprises of Plant Pathology and Entomology, while the Basic Science unit covers Plant Microbiology, Plant Physiology and Plant Biochemistry; and Agriculture Extension and Agricultural Economics under Social Science unit. The supporting sections of the Directorate include Library, ARIS Cell, Farm Section, Establishment and Audit & Accounts.

Groundnut crop is affected by many abiotic and biotic stresses, posing challenges in increasing its productivity and production. High temperature, moisture-deficit and salinity stresses are the major stresses, along with the occurrence of diseases and pests at critical stages of crop growth affecting its growth and development. Therefore, concerted efforts are being made to address these major challenges by development of improved varieties, crop production and protection technologies, and extension/adoption of these to improve the productivity of groundnut crop. In this context, thirteen research projects have been formulated to achieve the Directorates' mandate during plan period of 2021-2026, and appropriate strategies have been followed for the successful implementation of these projects. In addition, several projects funded by external funding agencies are also being implemented at the Directorate. This annual report of the institute highlights the significant achievements made under research, extension, and training programmes being carried out at the Directorate and its three regional stations, and forty-two centers of AICRP on Groundnut.

During 2021 some very promising advanced breeding lines, namely PBSA 11135, PBSA 11127 and PBSA 21111 (produced higher yields to the tune of 22, 10 and 22%, respectively over the best check); PBS 15044, 16015, 16021 and 16023 (identified with more than 3 weeks fresh seed dormancy); PBS 19040, PBS 19042, PBS 19050, PBS 19052, PBS 29243, PBS 29247 and PBS 29248 (having good combinations of confectionery traits *viz.,* ≥60g large seed, >30% protein, 45-48% oil content in seed); PBS-12228 (59%)

Preface

superiority in kernel yield over the best check, TG37A); PBS-12231 and PBS 12232 (39 and 55% superiority in pod yield over the best check, TG37A); PBS 22040 and PBS 29192 (Iron chlorosis tolerant advanced breeding lines) have been identified. An online groundnut germplasm database is being maintained and updated regularly. Genotype PBS 29079B was registered as a novel source for high 100-kernel weight (85.36 g). Three CAM variants viz., DGRMB5, DGRMB19 and DGRMB32 significantly enhanced the pod yield of groundnut (27-33%) over the best check, GG7 during summer 2021. Cultivars GJG 9, DH 86, GJG 31, Kadiri 9 and SG 99 were identified as nutrient dense cultivars with low phytic acid content (> 2.0 g/100g). Two CAM variants, DGRMB5 (INGR21060) and DGRMB19 (INGR21061), developed through facultative CAM transition, were registered with NBPGR as novel sources of tolerance to salinity. The institute has produced about 85 q of nucleus seeds during 2021.

ICAR-DGR also organized a number of extension outreach programmes including farmer's trainings, farmers' fair-cum-exhibition, FLDs, Mera Gaon Mera Gaurav (MGMG), Swachchata Pakhwada and other diverse/theme based programmes, SCSP, and NEH programmes.

The ICAR-DGR Annual Report 2021 gives an insight into the diverse research and extension activities undertaken by the institute. In spite of the challenges posed by Covid-19 pandemic, the ICAR-DGR continued to perform with enthusiasm for the cause of groundnut farmers. The support and cooperation received by the scientific, technical, administrative, and supporting staff of this institute is greatly acknowledged. I sincerely thank the publication committee for compiling and editing this annual report.

(C. S. Praharaj)
Director (A)

सारांश

फसल सुधार

- एआईसीआरपीजी मूल्यांकन के लिए K 1812 से अधिक उपज वाली सात उन्नत प्रजनन लाइनों (पीबीएस 11009, 11010, 11061, 11135, 11127, 21056 और 21120) के एक समूह की पहचान की गई।
- लंबी अवधि भंडारण हेतु स्पेनिश और वेलेंसिया समूहों के कुल 3460 जर्मप्लाज्म एक्सेसन (562 ग्रीष्म ऋतु 2021 और 2898 खरीफ 2021 के दौरान) का गुणन किया गया|
- दो ऋतुओं (रबी- ग्रीष्म 2021 और खरीफ-2021) के दौरान सीटीटी संचय के आधार पर, एनआरसीजी 12240, 203, 99, 6133, 135, 145 और 9966 की 85 दिनों की परिपक्वता के लिए पहचान की गई। अन्य एनआरसीजी 10340, 12352, 12374, 12698, 12428, 10337, 6371, 10888, 10275, 10278, 10283, 10291, 10580, 10294, 12332, 12349, 12369, 12379, 12380, 12385, 12386, 12435, 10290, 13003, 11019, 6236 और 10569 एक्सेसन में 90-95 दिनों की परिपक्वता थी।
- एनआरसीजी 3396, 6752,10413, 9300, 9866 और 9323 की पहचान उच्च प्रोटीन (> 32%) वाली लाइनों के रूप में की गई।
- एनआरसीजी 10340, 1108, 201, 12698, 10337, 6371, 10813, 10283, 10291, 10580, 10294, 11445, 10967, 11019, 12348 और 12377 को उच्च शेल्लिंग प्रतिशत (71-72%) के लिए पहचाना गया। इसके अलावा, एनआरसीजी 99 और 10888 में 75% शेल्लिंग प्रतिशत पाया गया|
- खरीफ 2021 के दौरान कम अवधि और ताजा बीज सुप्तावस्था के लिए दस क्रॉस किए गए और 493 संभावित संकर परिपक्व फलियाँ प्राप्त की गई।
- 15 दिनों से अधिक ताजा बीज सुप्तता वाली उन्नत प्रजनन लाइनों, पीबीएस 15044, 16015, 16021 और 16023 की पहचान की गई।
- स्पैनिश बंच की वीआरआई 2, तिरुपति 3, कादिरी 6, टीजी 26, आईसीजीएस 1, जीजेजी 31; वर्जीनिया रनर की सोमनाथ (टीजीएस 1), उत्कर्ष, जीजी16 और जीजेजी17; वर्जीनिया बंच की टीएमवी 10, जीजी 20, आईसीजीएस 5, आईसीजीवी 86325, मांजरा (एलजीएन2), टीजी 39, आईसीजीवी 00348, कादिरी 7, कादिरी 8, सीओ 6, जीजेजी 22, आरजी 578, बिरसा मूंगफली 4, राज मुंगफली 3, केडीजी 128 और केडीजी 123 में 90% से अधिक ब्लैंचेबिलिटी दर्ज की गई।
- खरीफ, 2021 के दौरान बीज के आकार, तेल और प्रोटीन से संबंधित मूंगफली की गुणवत्ता में सुधार लाने के लक्ष्य से नौ क्रॉस से कुल 300 परिपक्व क्रॉस्ड फलियाँ प्राप्त की गई।
- F_2 पीढ़ी में आठ क्रॉस से कुल 190 एकल पौधे, F_3 में 10 क्रॉस से 309 एकल पौधे, F_4 में 8 क्रॉस से 395 एकल पौधे और F_6 पीढ़ी में 7 क्रॉस से 37 एकल पौधे चुने गए और नर जनक पौधे के लक्षणों के आधार पर अगली पीढ़ी प्राप्त की गई।
- टेट्राप्लोइड अंतर प्रजाति संकर, कल्टीवेटेड मूंगफली और सिंथेटिक टेट्राप्लोइड प्रजातियों (अरेचिस ड्यूरानेंसिस x अरेचिस खुलमानी) और (अरेचिस स्टेनोस्पर्मा x अरेचिस चाकोएन्स) के बीच विकसित किए गए।
- कल्टीवेटेड मूंगफली और अरेचिस स्टेनोस्पर्मा के बीच ट्रिपलोइड अंतर प्रजाति संकर विकसित किए गए|
- तना गलन प्रतिरोधी अंतरप्रजाति प्रजनन लाइनों में अंकुरण के बाद 40-60 दिनों के बीच अधिकतम मृत्यु दर दर्ज की गई|
- कवक के कृत्रिम इनोकुलेसन में नियंत्रित नमी और तापमान की स्थिति में, नियंत्रित नमी और तापमान की अभाव वाली स्थिति की तुलना में 20-25% अधिक तना गलन रोग देखा गया।

- आठ आरआईएल की पहचान दिए गए सूखे की स्थिति में 0-9% कम फली उपज के साथ की गई|
- आठ उच्च ओलिक वर्जीनिया उन्नत प्रजनन लाइनों (एचएफएस संख्या 116, 104, 113, 62, 120, 115, 102, और 100) की पहचान जीजी 22 से 3-26% अधिक फली उपज के साथ की गई।
- तीन उच्च ओलिक स्पेनिश बंच उन्नत प्रजनन लाइनों (एचएफएस संख्या 91, 93, और 74) में जीजेजी 32 की तुलना में 2-11% अधिक फली उपज दर्ज की गई|
- चार क्रॉस, जीजेजी 32 × गिरनार 4, टीजी 81 × एचएफएस 24, जे 87 × एचएफएस 24 और के1812 × एचएफएस 62 से F_{2-3} संततियों में *ah*FAD2A और *ah*FAD2A उत्परिवर्ती एलील्स हेतु जीनोटाइपिंग पूरा किया गया | समरूपी *ah*FAD2A और *ah*FAD2A उत्परिवर्ती एलील्स के साथ सकारात्मक पौधों का चयन किया गया|
- *ah*FAD2A उत्परिवर्ती एलील्स के साथ हजार चौंतीस (स्पैनिश बंच F_{4-5} संततियाँ) और 140 (वर्जीनिया F_{4-5} संततियाँ) नौ क्रॉस से चुने गए|
- उच्च ओलिक मूंगफली की किस्मों गिरनार 4 और गिरनार 5 का क्रमशः 70.0 क्विंटल और 15.0 क्विंटल न्यूक्लियस बीज का उत्पादन 2021 के दौरान किया गया।
- ताजा बीज सुप्तता के लिए नया यौगिक 1 1 0 एसएसआर मार्करों और तना गलन लक्षणों के लिए 45 एसएसआर मार्करों का विकास और पहचान की गई।
- *ah*FAD2A उत्परिवर्ती एलील्स को जीजी 20, जीजी7, टीकेजी 19ए और टीजी 37ए में इंट्रोग्रेस किया गया और 124 उच्च ओलिक उन्नत प्रजनन लाइनें विकसित की गई । इनमें से 13 लाइनों को बीज गुणन और एआईसीआरपीजी परीक्षण के लिए बढ़ावा दिया जा रहा है|
- *ah*FAD2A उत्परिवर्ती एलील्स को नई 15 उच्च उपज देने वाली किस्मों में इंट्रोग्रेस किया गया है और 1447 लाइनों को आगे के चयन और फेनोटाइपिंग के लिए F_3 (324) और F_6 (1123) पीढ़ियों में अग्रेषित किया गया है।

फसल उत्पादन

- अनंतपुर में SPG 1118 हाइड्रोजेल को अपनाने से किसानों की उपज में 30 से 40 प्रतिशत की वृद्धि हुई|
- अनंतपुर की वर्षा सिंचित परिस्थितियों में आयरन सल्फेट, जिंक और बोरॉन का पत्तों पर अनुप्रयोग से कंट्रोल की तुलना में 20 प्रतिशत अधिक उपज प्राप्त हुआ|
- खरीफ 2021 में कॉलर रोट प्रतिरोधी उन्नत किस्मों को विकसित करने के लिए दस क्रास किए गए और संकरण की सफलता दर 17.5% थी|
- ग्रीष्म 2021 (234) और खरीफ 2021 (27) के दौरान 18 क्रॉस में से स्टेम रोट और कॉलर रोट के प्रतिरोधक क्षमता वाले कुल 261 एकल पौधे हाइब्रिड की पहचान की गई है।
- खरीफ 2021 के दौरान सबसे अच्छी चेक किस्म TG 37A की तुलना में दो स्पेनिश समूह के उन्नत प्रजनन लाइन PBS 12231 और PBS 12232 की फली उपज में 39 और 55% की अधिकता प्रदर्शित की। यह खरीफ मौसम के AICRP-G स्पेनिश समूह परीक्षणों के तहत बहु-स्थान परीक्षण के लिए प्रस्तावित किया जाएगा|
- बीकानेर में 60 किग्रा P_2O_5/हेक्टेयर और 60 किग्रा K_2O/हैक्टेयर के उपयोग से गिरनार 2 की उपज में उल्लेखनीय वृद्धि दर्ज की गई|

फसल सुरक्षा

- पूरे वर्ष में थ्रिप्स और लीफहॉपर की संख्या पाई गई, लेकिन 10वें मौसम विज्ञान मानक सप्ताह के दौरान थ्रिप्स संख्या सार्थक रूप से अधिक देखी गई और रबी - ग्रीष्म के दौरान लीफहॉपर की संख्या 11वें मौसम विज्ञान मानक सप्ताह में चरम पर थी।
- थ्रिप्स की दोनों प्रजातियां, थ्रिप्स पाल्मी और फ्रैंकलिनिएला शुल्त्ज़ी ने अपना जीवन-चक्र पूरा करने में कम समय लिया और छोटे पौधों पर अधिक अंडे दिए।
- क्लोरेंट्रानिलिप्रोल 18.5 एससी @ 0.3 मिली/ली के उपचार से हेलिकोवर्पा की संख्या सबसे कम पाई गई और 2.5 लार्वा प्रति मीटर पंक्ति लंबाई में सबसे कम संख्या भी दर्ज की गई और उच्चतम फली उपज (1638.2 किलोग्राम / हेक्टेयर) भी दर्ज की गई।
- इमिडाक्लोप्रिड + स्प्रेडर्स चूसने वाले कीटों के प्रबंधन में प्रभावी पाए गए।
- ऐसफेट 50% + इमिडाक्लोप्रिड 1.8% एसपी चूसने वाले कीटों के प्रबंधन में प्रभावी पाए गए।

- एपिफाइट्स ने बेसिलस सबटिलिस 5S1, बैसिलस सबटिलिस 7S2, और बेसिलस एमाइलोलिक्विफेशियन्स 9S2 के साथ छिड़काव कर प्रयोग करने पर अल्टरनेरिया लीफ ब्लाइट को अनइनोकुलेटेड कंट्रोल में 3.0 (1-9 स्केल) के स्कोर को कम करके 2.0 कर दिया।
- ग्रीष्म 2021 के दौरान आठ क्रॉस से लीफ स्पॉट, रस्ट और अल्टरनेरिया लीफ ब्लाइट प्रतिरोधी कुल 125 संकर एकल पौधे की पहचान की गई।

बुनियादी विज्ञान

- भाकृअनुप-राष्ट्रीय पादप आनुवंशिक संसाधन ब्यूरो के साथ पंजीकृत दो CAM वेरिएंट DGRMB5 (INRG21060) और DGRMB19 (INRG 21061), लवणता प्रतिरोध के नए स्रोत हैं, जिन्हें वैकल्पिक CAM परिवर्तन के माध्यम से विकसित किया गया है|
- एंडोफाइट्स और पांच सिंचाई के उपयोग से उतनी ही फली उपज मिल सकती है, जितना अंकुरण के बाद 10 पूरक सिंचाई एवं बिना एंडोफाइट्स के उपयोग से मिलती है|
- मिनी-कोर जर्मप्लाज्म (179) में लवणता सहिष्णुता के संभावित स्रोतों के रूप में NRCG14343, NRCG 14344, NRCG14381, NRCG14424, NRCG14429, NRCG14434, NRCG14461, NRCG14468, और NRCG14485 लाइनों को पहचाना गया | जिसका परीक्षण 4.30-4.85 EC पर किया गया, जिसमें अलग-अलग स्थानों पर 6.32 से 12.56 g/plant की फली उपज दर्ज की गई|
- तीन CAM वैरिएंट अर्थात DGRMB5, DGRMB 19 और DGRMB32 ने रबी 2021 (EC 4.65) में GG7 (सर्वश्रेष्ठ चेक) और अन्य चार जीनोटाइप के अपेक्षा फली उपज में उल्लेखनीय रूप से वृद्धि (27-33%) हुई|
- गेहूँ के भूसे की मल्चिंग (10 टन/हेक्टेयर) एवं एंडोफाइट्स (बैसिलस फर्मस J22N और बैसिलस सबटिलिस REN51N) के संयोजन से एंडोफाइट्स की तुलना में मूँगफली की उपज 700 किलोग्राम/हेक्टेयर अधिक प्राप्त की गई (EC 3.89)|
- कैल्शियम क्लोराइड (@50 mM) के फोलियर अनुप्रयोग से क्लोरोफिल की मात्रा, फोटोकैमिकल अधिकतम क्वांटम उपज और पत्ती सापेक्ष पानी की मात्रा, 2 और 4 EC में मध्यम सहिष्णु (GG 7 और GG 2) की तुलना में संवेदनशील किस्मों (TG 37A और GJG 31) में बेहतर थी|
- सूक्ष्मजीवी Zn स्रोतों (FP 82 और BM 6) से मूँगफली के बीज में फाइटिक एसिड की मात्रा (10-18%) में कमी दर्ज की गई, जिसमें GJG 9 (12-23%), GG 7 (7-16%), SG 99 (8- 20%), GJG 32 (7- 22%) और Dh 86 (26-40%) में अधिकतम कमी दर्ज की गई|
- PBS 22040 और PBS 29192 में उच्च क्लोरोफिल और कैरोटीनॉयड की मात्रा, कम लिपिड पेरोक्सीडेशन और ROS स्केवेनजिंग एंजाइम की कम संचयन होती है| इसके साथ-साथ इन्हें आयरन की कमी वाले क्लोरोसिस, सहिष्णु उन्नत प्रजनन लाइनों के रूप में पहचाना गया हैं|
- फिनॉलिक्स प्रोफाइलिंग द्वारा सहिष्णु एडवांस ब्रीडिंग लाइन (PBS 22040 और PBS 29192) में रेस्वेराट्रोल (>5 पीपीएम) और फेरुलिक एसिड (>250 पीपीएम) में उल्लेखनीय वृद्धि का पता चला, जबकि अतिसंवेदनशील एडवांस ब्रीडिंग लाइन (PBS 12185 और PBS 12215) के दानों में कम रेस्वेराट्रोल (3-3.6 पीपीएम) और फेरुलिक एसिड की मात्रा (103-124 पीपीएम) दर्ज किया गया|
- मूँगफली राइजोबिया के पांच नए प्रतिस्पर्धी उपभेदों (DGR 23, DGR 24, DGR 25, DGR 26, और DGR 35) के साथ बीजोपचार के परिणामस्वरूप मूँगफली TG 37A की फली उपज में उल्लेखनीय वृद्धि हुई तथा अधिकतम DGR 26 (21.8%) के साथ प्राप्त हुआ|
- तीन कुशल Zn-सॉल्युबिलाइजिंग आइसोलेट्स (एंटरोबैक्टर क्लोएसी उप प्रजाति डिसॉल्वन्स स्ट्रेन ZM-7, एंटरोबैक्टर क्लोएसी उप प्रजाति डिसॉल्वन्स स्ट्रेन ZM-9 और एसिनेटोबैक्टर ओलिवोरन्स स्ट्रेन ZM-12) से बीजोपचार के परिणामस्वरूप फली उपज में उल्लेखनीय वृद्धि हुई|
- दो कुशल पोटैशियम-सॉल्युबिलाइजिंग आइसोलेट्स, एसिनेटोबैक्टर लैक्टुसी स्ट्रेन KM8-2 और स्यूडोमोनास ताइवानेंसिस स्ट्रेन KM-9 के साथ बीजोपचार के परिणामस्वरूप फली की उपज में

उल्लेखनीय वृद्धि हुई, तथा अधिकतम K M - 9 (17.8%) के साथ प्राप्त हुआ।

- $FeSO_4$ @ 0.5%, Ca-EDTA @ 0.5%, बोरॉन और जिंक @ 1.0% की दर से पर्ण अनुप्रयोग से अनंतपुर में कादिरी अमरावती मूँगफली की किस्म में उच्च फली उपज दर्ज किया गया।
- 50 किग्रा P_2O_5/हेक्टेयर और DGRC कल्चर के अनुप्रयोग से उच्च फली उपज (2218 किग्रा/हेक्टेयर) और पॉड फास्फोरस (12.8 किग्रा/हेक्टेयर) का उच्च अपटेक प्राप्त किया गया | केवल 2 5 किग्रा P_2O_5/हेक्टेयर की तुलना में 25 किग्रा P_2O_5/हेक्टेयर और DGRC कल्चर प्रयोग करने पर लैबाइल-फास्फोरस पूल में 47% वृद्धि देखी गई।
- 18:46:0 (50 किग्रा P_2O_5/हेक्टेयर) + DGRC + जैव उत्तेजक अनुप्रयोग के साथ उल्लेखनीय रूप से उच्च फली उपज (2304 किग्रा/हे.) और भूसा (6952 किग्रा/हे.) उपज प्राप्त की गई | केवल 18:46:0 (37.5 किग्रा P_2O_5/हेक्टेयर) के उपयोग की तुलना में, 18:46:0 (37.5 किग्रा P_2O_5/हेक्टेयर) + DGRC1 + जैव उत्तेजक का उपयोग करने से लैबाइल- फास्फोरस पूल में 61.6% की वृद्धि दर्ज किया गया।
- 50 किग्रा P_2O_5 + 40 किग्रा सल्फर + मल्च + डीजीआरसी + जैव उत्तेजक के अनुप्रयोग से अधिकतम फली उपज (2198 किग्रा / हेक्टेयर) प्राप्त की गई | सल्फर डोज में 20 से 40 किग्रा सल्फर/हेक्टेयर की वृद्धि के साथ मध्यम लैबाइल-फास्फोरस पूल में 5.8% की कमी देखी गई।
- गिरनार-2 में, जिंक की मात्रा 1 घंटे बीज भिगोने (1000 मिलीग्राम ZnSO4 / किग्रा) के बाद लगभग 2 गुना और कंट्रोल (53.6 मिलीग्राम / 100 ग्राम बीज) की तुलना में 2 घंटे भिगोने के साथ 3.5 गुना की वृद्धि देखी गई।
- मूँगफली के दानों में एस्कॉर्बिक एसिड की मात्रा, बीजों को 1 और 2 घंटे के लिए भिगोने (500 और 1000 मिलीग्राम एस्कॉर्बिक एसिड/किलोग्राम) से 2 से 3 गुना बढ़ जाता हैं।
- भुनने के बाद मूँगफली के दानों में मुक्त फैटी एसिड की मात्रा थोड़ी बढ़ जाती है।
- नियमित प्लास्टिक पैकेजिंग के तहत भुनी हुई गिरनार-2 के दानों में भंडारण के 60 दिनों के बाद अधिकतम मुक्त फैटी एसिड की मात्रा (7.77%) देखी गई।

Executive Summary

Crop Improvement

- A set of seven advanced breeding lines (PBSA 11009, 11010, 11061, 11135, 11127, 21056 and 21120) with higher yield advantages over K 1812 have been identified for AICRPG evaluation further.
- A total of 3460 germplasm accessions (562 during summer 2021 and 2898 during *kharif* 2021) comprising of both Spanish and Valencia groups were multiplied for long term storage.
- Based on CTTs harvest for two seasons (*rabi*-summer 2021 and *kharif*-2021) NRCGs 12240, 203, 99, 6133, 135, 145 and 9966 were identified with early maturity (85 days). Other accessions *viz*., NRCGs 10340, 12352, 12374, 12698, 12428, 10337, 6371, 10888, 10275, 10278, 10283, 10291, 10580, 10294, 12332, 12349, 12369, 12379, 12380, 12385, 12386, 12435, 10290, 13003, 11019, 6236 and 10569 took 90-95 days for maturity.
- NRCGs 3396, 6752,10413, 9300, 9866 and 9323 were identified as lines having high protein content (> 32 %).
- NRCGs 10340, 1108, 201, 12698, 10337, 6371, 10813, 10283, 10291, 10580, 10294, 11445, 10967, 11019, 12348 and 12377 were identified with high shelling (71-72 %) out-turn. Moreover, NRCGs 99 and 10888 had 75% shelling out-turn.
- Ten crosses were made for short duration with fresh seed dormancy during *Kharif* 2021, and 493 mature probable hybrid pods were harvested.
- Advanced breeding lines namely, PBS 15044, 16015, 16021 and 16023 were identified with more than 15 days of fresh seed dormancy.
- VRI 2, Tirupathi 3, Kadiri 6, TG 26, ICGS 1, GJG 31 of Spanish bunch; Somnath (TGS 1), Utkarsh, GG16 and GJG17 of Virginia runner; TMV 10, GG20, ICGS 5, ICGV 86325, Manjra (LGN2), TG 39, ICGV 00348, Kadiri 7, Kadiri 8, CO6, GJG 22, RG 578, Birsa groundnut 4, Raj Mungfali 3, KDG 128 and KDG 123 of Virginia bunch recorded >90% of blanchability.
- Total 300 mature crossed pods from nine crosses were obtained during *kharif*, 2021 targeting to improve the quality traits in groundnut involving seed size, oil and protein content.
- Total 190 single plants from eight crosses in F_2 generation, 309 single plants from 10 crosses in F_3, 395 single plants from 8 crosses in F_4, and 37 single plants from 7 crosses in F_6 generations were selected and advanced to next generation based on male parent characters.
- Tetraploid interspecific hybrids have been developed between cultivated groundnut and synthetic tetraploid species (*A. duranensis* x *A. khulmani*) and (*A. stenosperma* x *A. chacoence*).
- Triploid interspecific hybrids have been developed between cultivated groundnut and *A. stenosperma.*
- Stem rot resistant interspecific breeding lines showed maximum mortality between 40-60 days after germination.
- 20-25% higher disease pressure for stem rot is observed in case of artificial inoculation of fungus under controlled moisture and temperature conditions compared to that without controlled moisture and temperature conditions.
- Eight RILs, were identified with few (0-9%) pod yield reduction under imposed drought conditions.
- Eight high oleic Virginia advanced breeding

lines (HFS Nos. 116, 104, 113, 62, 120, 115, 102, and 100) have been identified with 3-26% higher pooled pod yield over GG 22. Three high oleic Spanish bunch advanced breeding lines (HFS Nos. 91, 93, and 74) recorded 2-11% higher pooled pod yield over GJG 32.

- Genotyping for *ahFAD2A* and *ahFAD2B* mutant alleles in $F_{2\text{-}3}$ progenies from four crosses (GJG 32 × Girnar 4, TG 81 × HFS 24, J 87 × HFS 24 and K1812 × HFS 62) has been completed and plants positive with homogygous *ahFAD2A* and *ahFAD2B* mutant alleles were selected.
- Thousand and thirty-four (Spanish bunch $F_{4\text{-}5}$ progenies) and 140 (Virginia $F_{4\text{-}5}$ progenies) with *ahFAD2* mutant alleles were selected from nine crosses.
- Nucleus seeds of 70.0 q and 15.0 q for high oleic groundnut cultivars (Girnar 4 and Girnar 5) were produced respectively during 2021.
- Developed and identified 110 SSR markers for fresh seed dormancy and 45 SSR markers for stem rot.
- Following introgression of *ah*FAD2 mutant alleles into GG 20, GG7, TKG 19A and TG 37A,124 high oleic advanced breeding lines have been developed. Out of these 13 lines are being promoted for seed multiplication and evaluation under AICRPG. Similarly, *ah*FAD2 mutant alleles have been introgressed into fresh 15 high yielding cultivars and 1447 lines developed and forwarded to F_3 (324) and F_6 (1123) for further selection and phenotyping.

Crop Production

- Adoption of novel SPG 1118 hydrogel at Anantapur had 30 to 40 per cent advantage in yield over farmers produce.
- Foliar application of Iron sulphate, Zinc and Boron exhibited 20 percent yield advantage over no-foliar application under rainfed conditions of Anantapur.
- Ten crosses were effected in *kharif* 2021 to develop improved varieties resistant to collar rot (with 17.5% success rate of hybridization).
- A total 261 single plant hybrids with resistance to stem rot and collar rot have been identified from 18 crosses during summer 2021 (234) and *kharif* 2021 (27).
- Two Spanish bunch advanced breeding lines, PBS12231 and PBS 12232 have been identified with 39 and 55% superiority in pod yield over the best check variety TG 37A during *kharif* 2020-2021. This is proposed for multi-locational evaluation under AICRP-G Spanish bunch during *kharif* season. Significantly higher yield in cultivar Girnar 2 was recorded with 60 kg P_2O_5/ha and 60 kg K_2O/ha at Bikaner.

Crop Protection

- Thrips and leafhopper population was found throughout the year, but one significant peaks of thrips population was observed during 10th Meteorological Standard week and leafhopper population had its peak at 11th Meteorological Standard week during *rabi*-summer.
- Both the species of thrips, *Thrips palmi* and *Frankliniella schultzei* took shorter duration to complete their life-cycle and laid more eggs on younger plants.
- *Helicoverpa* population was found lowest in the treatment of Chlorantraniliprole 18.5 SC @ 0.3 ml/l recorded lowest population of 2.5 larva per meter row length and also recorded highest pod yield (1638.2 kg/ha).
- Imidacloprid + Spreaders was found to be effective in managing sucking pests.
- Acephate 50% + Imidacloprid 1.8% SP were found effective in managing the sucking pests.
- Application of epiphytes reduced *Alternaria* leaf blight from a score of 3.0 (1-9 scale) in uninoculated control to 2.0 when sprayed with *Bacillus subtilis* 5S1, *Bacillus subtilis* 7S2, and *Bacillus amyloliquefaciens* 9S2.
- A total of 125 single plant hybrids resistant to leaf spot, rust and *Alternaria* leaf blight have been identified from eight crosses during summer 2021.

Basic Sciences

- Two CAM variants, DGRMB5 (INGR21060) and DGRMB19 (INGR21061) registered with NBPGR as novel source of resistance to salinity have been developed through facultative CAM transition.
- Application of endophytes and five irrigations could provide similar pod yield with that of 10 supplementary irrigations after emergence without endophytes.
- NRCG14343, NRCG14344, NRCG14381, NRCG14424, NRCG14429, NRCG14434, NRCG14461, NRCG14468, and NRCG14485 accessions were identified as possible sources of salinity tolerance among mini-core germplasm accessions (179) evaluated at 4.30-4.85 EC soil (with pod yield of 6.32 - 12.56 g/plant across locations).
- Three CAM variants *viz*., DGRMB 5, DGRMB 19 and DGRMB 32 significantly enhanced (27-33%) the pod yield over GG 7 (best check) and other four genotypes during summer 2021 (at soil EC 4.65).
- Wheat straw mulch (10 t/ha) in combination with endophytes (*Bacillus firmus* J22N and *B. subtilis* REN 51N) improved groundnut yield by 700 kg/ha compared to endophytes alone at EC 3.89.
- Foliar application of calcium chloride @50 mM improved chlorophyll content, photochemical maximum quantum yield and leaf relative water content in sensitive cultivars (TG 37A & GJG 31) as compared to moderately tolerant ones (GG 7 & GG 2) with 2 & 4 EC.
- A significant reduction in phytic acid content (10- 18%) in kernels of groundnut cultivars was recorded following application of microbial Zn sources (FP 82 and BM 6) with maximum reduction recorded in GJG 9 (12- 23%), GG 7 (7-16%), SG 99 (8- 20%), GJG 32 (7- 22%) and Dh 86 (26-40%).
- PBS 22040 and PBS 29192 identified and characterized as Iron deficiency chlorosis (IDC) tolerant advanced breeding lines (ABLs) with higher chlorophyll & carotenoid content, lower lipid peroxidation and lesser accumulation of ROS scavenging enzymes over the susceptible check, NRCG 7472.
- The phenolics profiling revealed significant increase in resveratrol (> 5 ppm) and ferulic acid content (> 250 ppm) in tolerant ABLs (PBS 22040 and PBS 29192) while the susceptible ABLs (PBS 12185 and PBS 12215) recorded lower resveratrol (3- 3.6 ppm) and ferulic acid content (103- 124 ppm) in kernels.
- Seed inoculation with five new competitive strains of groundnut rhizobia (DGR 23, DGR 24, DGR 25, DGR 26, and DGR 35) significantly enhanced pod yield in groundnut, TG37A, the maximum with DGR26 (21.8%).
- Seed inoculation with three efficient Zn-solubilising isolates, *Enterobacter cloacae* subsp. *dissolvens* strain ZM-7, *Enterobacter cloacae* subsp. *dissolvens* strain ZM-9 and *Acinetobacter oleivorans* strain ZM-12 increased pod yield significantly (23% with ZM-12, which was at par with ZM-7 and ZM-9).
- Seed inoculation with two efficient K-solubilising isolates, *Acinetobacter lactucae* strain KM8-2 and *Pseudomonas taiwanensis* strain KM-9 increased pod yield significantly, the maximum with KM-9 (17.8%)
- Foliar application of $FeSO_4$ at 0.5%, Ca-EDTA at 0.5% while Boron and Zinc at 1.0% recorded higher pod yield in Kadiri Amravathi variety of groundnut at Anantapur.
- Higher pod yield (2218 kg/ha) and Pod P (12.8 kg P/ha) uptake were significantly obtained with 50 kg P_2O_5/ha + DGRC culture. A 47 % increase in labile-P pool is noted when DGRC culture is applied along with 25 kg P_2O_5/ha, compared to 25 kg P_2O_5/ha alone.
- Significantly higher pod yield (2304 kg/ha) and haulm yield (6952 kg/ha) were obtained with 50 kg P_2O_5/ha + DGRC for Phosphorus + Bio-stimulants application. A 61.6% increase in labile-P pool was noted when 37.5 kg P_2O_5/ha + DGRC1 + Bio-stimulant were used, over 37.5

kg P_2O_5/ha alone.

- Maximum pod yield (2198 kg/ha) was realized with 50 kg P_2O_5 + 40 kg S + Mulch + DGRC for P+ Bio-stimulant application. Decrease of moderate labile-P pool by 5.8% was observed, with increase in S dose from 20 to 40 kg S/ha.
- In Girnar 2, Zn content in kernel was increased about 2-times after 1 hr seed soaking in 1000 mg $ZnSO_4$/ kg seeds and 3.5-times with 2 hr soaking in the above compared to control (53.6 mg/100 g seeds). Similarly, the ascorbic acid content of groundnut kernels was enhanced 2 to 3-times by seed soaking in 500 and 1000 mg ascorbic acid/kg seeds for 1 and 2 hrs.
- Free fatty acid content of groundnut kernels was slightly increased after roasting. The maximum free fatty acid content (7.77 %) was observed at 60 days after storage in roasted Girnar 2 kernels under regular plastic packaging.

Meteorological situation (2021)

The monsoon, the lifeline of the country's $3.2 trillion economy, delivers nearly 70% of rains that India needs to water farms and recharge reservoirs and aquifers. Nearly half of India's farmland, without any irrigation cover, depends on annual June-September rains to grow crops including groundnut. Since both excess and deficient rainfall event have its role on the productivity realized by our farmers, water conservation plays a key role for scaling farm productivity in both the situations.

Salient features of Monsoon 2021 in India indicated that the SW seasonal monsoon rainfall during 1st June to 30th September for the country as a whole has been normal (96 -104% of LPA) and quantitatively it has been 87.0 cm (*99% of its Long Period Average, LPA)* against long period average of 88.0 cm based on data of 1961-2010. The SW monsoon seasonal (June to September) rainfall over the four homogeneous regions is Normal over Northwest India (96%) and Central India (104%). And, it is below normal over East and Northeast India (88%) and above normal over South Peninsula India (111%). Moreover, the SW monsoon seasonal (June to September) rainfall over the monsoon core zone, which consists of most of the rainfed agriculture regions in the country, is above normal (>106% of LPA).

Out of the total 36 meteorological subdivisions, 20 subdivisions constituting 58% of the total area of the country received normal seasonal rainfall, 10 subdivisions received excess rainfall (25% of the total area) and 6 subdivisions (17% of the total area) received deficient season rainfall. These six Met. subdivisions which got deficient rainfall are *Nagaland, Manipur, Mizoram & Tripura, Assam* and *Meghalaya, Arunachal Pradesh, Jammu & Kashmir* and *Ladakh, West Uttar Pradesh* and *Lakshadweep* (Out of these six Subdivisions, three lie in NE India). Two Met Subdivisions which got much higher than normal rainfall in the season are Marathawada and Telangana. Considering month to month rainfall variation over India as a whole, the season is very uniquely placed in the historical record for its distinct and contrasting month to month variation. Thus, with regard to monthly rainfall occurrence, the rainfall over country as a whole was 110%, 93%, 76% and 135% of LPA during June, July, August and September (2021) respectively. A deep depression formed during 12-15 September, 2021 and cyclonic storm "GULAB" during 24-28 September, 2021 caused also wide spread rain both western and eastern Ghats.

These rainfall and soil characteristics did influence the overall production of *kharif* groundnut and later spring/summer groundnut in a particular agro-ecological region. Both *kharif* and summer (mostly dry) production were normal (85.56 lakh tonnes during *kharif*) except some effect by flood (during *kharif*), leaf spot and root rot etc. in some locations. Nevertheless, a record production of 102.10 lakh tonnes of groundnuts were produced during 2020-21 and higher production of 82.54 lakh tonnes was produced during *kharif* (2021-22).

1 Crop Improvement

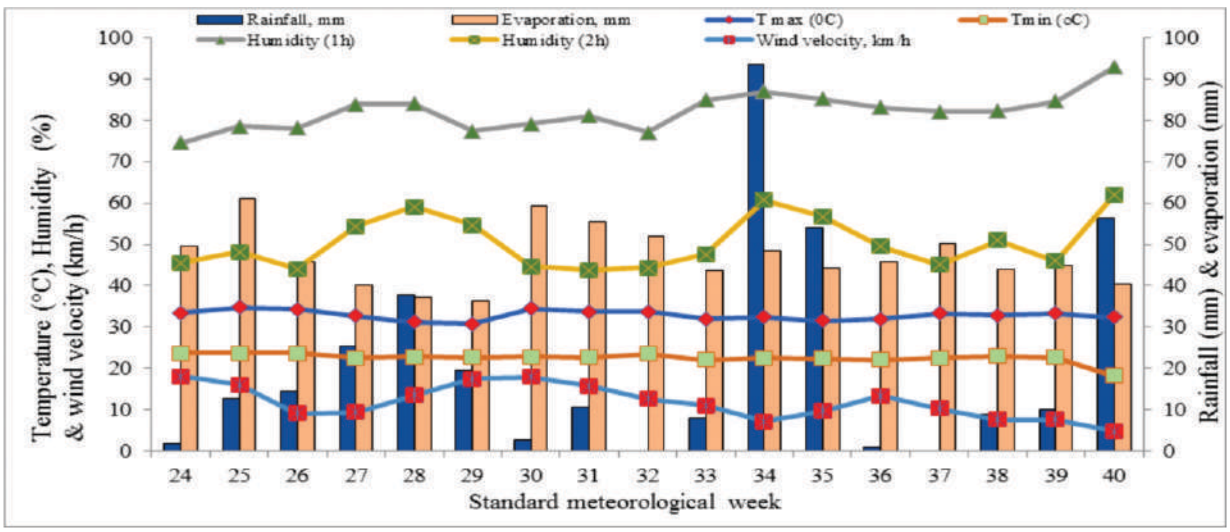
Project 1: Management of drought stress in groundnut at Anantapur and adjacent areas

PI: *Ajay BC*

Co-PI: *KK Pal, Praveen Kona, Rajanna GA and KK Reddy*

Weather conditions

The field studies were conducted during *kharif* season of 2021 at ICAR-DGR, RRS, Ananthapur, Andhra Pradesh on a red sandy loam texture soils. The mean minimum air temperature varied from 19-24°C, and the mean maximum temperature was at ~32-34°C during the entire crop growth period. An amount of ~296 mm rainfall was received during the crop growth period from July to first fortnight of October 2021. During the period of July end to second fortnight of August, and second fortnight of September, crop growth was severely affected as a result of moisture stress due to scanty rainfall and high evaporation rates under RRS, Anathapur (Andhra Pradesh) conditions.



Hybridization, selection and generation of advancement in segregating populations during *kharif* 2021

Five fresh crosses were attempted in *kharif* 2021 to enhance yield under drought stress; and more than 140 hybrid pods were harvested with 20.2% crossing success. Probable hybrid (F_1 generation) from seven crosses attempted in *kharif* 2020 were raised in summer 2021 and F_2 hybrid pods were harvested as single plants. These seven crosses in F_2 generation were raised in Anantapur under rainfed conditions during *kharif* 2021 and advanced to next generation by single seed descent method. A set of 227 single plant progenies (SPP) were advanced to F_7, 52 SPPs to F_5 and 23 SPPs to F_4 generations. Selections performed among seven crosses in F_3 generation identified 275 high yielding genotypes and selections among two crosses in F_4 generations yielded 96 high yielding genotypes. All new selections performed during *kharif* 2021 were assigned 'PBSA' numbers separately for Spanish and Virginia. From the cross Kadiri 6 x NRCG 12998 (TMV2 NLM) 40 narrow leaf segregants were identified for further advancement

Generation advancement during *rabi* 21-22

A set of 275 SPPs identified in F_3 generation and 96 SPPs identified in F_4 generation during *kharif* 2021 were raised in a plant to row progeny during post-rainy season (November 2021) at Anantapur for rapid generation advancement. At the time of harvest

(3rd week of February 2022) selections were not imposed during *rabi* 2021-22. Instead two representative pods from each plant in a row were bulked for further generation advancement.

A set of 40 Narrow leaf (NL) segregants were raised in a plant to row progeny during post-rainy season (November 2021) at Anantapur for rapid generation advancement. All the progeny rows were still segregating and hence at the time of harvest each and every plants were selected for further generation advancement. From initial 40 NL SPPs in F_4 generation, 250 fresh NL SPPs were identified for F_5 generation. Among these 250 NL SPPs in F5 NLM 41, 42 and 44 were identified as high yielders (> 30 pods). In addition, NLM 40 was identified with double collar regions and pods were observed at both these collar region.

Multiplication of promising breeding lines

Five advanced breeding lines, PBSA 11009, PBSA 11010, PBSA 11061, PBSA 21056 and PBSA 21120, were identified for AICRPG evaluation and these genotypes were mass multiplied during *rabi* 2021-22 to get sufficient seed required for AICRP-G evaluation.

NLM 40 (Double collar)

NLM 42 (Narrow Leaf and high yield)

Advanced yield evaluation

Advanced yield evaluation of 12 Spanish and 9 Virginia breeding lines were made along with K1812, and R 2001-2 as Spanish check and KadiriAnantha as virginia checks during rainy season of 2021 at Anantapur. Genotypes Jun30 and PBS 25069 had high yield compared to checks.

Pooled analysis of pod yield data of *kharif* 2020 and *kharif* 2021 indicated large genotypic variations for pod yield between seasons. Check genotypes K 1812 and KadiriAnantha recorded higher average yield among Spanish and Virginia groups, respectively. However, none of these test entries could surpass average yield of checks among both the groups.

Advanced yield evaluation of CAM transited genotypes

A set of 20 CAM transited genotypes were evaluated with three replications in row length of 5m having 5 rows with R 2001-2 and K 1812 as checks. Pooled analysis of pod yield data of *kharif* 2020 and *kharif* 2021 indicated large genotypic variations for pod yield between seasons. Check genotype K 1812 recorded higher average yield and none of the CAM transited genotypes were superior to check.

Advanced yield evaluation of inter-specific derivatives

A set of 20 interspecific derivatives were evaluated with three replications in row length of 5m having 5 rows with R 2001-2 and K 1812 as checks. Pooled analysis of pod yield data of *kharif* 2020 and *kharif* 2021 indicated large genotypic variations for pod yield between seasons. Check genotype K 1812 recorded high average yield and none of the interspecific were superior to check.

Yield evaluation trials

A set of 62 Spanish advanced breeding lines and 27 Virginia advanced breeding lines were evaluated in five-meter row with two replications during *kharif* 2020 and *kharif* 2021. For Spanish K 1812 and R 2001-2 were used as check varieties and KadiriAnantha as a check for Virginia group. Pooled analysis of yield data of both the years indicated that advanced breeding lines, PBSA 11135 (2429 kg/ha) and PBSA 11127 (2173 kg/ha) produced 22 and10% higher yield respectively over the best check, K 1812 (1983 kg/ha). Among Virginia group, PBSA 21111 (2103 kg/ha) produced 22% higher yield over the best check KadiriAnantha. The above three advanced breeding lines have been identified for advanced yield evaluation in large plots.

A set of 80 Spanish and 92 Virginia advanced breeding lines were evaluated for their yield

PBSA 11135 Elite breeding line identified for AICRPG trial

PBSA 11127 Elite breeding line identified for AICRPG trial

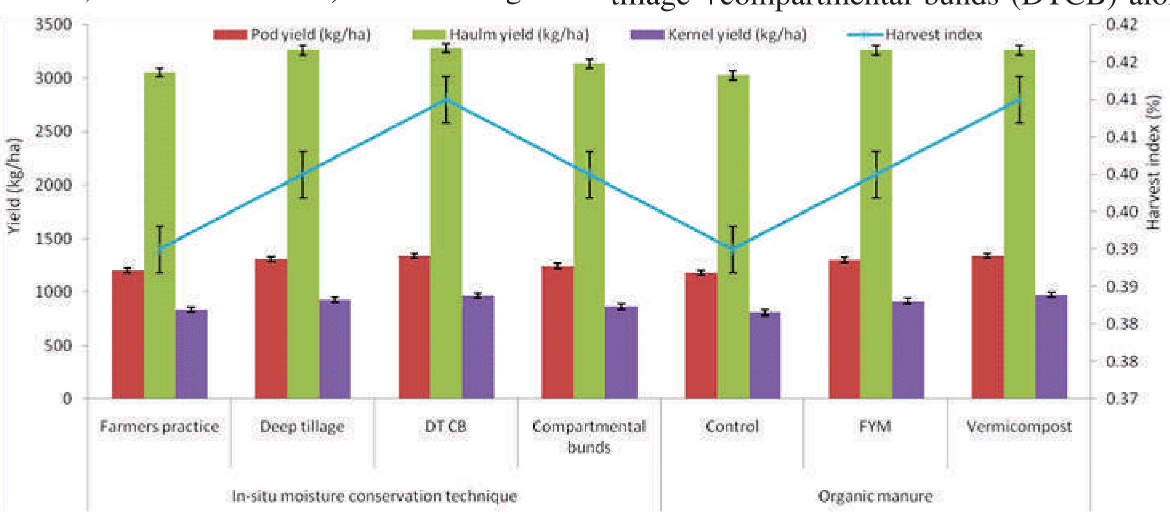
PBSA 21111 Elite breeding line identified for AICRPG trial

performance during *kharif* 2021 with K 1812 and KDG 128 as the checks, respectively. Six Spanish (PBSA 11027, 11038, 11041-1, 11047-1, 11193 and 11236) and 12 Virginia (PBSA 21006, 21010, 21015, 21019, 21022, 21031, 21031-1, 21052, 21059, 21079, 21083 and 21134) lines had higher yields in comparison to checks.

Evaluation of in-situ rainwater conservation practices and organic manures to mitigate drought in groundnut

The study was conducted during *kharif* season of 2021 at ICAR-DGR, RRS, Ananthapur, Andhra Pradesh on a red sandy loam texture soils. The experiment consisted of 4 *in-situ* moisture conservation techniques [Farmers practice, deep tillage, deep tillage+ compartmental bunds, and only compartmental bunds] in main plots with three organic manures [control, FYM and vermicompost] in sub plots was laid out in a split plot with three replications. Sowing was done on 4^{th} July 2021 using Kadari Amaravathi variety of groundnut planted at 30×10 cm (in a gross plot area of $18m^2$). Harvesting was done on 12.10.2021. The recommended rate of fertilizers used was 20:40:50 kg N:P:K/ha along with gypsum (500 kg/ha) at 25 days after sowing.

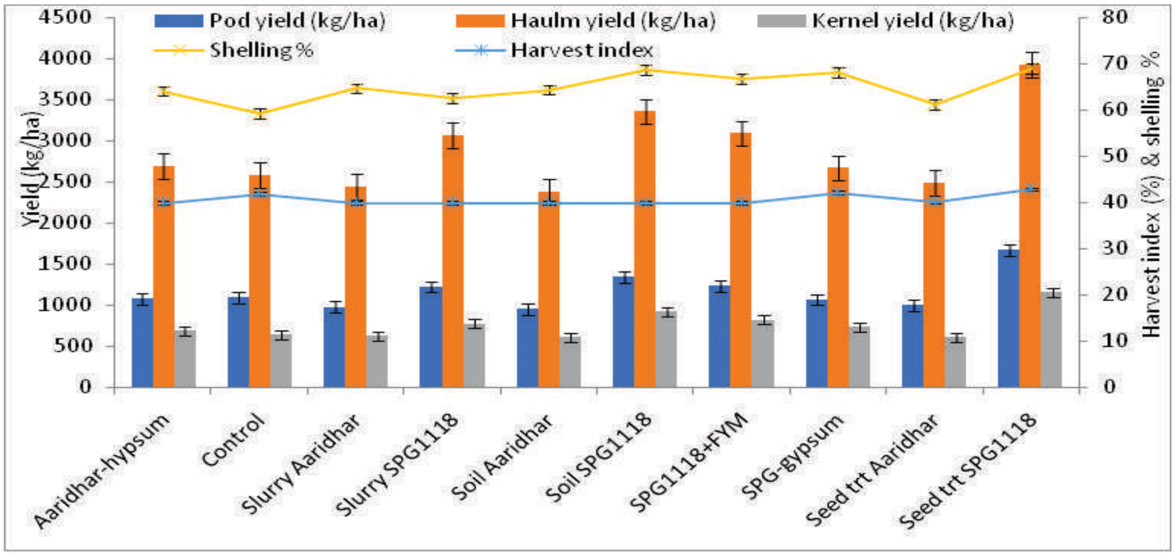
The study showed that deep tillage + compartmental bunds (DTCB) recorded significantly higher pod yield (1335 kg/ha), haulm yield (3283 kg/ha), kernel yield (968 kg/ha), shelling percentage (72.4%), 100 kernel weight (46.8g) and harvest index (0.41) as compared to other *in-situ* moisture conservation techniques. However, the above treatment was similar to deep tillage. Among organic manures, application of vermicompost @ 2 t/ha recorded significantly higher pod yield (1338 kg/ha), haulm yield (3262 kg/ha), kernel yield (973 kg/ha), shelling percentage (72.7%), 100 kernel weight (46.6g) and harvest index (0.41) as compared to others. However, it was similar to FYM at 5 t/ha.. Deep tillage +compartmental bunds (DTCB) along with



vermicompost applied plots exhibited significantly higher pod yield (1583 kg/ha), haulm yield (3710 kg/ha), kernel yield (1176 kg/ha), shelling percentage (74.3%) and 100 kernel weight (47.4 g) as compared to other interaction effects.

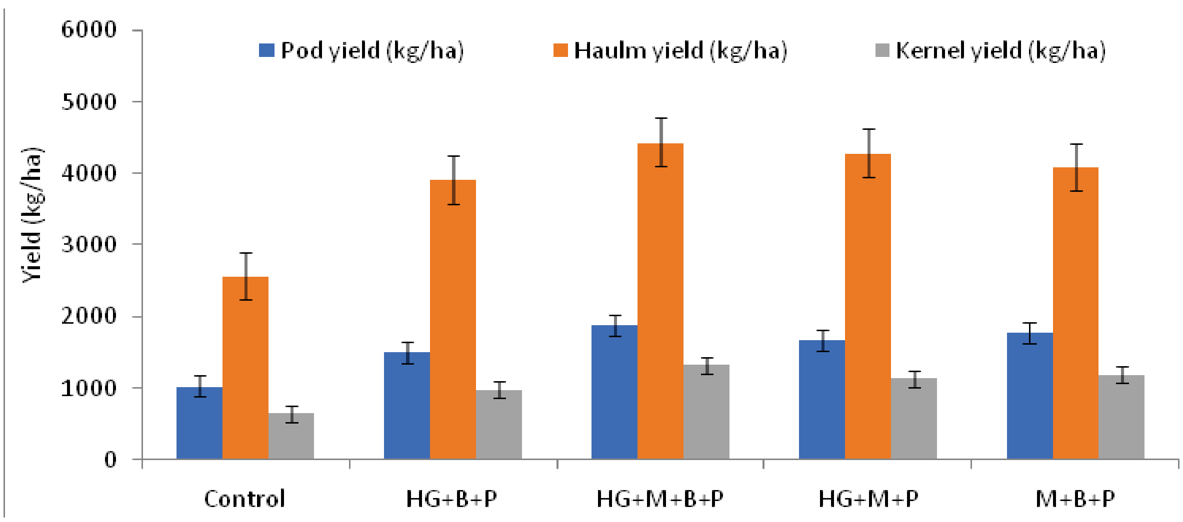
Modified agronomic practices for enhancing efficiency of hydrogels in groundnut under arid-ecologies of Andhra Pradesh

The experiment consisting of ten treatments having two types of hydrogels (SPG 1118 and Aaridhar) with three types of method of application (soil application, slurry application and seed treatment) along with FYM, no gypsum application and a control base laid out in a RBD with three replications. Sowing was done on 6th July 2021 using Kadiri Lepakshi (K1812) variety of groundnut planted at 30×10 cm in a gross plot area of 27m^2. Harvesting was done on 18.10.2021. The recommended rate of fertilizer used was 20:40:50 kg N:P:K/ha along with gypsum (500 kg/ha) at 25 days after sowing. Seed treatment with SPG-1118 hydrogel application exhibited significantly higher pod yield (1674 kg/ha), haulm yield (3920 kg/ha), kernel yield (1153 kg/ha) and shelling percentage (69.0%) as compared to control plots and other aaridhar hydrogel applied plots. However it was at par with soil application of SPG 1118 plots.



Minimizing yield losses under frequent drought situations

The experiment consisted of five treatments having control, hydrogel (aardhar)+ mulching with agrowaste + paclobutrazol (HgMP), hydrogel + endophyticbacteria + paclobutrazol (HgEbP), mulching with agrowaste + endophytic bacteria +



paclobutrazol (MEbP), and hydrogel+mulching with agrowaste+ endophytic bacteria+pycobutrazol (HgMEbP) assigned in a RBD with four replications. Sowing was done on 06th July 2021 using Kadari Lepakshi (K1812) variety of groundnut planted at 30×10 cm in a gross plot area of 27m^2. Harvesting was done on 18.10.2021. The recommended rate of fertilizer used was 20:40:50 kg NPK/ha along with gypsum (500 kg/ha) at 25 days after sowing. Application of hydrogel + mulching with agrowaste + endophytic bacteria+ pycobutrazol (HgMEbP) exhibited significantly higher pod yield (1883 kg/ha), haulm yield (4438 kg/ha), kernel yield (1326 kg/ha), shelling percentage (70.4%) and 100 kernel weight (40.2g) as compared to control. Although, it was at par with that in MEbP and HgMP.

'Habitat adapted' endophytes

The endophytic isolates obtained from Anantapur (379 new putative endophytes and 47 putative rhizobia) and rhizobia isolated from groundnut grown under extreme drought situation were purified to single colony types. Ninety endophytes were evaluated for tolerance to moisture-deficit stress using PEG gradient. While 57 of these isolates could tolerate upto -4.0 MPa, the rest 33 could tolerate upto -3.0 MPa.

Evaluation of facultative CAM transited variants for drought tolerance and yield

A total of seven variants of TG37A (DGRMB3, DGRMB5, DGRMB17, DGRMB19, DGRMB24, DGRMB31 and DGRMB32) were evaluated along with TG37A with two levels of irrigations (two at 56 and 75 days after emergence) while ten applied at regular intervals after emergence. Reduction of biomass was around 49% in TG37A with two supplementary irrigations (against normal condition). However, C3-CAM transited variants showed biomass reduction from 28-39% in similar conditions. Least reduction in biomass was obtained with DGRMB5 (**Table 1.1**).

Analysis of samples of summer 2017, 2018, 2019 and 2020 indicated the expression of CAM genes began between 25-30 days of (moisture-deficit) stress and all modules (carboxylation, decarboxylation, mesophyll succulence, and inverse stomatal behaviour) led to transition from C3 to CAM mode of photosynthesis. Variation among CAM variants was conspicuous in terms of expression of genes involved in different modules of CAM.

Endophytes for alleviation of drought stress and saving of irrigation water

To ascertain whether irrigation water can be saved by application of endophytic bacteria in summer groundnut, experiment was conducted involving five endophytes (*Bacillus firmus* J22N, *Bacillus subtilis* R51N, *Pseudomonas pseudoalcaligenes* SEN29N, *Acinetobacter junii* J20 and *Pseudoxanthomonas mexicana* REN47N) during summer 2021 with cultivar TG 37A and four different levels of irrigation (three, four, five, and 10 irrigations after

Table 1.1. Evaluation of CAM transited variants at different level of supplementary irrigation

	Haulm Yield (kg/ha)			Pod yield (kg/ha)			Biomass reduction (kg/ha)		
Treatments	2	10	**Mean**	2	10	**Mean**	Drought	Irrigated	Reduction (%)
TG37A	1927	3613	**2770**	1030	2230	**1630**	2957	5843	49.40
DGRMB17	2685	3840	**3263**	1613	2640	**2127**	4298	6480	33.67
DGRMB19	2800	3867	**3333**	1865	2842	**2353**	4665	6708	30.46
DGRMB24	2743	3695	**3219**	1818	2823	**2321**	4562	6518	30.02
DGRMB3	2333	3790	**3062**	1630	2740	**2185**	3963	6530	39.31
DGRMB31	2778	3588	**3183**	1662	2627	**2144**	4440	6215	28.56
DGRMB32	2765	3612	**3188**	1825	2767	**2296**	4590	6378	28.04
DGRMB5	2687	3533	**3110**	1787	2800	**2293**	4473	6333	29.37
Mean	**2590**	**3692**	**3141**	**1654**	**2684**	**2169**			
LSD (0.05)									
Treatments	150			100					
Level of Irrigation	79			61					
TXL	223			173					

Table 1.2. Interactive effects of irrigation and endophytes on pod yield of groundnut, TG37A during summer 2021 and saving of water

	Haulm yield (kg/ha)					Pod yield (kg/ha)				
Treatments	Supplementary Irrigations (No.)					Supplementary Irrigations (No.)				
	3	4	5	10	Mean	3	4	5	10	Mean
Control	3053	3530	3827	4307	**3679**	1392	2110	2220	2288	**2003**
REN47N	3647	3670	4020	4467	**3951**	1878	1955	2393	2498	**2181**
SEN29N	3710	3667	4053	4750	**4045**	1963	2033	2422	2543	**2240**
J20N	3973	3565	3903	4713	**4039**	1993	2030	2337	2448	**2202**
REN51N	3633	3633	4160	4693	**4030**	1845	2045	2437	2592	**2230**
J22N	3740	3850	4360	4747	**4174**	1940	1927	2445	2477	**2197**
Mean	**3626**	**3653**	**4054**	**4613**	**3986**	**1835**	**2017**	**2376**	**2474**	**2176**
LSD (0.05)										
Treatments	234					114				
Level of irrigation	143					103				
TXL	350					251				

emergence). Results indicated that application of endophytes and 5 irrigations can provide as much as pod yield with 10 supplementary irrigations after emergence without endophytes (**Table 1.2**). Inoculation of endophytes improved the pod and haulm yield of groundnut at all level of irrigations.

Application of endophytes modulated the expression of C3-CAM transition. The expression of genes of de-carboxylation modules (ppdk2, nad(p)me2, and pck1) was improved upto 1.72 folds following inoculation of endophytes over uninoculated control.

Evaluation of mini-core germplasm accessions for drought tolerance

The mini-core germplasm accessions (179) along with checks were grown (TG 37A, Dharani, ICGV 91114, GG 7, JL 501) in 5 m row with single replication. The crop was raised without any supplementary irrigation after emergence till harvest during summer 2021 with imposition of 105 days of drought and with water equivalent to 120 mm of rainfall before emergence. Only nineteen accessions viz. NRCG14472, NRCG14344, NRCG14447, NRCG14348, NRCG14470, NRCG14362, NRCG14369, NRCG14461, NRCG14501, NRCG14430, NRCG14398, NRCG14355, NRCG14425, NRCG14456, NRCG14448, NRCG14365, NRCG14419, NRCG14351, and NRCG 14324 produced 5-10 pods/plant at harvest in 3-5 plants in each accession against no bearing in the checks. Selected plants of these accessions were multiplied during *kharif* 2021 for evaluation during summer 2022 (for CAM transition and further evaluation).

Selection of mutants from CAM variants

One hundred five mutants from variegated leaf mutant populations of DGRMB5, DGRMB19, DGRMB24, and DGRMB32 were further advanced during summer and kharif 2021. These mutants are at M4-M5 stages and will be evaluated for yield under normal and drought condition during summer 2022.

Project 2: Management of groundnut genetic resources and trait specific characterization

PI: *Kirti Rani*

Co-PIs: *Harish G, Ajay BC, Sushmita Singh and Ananth Kurella*

Field maintenance of wild Arachis germplasm

A total of 72 wild accessions from six sections *viz., Arachis (12), Erectoides (6), Caulorhizae (1),Heteranthae (2), Procumbentes* (6) and *Rhizomatosae* (45) were maintained in the field gene bank. Out of these six species (*Rhizomatosae -5 Caulorhizae -1)* maintained are fodder purpose species.The seeds of annual species from wild accessions are also conserved in cold storage. The seeds of four amphidiploid derivatives (synthetic groundnut) have also been established in the field gene bank.

Large scale multiplication and conservation of germplasm accessions

A total of 562 germplasm accessions (116 accessions in Valencia group and 446 accessions in Spanish bunch) were multiplied in summer 2021. In *kharif* 2021 a total of 2898 germplasm accessions (1248 accessions in Valencia group and 1650 accessions in Spanish bunch) along with 270 germplasms from *rabi*-summer harvested crop were multiplied. The germplasm accessions that yielded low (< 40 kernels/ genotype) were further multiplied in *rabi*-summer 2022 and seeds obtained will be rejuvenated in *kharif* 2022 for long term storage. Altogether 3168 accessions were multiplied and rejuvenated to sufficient quantity, harvested, dried and cleaned for further shelling and conservation for long term storage as working collections. A total of about seven thousand five hundred (7500) groundnut accessions have been maintained in the medium cold storage module (4-5^0 C and 30 % RH) as working collection; and also a set is seperately maintained through long term storage (10-12 years).

Acquisition and distribution of germplasm accessions

From *rabi*-summer 2020-2021 and *kharif* 2021 harvest, a comprehensive list comprising 166 germplasm accessions (58 accessions in Valencia group and 58 accessions in Spanish bunch) have been prepared which had no germination in both the seasons. Along with germplasm accessions a list of 42 released varieties of groundnut from India have also been prepared which needs to be acquired from NBPGR for further multiplication in *kharif* 2022 for long term storage as working collection.

During the year, seed request from 22 indenters were received, and a total of 3812 germplasm accessions, 4 wild species, 7 fodder purpose species and 124 released varieties were shared for research purpose to the scientists of ICAR-DGR, SAUs, ICAR institutes and to the students of other institutes to identify promising lines for short duration, fresh seed dormancy, quality traits, drought tolerance, salinity tolerance, resistance to foliar diseases and insect pests and for use in hybridization programme.

Trait specific characterization of germplasm accessions

Early maturity

During *rabi*-summer 2021, a total of 184 germplasm accessions (VUL) were grown in augmented randomized complete block design with four checks (Dh 86, GG 7, TAG 24, and TAG 26). Each genotype was grown in a row of 5m length at 45 x 10 cm. The experiment was undertaken in *kharif*-2021 with 460 germplasms including 184 germplasms from *rabi*-summer 2021 for evaluation for two seasons. The Spanish buch germplasms were taken for the study as received the major thrust due to its synchronous maturity and shorter duration. The recommended agronomic practices were followed and the crop was irrigated whenever required. No fungicides/ insecticides was sprayed as the genotypes were also scored for their reaction to major foliar diseases and insect pests. The Thermal Time Concept was used as a Selection Criterion for Earliness in groundnut germplasms. In this study, the yield evaluation system was modified by harvesting the trials at predetermined CTTs (cumulative thermal time or growing day-degrees or accumulated heat units, expressed as °Cd) in a staggered harvesting system to select for high-yielding lines with acceptable levels of maturity in early harvests. The daily thermal time was accumulated each day from planting to harvest to arrive at the calculated CTTs. Maximum and Minimum temperature data for Junagadh location for past 20 years were collected. Second week of June was assumed as the planting date in the *kharif* season in all the years. Thermal time accumulation for 80, 90, 100 and 120 days after planting (DAP) was determined for every year and a mean CTT over the years was obtained for each of the assumed crop growing period. The mean CTTs so obtained were referred to as 'standard CTT's. During the same period, the number of calendar days required by the *rabi*-summer season crop to accumulate the standard CTTs, using 8th February as the planting date were calculated. The standard CTTs for 80, 90, 100 and 120 days crop growing periods (1490, 1670, 1850 and 2230°Cd, respectively) were used to predict the harvest dates for early-maturity peanut genotypes during the experimental season. Here, in the preliminary screening for early maturity, the crop was harvested at three CTTs equivalent to 80, 90, 100 DAS. From an experiment on the released short duration varieties for Gujarat standard CTTs for 85-90 days maturity duration at Junagadh location was standardized to be 1580 °Cd from two seasons(' *rabi*-summer 2021 and *kharif*-2021) experiments. The crop was harvested three times when the desired CTTs were accumulated by the crop. The observations on pod yield, seed yield, shelling %, 100 seed weight and mature/ immature seed ratio were recorded for each harvest. The data of "first harvest *vs* 90 days" and "90 days *vs* last harvest" were compared. The genotypes that showed the least differences in the observed characters were identified as early lines. Thus, based on CTTs harvest for two seasons (*rabi*-summer 2021 and *kharif* 2021), NRCGs 12240, 203, 99, 6133, 135, 145 and 9966 were identified with 85 days of maturity. Other, NRCGs 10340, 12352, 12374, 12698, 12428,10337, 6371, 10888, 10275, 10278, 10283, 10291, 10580, 10294, 12332, 12349, 12369, 12379, 12380, 12385, 12386, 12435, 10290, 13003, 11019, 6236 and 10569 had 90-95 days of maturity.

Fresh seed dormancy

During *rabi*-summer 2021, a total of 184 germplasm accessions (VUL) were grown in augmented randomized complete block design with four checks (Dh 86, GG 7, TAG 24, and TAG 26). Each genotype was grown in a row of 5m length with spacing of 45 x 10 cm. The experiment was also undertaken in *kharif*-2021 with 460 germplasms including 184 germplasms from *rabi*-summer 2021 for second season evaluation. Production and seed quality in peanut can be reduced substantially by *in- situ* germination under unpredictable rainfed environments. Prolonged seed dormancy may be undesirable but short period of dormancy or fresh seed dormancy preferably 10-15 days dormancy is required in Spanish types to avoid yield losses. Hence, exploring the sources of fresh seed dormancy in Spanish types are an important objective in groundnut. For germination test of large number of germplasms at physiological maturity stage, for 110-120 DAS the field was flodded and moisture was maintained at field capacity thereafter, after 15 days of flooding, the germplasms were uprooted (6 plants/genotype) to look for *in-situ* germination. Based on this preliminary field screening from two seasons experiment *rabi*-summer 2021 and *kharif* 2021, few germplasms *viz.,*NRCGs 203,10404, 10338, 9335, 16833, 11131, 10329, 8457, 11736, 12379,12371,12294,10981,8155,14493,12435,14308,11444,10272,10418,10281,16860,10262,10263, 10530, 9327, 14588, 10532, 145, 10419, 10397, 9866, 15870, 10569, 9478, 10403, 10277 and 10556 were selected for further germination test in the laboratory and under field conditions for 1-2 more seasons to score intensity of dormancy.

Other specific traits

Four hundred and fifteen germplasm accessions from Spanish bunch have been evaluated for oil and protein content. The oil content in these accessions ranged from 40.72 to 52.80. From the biochemical analysis of germplasms through NIR from *kharif*-2019 harvests, and further confirmation from *kharif*-2021 harvests, NRCGs 3396, 6752,10413, 9300, 9866 and 9323 were characterized with >32 % protein; and NRCGs 6677,7326, 7063, 7128 and 5239 with an average of 51 % oil content. From two seasons trial (*rabi*-summer 2021 and *kharif* 2021) from the same set of germplasms, NRCGs 10340, 1108, 201, 12698, 10337, 6371, 10813, 10283, 10291, 10580, 10294, 11445, 10967, 11019, 12348 and 12377 were identified with 71-72 % shelling outturn, while two germplasms namely, NRCGs 99 and10888 had 75% shelling outturn.

In *kharif* 2021, observations were recorded on incidence of insect pests of groundnut from 500 germplasm sown in augmentative design with five blocks and 8 checks. After analysis, 51 germplasm lines were tolerant to *Helicoverpa;* while NRCG 14643 and 12352 and 937 were highly susceptible.

Evaluation of germplasm accessions for drought tolerance

Spanish germplasm set consisting of 2500 germplasm accessions were screened for drought tolerance and yield attributes under natural rainfed conditions of Regional Research Station, ICAR-DGR Anantapur. Sowing of accessions was done on 1st week of July 2021 and harvested during 3rd week of October 2021. Drought tolerance attributes such as canopy temperature, Leaf Relative water content (Leaf RWC), Stem relative water content (Stem RWC) were recorded during pod development stage when more than 30 days of dry spell was experienced. Yield related attributes such as mature pod weight, immature pod weight, haulm yield and shelling percent were recorded at maturity. These germplasm accessions were tested against R 2001-2, KDG 128, K6, K 1812 and Dh 256. Number of germplasm accessions superior over the best check for respective characters are listed in **Table 2.1**. Among these 2500 germplasm accessions, 17 accessions recorded high mature pod weight and low immature pod weight.

Table 2.1: Evaluation of germplasm accessions for drought tolerance

S. No	Parameter	Best Check	No. of superior accessions
1	Leaf RWC	R 2001-2 (73.8%)	325 (> 75%)
2	Stem RWC	KDG 128 (84.4%)	40 (>84%)
3	Days to 50% flowering	K6 (25.5 days)	100 (<25 days)
4	Canopy temperature	Dh 256 (99.5 °C)	680 (< 99°C)
5	Mature pod weight (g/plant)	Dh 256 (7.38 g/plant)	80 (> 7.5 g/plant)
6	Immature Pod weight (g/plant)	K6 (0.3 g/plant)	100 (<0.05 g/plant)
7	Shelling percent	K6 (74%)	42 (>78%)
8	Haulm yield	K 1812 (29g/plant)	50 (>30 g/plant)
9	Harvest Index	Dh 256 (37.8%)	35 (>38%)
10	High mature pod weight (>7.4g/plant) and Low immature pod weight (< 0.3g/plant)	Dh 256	17

DUS characterization: Testing of candidate varieties of groundnut under DUS project

Three farmer varieties FV (2879/2930), Bhadai Nawa (REG/2015/958) and Moongfalla (REG/2016/2094) and one Type New (Trial Code 2877/3187) varieties received from PPV &FRA, New Delhi under different registration numbers and Trial code were sown along with eight reference varieties namely, Spanish Bunch: GG 2, SG 84, Valencia: Kopergaon 3 and Gangapuri, Virginia Bunch: GG 20, BAU 13, Punjab 1 and Somnath in 2020 *kharif* season. All the recommended practices were followed to raise a healthy crop. Observations were been recorded at appropriate growth stages as per format given by PPV & FRA, New Delhi under DUS guidelines. This includes 13 qualitative and 5 quantitative traits.

During *kharif* 2021 one Type New (Trial Code 2877/3187) variety was sown for characterization during second season with 16 reference varieties viz, GG 2, SG 84, AK 12-24, ALR 2, JL 24, TKG 19 A, TPG 41, KOPERGAON 3, GANGAPURI, MH 4, GG 20, BAU 13, ALR 1, SOMNATH and PUNJAB 1. Observations were recorded at appropriate growth stages as per format given by PPV & FRA, New Delhi under DUS guidelines which includes 13 qualitative and 5 quantitative traits, along with fresh seed dormancy. Also a set of 30 reference varieties were multiplied and rejuvenated during *kharif*-2021 namely, VUL: AK 12-24, ALR 2, GG 2, GG 3, Girnar 1, ICG(FDRS) 4, ICG (FDRS)10, JL 24 ,TG 26, Tirupati 1, TKG 19 A, ICGV 86590 and SG 84; HYB: ALR 1, BAU 13, GG 20, ICGV 86325, M 145, RS 138 and TMV 10; FST: Gangapuri and MH-4 and HYR: Chitra, CSMG 84-1, GG 11,M 13, M 335,M 37,Punjab 1 and Somnath. From two years evaluation one Type New (Trial Code 2877/3187) were characterized as distinct, uniform and stable variety.

Project No. 3: Breeding groundnut for earliness, fresh seed dormancy and confectionery types

PI: *Praveen Kona*

Co-PIs: *Kirti Rani, Narendra Kumar and Chandramohan S*

Sub-Project 1: Breading groundnut for earliness and fresh seed dormancy

Hybridization and generation advancement

Ten crosses *viz.*,TAG 24 x Gangapuri, TG 37A x Gangapuri, GJG 32 x Gangapuri, GJG 32 x VRI 3, TG37A x VRI 3, TAG 24 x ICGV 92206, TG37A x ICGV 92206, TAG 24 x K 1812 TG37A x K 1812 and TAG 24 x VRI 3 were effected for short duration and fresh seed dormancy during *kharif* 2021, and

493 mature probable hybrid pods were harvested. Further F_1s pods will be sown in *rabi*-2022 to identify true F_1 plants and will be harvested individually for further generation advancement.

One hundred and eight F_{1s} plants identified (TG 37A × TLG 45, PBS 15022 × KDG 128, TG 37A × NRCG 14380, TG 37 A × Girnar 1, TG 51 × NRCG 14380, PBS 16004 × GG 20, TAG 24 × NRCG 14380 and TAG 24 × JL 501) and harvested individually were sown in individual lines. In F_2 population, about 52 individual plants were selected from segregating lines.

A total 2511 family progenies from different crosses (**Table 3.1**) were evaluated for pod yield and days to maturity during *Kharif* 2020. Out of these, 747 SPPs have been isolated based on pod yield and short duration for further generation advancement and yield evaluation of progenies selected from F_6 onwards.

A total of 202 family progenies (F_8) from four crosses (TAG 24 x NRCG 6255 (22), TAG 24 x Girnar 1 (19), JL 24 ×NRCG 14338 (6) and JL 24 × NRCG 14368 (6) were evaluated for pod yield and days to maturity during *kharif* 2021 in separate experiments in RCBD design in three replications with 5 checks *viz.,* JL 24, TAG 24, TG 37 A, TG 26 and JL 501. A total of 26 new breeding lines *viz.,* nine ABLs (#28,44,46,47,89,63,95,120 and 164) from TAG 24×NRCG 6255; ten ABLs (#108,73, 189,134,120,136, 50, 151, 8 and 10) from TAG 24 × Girnar 1; two ABLs (#125,61) from JL 24 × N 14338 and four ABLs (#49,20,3 and 39) from JL 24 × N14368 crosses have been isolated based on pod yield and short duration for further yield evaluation.

Field evaluation of advanced breeding lines for Fresh Seed dormancy

During *kharif*-2021, a set of advanced breeding lines (PBS 15044, 16004, 16013, 16015, 16016, 16017, 16020, 16021, 16024, 16025,16026,16027,16028, 16029, 16031, 16032, 16035, 16037, 16038, 16039, 16041, 16042, 16045,16046, 16047,16051, 16052, and 16053) were field screened for fresh seed dormancy in RCBD design in three replications. Also, a set of breeding lines along with 6 checks in three replications were evaluated for pod yield during *kharif* 2021. Advanced breeding lines namely, PBS 15044, 16015, 16021 and 16023 were identified with more than 15 days fresh seed dormancy *i.e.,* 100 % intensity of dormancy upto 15 DAS. Out of these, three ABLs *viz.,* PBS 15044, 16015 and 16021 showed 100 % intensity of dormancy (25 DAS). To combine FSD with high yield, these ABLs were also evaluated for yield and related traits in three replications in RCBD design in *kharif* 2021. Among dormant lines PBS 15044 had pod yield of 9g/plant but the highest pod yield/plant was observed in PBS 15056 (>12 g/plant) and PBS 16022 (>11 g/plant), but dormancy intensity in these advanced lines was less than 60 %. Intensity of dormancy in ABLs and yield traits need to be evaluated in 2-3 seasons to identify superior lines with FSD.

Sub-project 2: Breeding for improvement in confectionery quality traits in groundnut

Effecting fresh crosses for quality traits improvement in groundnut (low oil, high protein, large seed size)

Total nine crosses were effected during *kharif* 2021 to improve the quality traits in groundnut related to seed size, oil, and protein content. A total of 300 mature crossed pods were harvested from nine crosses with a range of 21 (K1812 X GJGHPS 2) to 72 (Dh 257 X PBS 29213). The mean success rate of the hybridization programme in nine crosses was 17.53% with a range from 10.6 to 30 %. The highest success rate was observed in Girnar 2X K 1812 (30 %) and the lowest one in GJG HPS 2 X TG 37A (10.6 %) (**Table 3.2**).

Advancement of segregating generations

Segregating materials realized in previous project was carried forward. Total 168 probable F_1s selected from eight crosses during summer, 2021 were sown to generate F_2 generation during *kharif* 2021. Total 190 single plants from eight crosses in F_2 generation were selected and forwarded to next generation. Total 309 single plants from 10 crosses in F_3, 395 single plants from 8 crosses in F_4, and 37 single plants from 7 crosses in F_6 generations were selected and advanced to next generation based on male parent characters. By using single pod descent method the cross ICGV 15090 X PBS 29148 was advanced from F_4 generation to next generation to develop RIL population.

Table 3.1: Advancement of segregating generations for short duration and yield traits

Sr.No.	No	Cross	Total number of SPPs	Generation advancement	SPPs selected
F_2 to F_3					
1	1	TAG 24 x JL 501	4	F_2 to F_3	7
2	2	TG37A x TLG 45	11	F_2 to F_3	24
3	3	TAG 24 x NRCG 14380	6	F_2 to F_3	No germination
4	4	TG 51 x NRCG 14380	10	F_2 to F_3	11
5	5	TG37A x Girnar 1	27	F_2 to F_3	26
6	6	PBS 16004 x GG 20	17	F_2 to F_3	26
7	7	PBS 15022 x KDG 128	22	F_2 to F_3	22
8	8	TG 37A x PBS 12192	8	F_2 to F_3	8
9	9	GG 20 x JL 501	15	F_2 to F_3	6
10	10	GG 20 x KDG 128	15	F_2 to F_3	15
11	11	GG 20 x RM 3	16	F_2 to F_3	7
12	12	TG37A x Dh 86	3	F_2 to F_3	1
13	13	TG 37A x NRCG 14380	5	F_2 to F_3	11
14	14	JL 24 x NRCG 14368	178	F_2 to F_3	8
15	15	JL 24 x Girnar 1	161	F_2 to F_3	13
16	16	GJG 31x VRI 3	38	F_2 to F_3	45
17	17	TG37A x Dh 256	30	F_2 to F_3	6
18	18	Dh 256 x Chico	19	F_2 to F_3	No germination
19	19	GJG 31 x Girnar 3	66	F_2 to F_3	9
20	20	TAG 24 x NRCG 6255	11	F_2 to F_3	12
F_3 to F_4					
21	1	TAG 24 x TG 26	184	F_3 to F_4	16
22	2	TAG 24 x TG 34	202	F_3 to F_4	No germination
23	3	TAG 24 x TG 26	193	F_3 to F_4	89
24	4	JL 24 x NRCG 14338	88	F_3 to F_4	No germination
F_4 to F_5					
25	1	JL 24 x NRCG 14368	59	F_4 to F_5	21
26	2	TAG 24 x Girnar 1	187	F_4 to F_5	46
27	3	PBS 25033 x PM 2	192	F_4 to F_5	88
28	4	JL 24x NRCG 1338	138	F_4 to F_5	56
29	5	TAG 24 x Girnar 1	117	F_4 to F_5	43
30	6	TAG 24 x NRCG 6255	78	F_4 to F_5	15
31	7	TAG 24 x NRCG 6255	26	F_4 to F_5	18
32	8	TAG 24 x Girnar 1	50	F_4 to F_5	15
33	9	PBS 25033 x YG 51	38	F_4 to F_5	23
34	10	TAG 24 x NRCG 6255	103	F_4 to F_5	18
35	11	TAG 24 x TG 26	44	F_4 to F_5	20
36	12	PBS 24133 x PM 1	16	F_4 to F_5	4
37	13	JL 24 x NRCG 14368	6	F_4 to F_5	2
38	14	PBS 24133 x PM 1	11	F_4 to F_5	10
39	15	TAG 24 x NRCG 6255	26	F_4 to F_5	No germination
40	16	JL 24 x NRCG 14338	1	F_4 to F_5	No germination
41	17	TG 24 x Girnar 1	22	F_4 to F_5	No germination
F_6 to F_7					
43	1	TAG 24 x N 6255	43	F_6 to F_7	4
F_7 to F_8					
44	1	TAG 24 x Girnar 1	25	F_7 to F_8	2
		Total			**747 SPP**

Table 3.2: List of crosses for quality traits improvement

S. No.	Name of Cross	Purpose of cross	Buds pollinated	F_1 pods (No.)	Success rate (%)
1	TG37 A x PBS 29079 B	Large seed size	214	25	11.6
2	K1812 X GJGHPS 2	Large seed size	141	21	14.8
3	J95 X ICGV 86564	Large seed size	181	46	25.4
4	KDG 123 X K7 Bold	Large seed size	169	24	14.2
5	J11 X PBS 29146	Large seed, high protein and low oil	192	23	11.9
6	K1812 X PBS29146	Large seed, high protein and low oil	200	23	11.5
7	Dh 257 X PBS 29213	Large seed, high protein and low oil	259	72	27.8
8	GJG HPS 2 X TG 37A	Large seed size	254	27	10.6
9	Girnar 2 X K 1812	Large seed size with high yield	130	39	30.0

Evaluation of large seed advanced breeding lines for quality and yield traits

In Spanish trial, 14 ABLs were evaluated with two checks, TPG41, TKG 19A in three replications under RBD design during *kharif*, 2021. All the traits *viz*., HKW, HPW, SP, KL, pod yield per plant, oil (%) and protein (%) showed significant variation when compared to checks. Genotype, PBS19050 and PBS19042 recorded 60.6g and 58g of hundred kernel weight, respectively and found superior over best check TKG 19A (45.3 g). Genotype, PBS 19042 recorded highest SP as 67.6 % followed by PBS 19038 (66.1 %) and found superior over the best check TKG 19A (63.6 %). The kernel length varied from 1.25 cm (PBS 19042) – 1.52 cm (PBS 19038). Oil (%) varied from 42.66 % (PBS 19044) to 48.76 % (PBS 19042). Total 6 genotypes recorded >30 % of protein of which PBS 19044 recorded the highest protein content (32.44 %). PBS 19040, PBS 19042, PBS 19050, and PBS 19052 lines were found superior over the best check TKG 19A (7.37g) in terms of pod yield/plant recording >11 g/plant.

In Virginia trial, 17 ABLs along with five checks (Mallika, Girnar 2, Raj Mungphali 3, GJG HPS2 and BAU13) were evaluated under RBD design with three replications. All the traits *viz*., HKW, HPW, SP, KL, pod yield per plant, oil and protein content showed significant variation when compared to checks. Genotype, PBS 29252 recorded the highest SP as 70.3% followed by PBS 29238 (69.9%). PBS 29236, PBS 29244, and PBS 29249 recorded >60g of HKW and was superior over the best check, GJGHPS2 (50 g). The kernel length varied from 1.32 cm (PBS 29238) – 1.54 cm (PBS 29254). Oil content varied from 43.37 (PBS 29237) to 49.0% (PBS 29244) compared to the best check, BAU 13 (46.3%). Protein content varied from 27.71 (PBS 29241) – 32.64 % (PBS 29243) compared to best check, GJGHPS 2 (31.8%). PBS 29243, PBS 29247 and PBS 29248 were superior over the best check GJGHPS 2 (8.5g) in terms of pod yield/plant recording >10 g/plant.

Seed multiplication of new Advanced Breeding Lines

A total of 17 newly selected advanced breeding lines were multiplied to get sufficient seed to conduct yield evaluation trial.

Evaluation of released groundnut varieties and minicore germplasm for blanching and sucrose content

A total of 185 (102 -SB, 44 -VB, 34 -VR and 5 -Valencia) released varieties of groundnut seed materials obtained from *kharif* 2021 harvest were used for the estimation of blanchability and sucrose content. Varieties *viz*., TMV 12, ICGS 11, Pratap Mungphali 1, ALG 06-320, Dh8, DH 86, GJG 31, RG 141, TG 37A, CTMG 6, VRI 2, Tirupati 3, and Kadiri 6 of Spanish bunch recorded > 90% of blanchability. In Virginia bunch, Konkan Gaurav, Manjra (LGN 2), ICGV 00348, GG 20, ICGV 86325, CO 6, HNG 123, KDG 128 and KDG 123 recorded > 90% blanchability. In both *kharif* 2020 and *kharif* 2021, GJG 31, GG 20, Manjra, ICGV 00348, CO 6, KDG 128 and KDG 123 varieties were stable with high blanchability (>90%) while R 2001-2 was stable with low blanchability (<50%). In a minicore collection of 180 genotypes, 10 genotypes recorded >90% of blanchability. The total soluble sugars were estimated using NIR in all the genotypes. A total of 29 varieties recorded > 6% of total soluble sugars of which HNG 10 recorded the highest (7.62%) followed by MH 2 (7.1%).

Germplasm registered

PBS 29079B, a virginia runner, was registered as a novel source of high hundred kernel weight (85.36 g) in groundnut under Plant germplasm registration committee of ICAR on 24th December, 2021.


Certificate

Plant Germplasm Registration

ICAR

It is certified that germplasm PBS 29079B of Groundnut (INGR21229) developed by
Kona Praveen, Gangadhara K., Ajay BC, Narendra Kumar, SK Bera, AL Rathnakumar, Radhakrishnan T, Kirti Rani, Dagla MC, Hariprasanna K, Manivel P, Mathur RK, Chuni Lal and HK Gor
ICAR-Directorate of Groundnut Research, Junagadh, Gujarat
has been registered by Plant Germplasm Registration Committee (PGRC) of Indian Council of Agricultural Research on December 24, 2021.

Member-Secretary
PGRC

Chairman, PGRC
DDG (CS) ICAR

Old project: Breeding Groundnut for Paddy and Potato Cropping systems

PI: *Kirti Rani*

Co-PIs: *K. K. Pal, M.V. Nataraja and K.K. Reddy*

Duration: January 2021 to May 2021

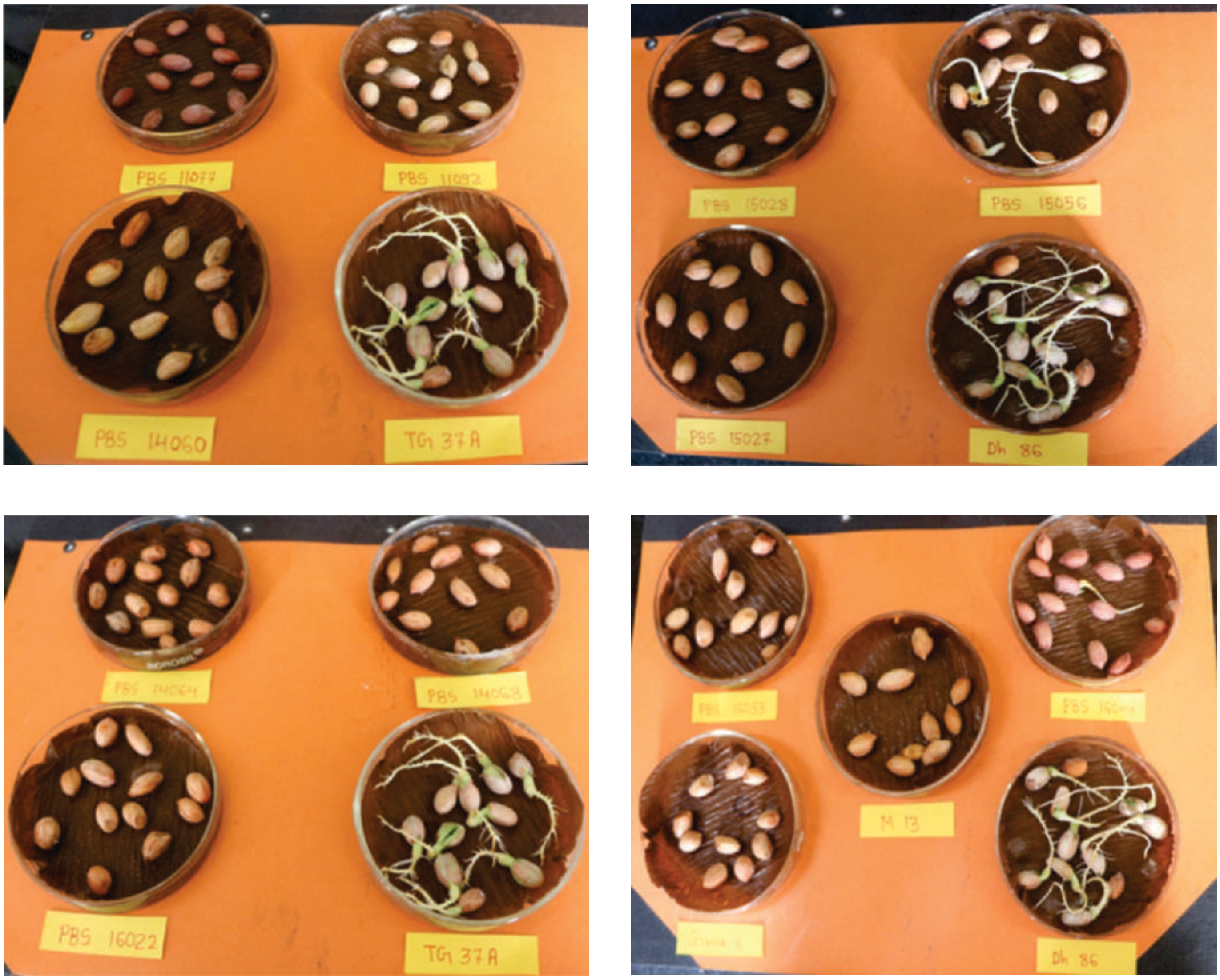
Evaluation of advanced breeding lines for Fresh Seed Dormancy and yield traits

In this study, a set of fourteen Spanish advanced breeding lines (ABLs) of groundnut genotypes *viz.*, PBS11077, PBS 11092, PBS 14060, PBS 14064, PBS 14068, PBS 15014, PBS 15022, PBS 15027, PBS 15028, PBS 15056, PBS 16022, PBS 16023, PBS 16033 and PBS 16044 were evaluated for fresh seed dormancy, yield and its component traits such as SMK (%), hundred pod and kernel weight in *rabi*-summer 2021 along with released varieties *viz.*, TAG 24, Dh 86, Girnar 3 and TG 37A as checks. Field trials were laid out in randomized complete block designs (RCBD) with three replications. To study fresh seed dormancy, a sample of mature pods were randomly selected and shelled immediately after harvesting of groundnut. Precaution was taken to prevent any damage of the testa, cotyledons and embryo while removing seeds from pods. The mean pod moisture content of *rabi*-summer harvested produce was 38 %.

Laboratory tests

To assess fresh seed dormancy in laboratory, freshly harvested pods were dried for 1-2 days and mature seeds (30 no.) from test genotypes were placed on germination paper in petri plates and regularly watered (**Fig 3.1**). The data on number of seeds germinated were recorded at weekly interval for up to three weeks. The seeds were surface sterilized before keeping them for germination to prevent possible fungal infections. When seeds don't germinate they tend to decay after a week. Therefore, after first and second week, new set of seeds were kept for germination from the same seed lot. Percent germination was calculated and the genotypes which showed dormancy for a period of two weeks or more

Fig 3.1. Laboratory tests for fresh seed dormancy



were selected.

Field tests

To further validate the laboratory tests, freshly harvested pods from *rabi*-summer season 2021 were used for germination tests. Seeds from fresh pods were treated with carbendazim (3g/kg of seed) to protect from soil-borne diseases. A total of fourteen groundnut genotypes were evaluated during summer 2021 at ICAR-Directorate of Groundnut Research, Junagadh, Gujarat, India (Lat. 21°31' N, Long. 70°36' E) in medium black calcareous soil. The data of maximum and minimum temperature (°C), relative humidity (%) and solar radiation (W/m^2) during the observation period was recorded. The experiment was laid out in a randomized complete block design with three replications. Each replication consisted of 50 freshly harvested seeds sown at a depth of 2 to 3 cm at 45x10 cm spacing (**Fig. 3.2**). The soil moisture was maintained at field capacity during the growth period up to 35 days after sowing (DAS). The observations were recorded on number of seeds germinated at weekly interval until the end of experiment.

Fig 3.2. Field screening for fresh seed dormancy

Mean performance and pooled analysis of variance

Mean performance of different genotypes for pod yield per plant (g), hundred pod weight (HPW), hundred kernel weight (HKW), and sound mature kernels (SMK) across environments is shown in **Table 3.3**. Grand mean for pod yield per plant of genotypes across seasons ranged from 11.2 g for PBS 11077 to 5.1 g in PBS 16044, with 6.8, 7.0, 7.1 and 8.7 g, respectively in high yielding checks *viz*., Dh 86, TAG 24, Girnar 3 and TG 37A. Other superior genotypes identified for higher pod yield comparative to superior checks were PBS 15056 (9.0 g) and PBS 15014 (8.3 g). The grand mean values for HPW was 81 g in PBS 16023, 79 g from PBS 14064 and 78 g in PBS 16022 and PBS 11077 compared to 74 g in check, TG 37A.The grand mean values for HKW was highest in PBS 14064 (37.4 g), followed by PBS 11077 (36.7 g), PBS 16033 (35.9 g) and PBS 14060 (35.8 g), while the checks TAG 24 and TG 37A had 34.9 and 32.9 g HKW, respectively. Further, percentage of sound mature kernels was 61, 60, 59 and 57, respectively in TG 37A, Dh 86, PBS 14064 and PBS 16022.

Intensity of fresh seed dormancy

Intensity of dormancy is defined as the percentage of seeds not germinated even after specified period of time after the harvest. From practical point of view, high intensity of dormancy for 2-3 weeks is very important. The grand mean values for intensity of dormancy ranged from 11% in TG 37A to 100 % PBS 15014 and PBS 14060 over the seasons during 2019-2021 at 7 DAS. Further, other ABLs namely, PBS 15014 (100 %), PBS 14060 (100 %), PBS 15028 (99 %), PBS 14064 (98 %), PBS 14068 (97 %), PBS 11077 (96 %), PBS 11092 (95 %), PBS 16023 (95 %), and PBS 15022 (95 %) were reported with 96 % of dormancy for Girnar 3 as check. Further from the pooled mean data at 21 DAS, PBS 14068 with 96 % and PBS 11077 with 95 % average intensity of dormancy, and PBS 14060 and PBS 15014 each with 92 % average intensity of dormancy

Table 3.3: The grand mean for Pod yield/plant, Hundred pod weight (HPW), Hundred kernel weight (HKW), Sound mature kernels (SMKs) and Fresh seed dormancy for 19 genotypes across five seasons for yield traits and four seasons for fresh seed dormancy

Genotypes	Pod yield/plant (g)	Hundred pod weight (HPW) (g)	Hundred kernel weight (HKW)(g)	Sound mature kernels (SMKs) (%)	Intensity of fresh seed dormancy (21 DAS)
Dh 86	6.8	62	29.9	60	18
Girnar 3	7.1	56	26.5	50	91
PBS 11077	11.2	78	36.7	51	95
PBS 11092	6.2	63	29.6	56	87
PBS 14060	7.5	75	35.8	50	92
PBS 14064	7.5	79	37.4	59	90
PBS 14068	7.1	71	32.8	49	96
PBS 15014	8.3	60	27.1	49	92
PBS 15022	6.5	56	27.9	56	82
PBS 15027	5.4	62	29.5	52	83
PBS 15028	5.8	70	29.9	52	85
PBS 15056	9.0	72	30.8	56	70
PBS 16022	7.9	78	33.6	57	81
PBS 16023	7.0	81	32.4	51	86
PBS 16033	7.9	73	35.9	54	80
PBS 16044	5.1	69	29.7	54	86
M13	6.4	75	33.8	58	85
TAG 24	7.0	73	34.9	55	34
TG 37A	8.7	74	32.9	61	11

*DAS: Days after sowing

Yield trials (5 seasons) for *kharif* 2019 and 2022, *rabi*/summer 2019, 2020 and 2021 and FSD trials (4 seasons) for *kharif* 2019 and 2020, *rabi*/summer 2020 and 2021 were most desirable compared to the dormant check, Girnar 3 (91%) and three high yielding but non-dormant varieties *viz*., TG 37A, Dh 86 and TAG 24 (11-34 %) (**Table 3.3**).

Field evaluation of advanced breeding lines identified for Fresh Seed dormancy

During *rabi* 2021, a set of advanced breeding lines (PBS 15044, 16004,16013, 16015, 16016,16017,16020, 16021, 16024, 16025,16026,16027,16028,16029, 16031,16032, 16035, 16037, 16038,16039,16041, 16042, 16045,16046, 16047,16051, 16052, and 16053) were field screened for fresh seed dormancy. Also, a set of breeding lines along with 6 checks in three replications were evaluated for pod yield during *rabi* 2021. Some of the advanced breeding lines *viz*., PBS 15044, 15056, 16004, 16015,16021, 16023, 16027, 16028 and 16039 for high pod yield were identified with more than 15 days fresh seed dormancy.

Evaluation of advanced breeding lines in Junagadh and Deesa for maturity and pod yield

Twenty two advanced breeding lines from the cross TAG 24 x NRCG 6255 along with five checks (JL 24, TG 26, GG 7, Dh 86 and JL 501) and 19 advanced breeding lines from cross TAG 24 x Girnar-1 along with five checks (JL 24, TG 26, GG 7, Dh 86 and JL 501) were evaluated as two separate experiments in Potato fallows at Deesa and Junagadh (Gujarat) in three replications during *rabi* summer 2021. Based on pooled data a total of 26 new breeding lines *viz.*, fifteen ABLs (8, 28, 42, 44, 46, 47, 89, 95, 42, 70, 73, 28,119, 120 and 164) from TAG 24 x NRCG 6255; fourteen ABLs (120, 125, 134, 136, 189, 8, 10, 50, 108, 73, 151, 176,148 and 182) from TAG 24 x Girnar1; have been isolated based on pod yield and short duration for further large scale yield evaluation.

Hybridization and generation advancement

F_1s from eight crosses (TG 37A × TLG 45,PBS 15022 × KDG 128, TG 37A × NRCG 14380, TG 37 A × Girnar 1, TG 51 × NRCG 14380, PBS 16004 × GG 20, TAG 24 × NRCG 14380 and TAG 24 × JL 501) generated during *kharif* 2020, were raised along with their parents during *rabi*-summer 2021 and total of 108 F_{1s} plants were selected and harvested individually for further generation advancement.

Project 4: Development of groundnut pre-breeding materials for biotic and abiotic stresses and quality traits

PI: *SK Bera*

Co-PI: *Narendra Kumar, Kirti Rani and Chandramohan S*

Development of Interspecific hybrids

In *kharif* 2020 four interspecific crosses *viz*., J11 x NRCG 17261 (*A. duranensis* x *A. khulmani*), J 11 x *A. stenosperma* (NRCG-14863), J 11 x NRCG 17262 (*A. stenosperma* x *A. chacoence*) and J11 x *A. stenosperma* (NRCG 14867) were attempted. Probable cross pods were planted in *kharif* 2021 in the field. Confirmed 10, 5 and 4 F_1 plants were identified in J11 x NRCG 17261 (*A. duranensis* x *A. khulmani*), J 11 x *A. stenosperma* (NRCG-14863) and J 11 x NRCG 17262 (*A. stenosperma* x *A. chacoense*) respectively. However, no confirmed F_1 plant could be identified in cross J11 x *A. stenosperma* (NRCG 14867). At harvest pods were harvested from J11 x NRCG 17261 (*A. duranensis* x *A. khulmani*) and J 11 x NRCG 17262 (*A. stenosperma* x *A. chacoense*). However, F_1 plants of J11 x *A. stenosperma* (NRCG 14867) were sterile though plants produced profuse flowering due to ploidy difference between parents. The sterile F_1 plants were triploid, hence produced sterile flower. In the other hand 334 and 118 pods, respectively were harvested from 10 plants of J11 x NRCG 17261 (*A. duranensis* x *A. khulmani*) and 4 plants of J 11 x NRCG 17262 (*A. stenosperma* x *A. chacoence*).

In a separate experiment, interspecific F_{1-2} pod from two crosses were exposed to EMS treatment aiming at more recombination, major insertion or deletion mutation. From both crosses 3 and 39 pods, respectively were harvested. All inter-specific progenies will be planted in *kharif* 2022 for further characterization and advancement.

Screening for optimum stage of resistance to stem rot

Artificial screening for resistance to stem rot was conducted at different stages of crop in summer 2021. The experiment was conducted to know the stage of crop expressing maximum resistance level. Three resistant and two susceptible genotypes were planted in RBD with three replications. Plants were inoculated at three stages, immediate after sowing, 40 days after sowing and 60 days after sowing. TG 37A, a highly susceptible genotype recorded 92-100% mortality in all three stages of screening, while GG 20 recorded comparatively less mortality during sowing and maximum during both 40DAS and 60 DAS. Similarly, CS 19, CS 319 and PBS18307 recorded less mortality during germination stage, while it reached maximum in both 40 DAS and 60 DAS. CS 19 could be more resistant during germination stage as it showed minimum mortality at this stage compared to all other genotypes. Results will be confirmed next season.

Screening of interspecific derivatives for resistance to stem rot

Interspecific breeding lines were screened for resistance to stem rot disease under artificially inoculated conditions during summer 2021. Hundred and ninety-five advanced breeding lines were planted with checks in RBD with three replications. Each line was planted in a row of two-meter length. Artificial inoculation was done after 40 DAS and mortality per cent was recorded at 15 days after inoculation. Mortality ranged from 65 to 100 per cent. Among check PBS 18037 recorded the lowest mortality percent (88%). Among breeding lines three lines (19, 16 and 118) were found promising with 65% to 68% average mortality.

Screening of RIL for resistance to stem rot

Three hundred and twenty RILs were screened for stem rot resistance under artificially inoculated field conditions during *kharif* 2021. Screening was done in two replications. Each RIL was sown in one line of two-meter bed. Inoculation of *S. rolfsii* was done at 40 DAS following protocol standardized at ICAR-DGR. Mortality percent ranged from 0-100 among RILs.

The same set of RILs were simultaneously screened following protocol standardized at ICAR-DGR but without covering of polythene on the crop, while other conditions remained same. Mortality percent ranged from 0-100 among RILs. RILs sowing mortality less than 20% will be confirmed further.

Comparison of methods of phenotyping for stem rot incidence

Screening of genotypes for resistance to stem rot was done using different methods under field conditions during summer 2021. In first method, only inoculation of fungus was done at 40 DAS under natural temperature and humidity, while in second method, inoculation of fungus was done at 40 DAS and temperature as well as humidity was maintained artificially. Sufficient soil moisture was maintained in both the methods. Mortality per cent was recorded after 15 days of inoculation in both the screening methods. It was observed that 13-20% less mortality was there in first method compared to second one. Thus, damage by *S. rolfsii* will be more under favourable climatic conditions.

Screening of RILs for tolerance to drought

Hundred and forty-four RILs of ICGV 4747 and TMV 2 NLM were screened for tolerance to drought during summer season. RILs were sown under fully irrigated and imposed drought conditions. Drought was imposed by skipping alternate irrigation from 60 DAS. Experiment was sown in augmented design with checks. Each RIL was sown in one row of three-meter length. Reduction in yield in RILs was calculated at harvest due to imposition of drought. Among checks TG37A recorded lowest reduction (8%) in yield and TAG 24 recorded maximum yield reduction (38%). Eight RILs recorded 0-9% reduction in yield.

Yield evaluation of selected ABLs

Advanced breeding lines along with checks were evaluated for yield during summer 2021. Experiment was sown in RBD with three replications. Each genotype was sown in five rows of five-meter length. Pod yield was recorded at harvest. Among checks GG 22 recorded the highest pod yield (1020 g/100 plants). None of the genotypes recorded significantly higher pod yield than GG 20. However, six genotypes recorded pod yield at par with that in GG22. The experiment was repeated in *kharif* 2021. None of the genotypes was found superior over check.

Project 5: Genetic enhancement of groundnut through genome editing and molecular approaches

PI: *Chandramohan S*

Co-PI: *SK Bera and Papa Rao Vaikuntapu*

Yield evaluation of selected high oleic Virginia Bunch (VB) lines

Eighty eight high oleic VB lines were evaluated for pod yield in summer 2020, *kharif* 20 and summer 2021 in an augmented design. Each genotype was planted in three rows of five-meter length during all three seasons. Recommended crop management practices were followed to raise an healthy crop. Among checks, GG 22 recorded the highest pooled pod yield. Eight high oleic lines (HFS Nos. 116, 104, 113, 62, 120, 115, 102, and 100) recorded 3-26% higher pooled pod yield over GG 22.

Yield evaluation of selected high oleic Spanish Bunch (SB) lines

Thirty six high oleic SB lines were evaluated for pod yield in summer 2020, *kharif* 2020 and summer 2021 in an augmented design. Each genotype was planted in three rows of five-meter length during all three seasons. Recommended crop management practices were followed to raise healthy crop. Among checks, GJG 32 recorded the highest pooled pod yield. Three high oleic lines (HFS Nos. 91, 93, and 74) recorded 2-11% higher pooled pod yield over GJG 32.

Genotyping of F_1 progenies for ahFAD2a and ahFAD2b mutant alleles

Crosses were made during *kharif* 2020 season to introgress *ahFAD2* mutant alleles, associated with high oleic content in the Spanish bunch high yielding background. A total of 639 F_1 plants from five crosses were genotyped for presence of *ahFAD2* mutant alleles and other associated SSR markers in summer 2021. A total of 22 plants were identified with desirable alleles.

Advancement of segregating progenies with ahfad2 mutant alleles

Selected F_{2-3} single plant progenies (1258 nos.) of 10 crosses (DH 257 × ICGV 15080, JL 501 × ICGV 15080, CS 25-7-39 × Girnar 4, K 6 × Girnar 4, KDG 128 × Girnar 4, TG 51 × ICGV 15080, Girnar 2 × Girnar 4, SG 99 × Girnar 4, GG 20 × BC_1F_2 (GG 20 × SunOleic 95R), and BC_1F_2 (TG37A × SunOleic 95R) with *ahfad2* mutant alleles were planted for generation advancement during summer 2021. All these were harvested for further advancement.

Hybridization

During *kharif* 2021, 18 crosses were made in net house conditions. Maximum number of flowers were pollinated in the cross SG 99 × HFS 22 and minimum number of flowers were pollinated in the cross NRCGCS 644 × HFS 22. Probable cross pods were collected at harvest. Similarly, maximum number of kernels were obtained in the cross GJG 32 × HFS 22, while minimum number of kernels were harvested in the cross JL 776 × HFS 22.

Genotyping of F_{2-3} plants for ahFAD2 mutant alleles associated for high oleic content

F_{2-3} progenies from four crosses, GJG 32 × Girnar 4, TG 81 × HFS 24, J 87 × HFS 24 and K1812 × HFS 62 were planted during *kharif* 2021 for genotyping and advancement. Thirty-eight, 26, 86 and 99 single plants from GJG 32 × Girnar 4, TG 81 × HFS 24, J 87 × HFS 24 and K1812 × HFS 62, respectively were genotyped for *ahFAD2a* and *ahFAD2b* mutant alleles. Plants positive with homogygous *ahFAD2*a and *ahFAD2b* mutant alleles were selected. Pod weight per plant of selected plants ranged 53-6 g, 31-2 g, 46-3 g and 75-6 g in GJG 32 × Girnar 4, TG 81 × HFS 24, J 87 × HFS 24 and K1812 × HFS 62, respectively.

Advancement of segregating progenies (F_{2-3}) developed for increasing oil content

High yielding groundnut variety, 'GJG 32' with 53% oil content was crossed with a novel advanced breeding line, 'HOS 89' with 57% oil content to increase the oil content in GJG 32. Single plant progenies (69 nos) were advanced to F_3 generation during *kharif* 2021. Pod yield and shelling percent ranged 3-62 g per plant and 44-80%, respectively in these lines.

Advancement of progenies (F_{4-5}) developed for increasing oleic content

Thousand and thirty-four Spanish bunch progenies with *ahFAD2* mutant alleles were selected from nine crosses (DH 257 × ICGV 15080, JL 501 × ICGV 15080, CS 25-7-39 × Girnar 4, K 6 × Girnar 4, KDG 128 × Girnar 4, TG 51 × ICGV 15080, Girnar 2 × Girnar 4, SG 99 × Girnar 4, GG 20 × BC_1F_2 of GG 20 × SunOleic 95R and TG 37A × BC_1F_2 of TG 37A ×

SunOleic 95R). These lines were advanced to F_4-$_5$ generation and selection was done at harvest during *kharif* 2021. Pod yield of these 1034 Spanish bunch lines was compared with the best check, GJG 32 (297 g /20 plants); and 111 lines were found with higher pod yield than GJG 32. Shelling percent and 100-kernel weight ranged from 48-78% and 18-38 g in these promising lines.

Similarly, 140 Virginia progenies with *ahFAD2* mutant alleles were selected from nine crosses (DH-257 × ICGV 15080, JL 501 × ICGV 15080, CS 25-7-39 × Girnar 4, K-6 × Girnar 4, KDG 128 × Girnar 4, TG 51 × ICGV 15080, Girnar 2 × Girnar 4, SG 99 × Girnar 4, GG 20 × BC_1F_2 of GG 20 × SunOleic95R and TG 37A × BC_1F_2 of TG 37A × SunOleic95R). These lines were advanced to F_4-$_5$generation and selection was done at harvest during *kharif* 2021. Pod yield of these 140 Virginia lines was compared with best check, KDG 123 (254 g /20 plants); and 34 lines were found with higher pod yield than KDG 123. Shelling percent ranged from 61-77%, while 100-kernel weight ranged from 22-44 g in these promising lines.

Screening of high oleic advanced breeding lines for foliar diseases

High oleic advanced breeding lines containing 78-80% oleic acid content were evaluated against late leaf spot (LLS) and rust under natural field conditions along with susceptible checks during *kharif* 2021. Disease scoring was done at 90 days after sowing. Scoring for LLS and rust in susceptible check were 8 and 5, respectively, while LLS and rust scoring ranged from 1-7 and 0-3, respectively in 111 high oleic lines. A few high oleic advanced lines were found resistant to LLS and rust which need further confirmation.

Seed multiplication of advanced breeding lines (ABLs) and submission for AICRPG testing

Seeds of five high oil and high oleic content ABLs were planted for multiplication during summer season. However, more than 50 kg of pods in single genotype, HOS 724, was produced. Similarly, fifteen selected advanced breeding lines (ABLs) were multiplied for seed production in *kharif* 2021. Lines with sufficient pods will be submitted to AICRPG for multilocational evaluation.

Testing of advanced breeding lines for AICRPG testing

HOS-724, a high yielding and high oil content advanced breeding line, was submitted to AICRPG for multilocational evaluation duirng *kharif* 2021.

Multiplication of Nucleus seed of high oleic groundnut varieties

Nucleus seeds of 570 kg and 109 kg for Girnar 4 and Girnar 5, respectively were produced during summer 2021. Similarly, nucleus seeds of 65.0 q and 14.0 q for Girnar 4 and Girnar 5, respectively were produced during *kharif* 2021.

Screening of Transgenic groundnut expressing defensin gene for aflatoxin resistance

Regeneration of transgenic groundnut

For transgenic groundnut containing GBNV gene, 741 lines were sown and out of which 502 lines germinated. For transgenic groundnut containing Mtld gene, 655 lines were sown and 633 lines germinated. For transgenic groundnut containing ZFN gene, 281 lines were sown and out of which 218 lines germinated. For transgenic groundnut containing Cry1-f gene, 409 lines was sown and out of which 314 lines germinated. For transgenic groundnut containing PSNV gene, 348 lines were sown and out of which 237 lines germinated. For transgenic groundnut containing defensin gene, 153 lines were sown out of which 106 lines germinated. The harvested produce was packed and kept in cold storage for future use.

Screening of Transgenic groundnut expressing defensin gene

Transgenic groundnut plants containing fusion defensin genes developed at ICAR-DGR was used to screen for aflatoxin resistance. In this process, initially 500 plants consisting of 29 lines were used to screen using gene specific marker (defensin gene) and none of the samples were found to be positive. The transgenic groundnut containing the fusion defensin gene was again screened using newly synthesized primers. This was done in batches and various combinations of primers and antibiotic markers. The first two sets were genotyped using gene specific primer and antibiotic marker. In the first set 23 lines consisting of 423 plants were used for screening using gene specific markers (IDT 628-F& IDT 1029-R) and tested positive in all samples including negative and positive control and water also. Similarly in the second set 75 lines consisting of 310 plants were used for screening using antibiotic marker (npt-II) and tested positive in all samples including negative and positive control and water also.

In the third set 55 lines consisting of 55 plants were used for screening using newly synthesized primers (Tfgd2-F & RsAFP2-R) and tested negative in all samples and amplification was found in positive control only. In the fourth set 75 lines consisting of 310 plants were used for screening using gene specific marker (Tfgd2-F & RsAFP2-R)and none were found positive and amplification was observed in positive control only. In the fifth set 55 Lines consisting of 55 plants were used for screening using gene specific marker (SynDEF1-F & SynDEF-1 R and SynDEF2-F & SynDEF-2 R) and none were found positive and amplification was observed in positive control only.

Mining of SSR markers for fresh seed dormancy

Mining of SSR markers for fresh seed dormancy was done using the genomic information from A09 and B05 chromosomes. A total of 110 SSR markers were identified from A09 and 275 SSR identified from B05 chromosome. Total of 96 Spanish varieties were taken for genotyping using newly developed markers for fresh seed dormancy (**Table 5.1**). Genotyping of all the SSR markers are completed and scoring/ data analysis are in progress.

Mining of SSR markers for stem rot resistance

Mining of SSR markers for stem rot resistance was done using the genomic information from Dodia *et al*. 2019 and Lou *et al*. 2020. A total of 55 SSR markers were identified. Total of 50 varieties were taken for genotyping using newly developed markers for stem rot resistance (**Table 5.2**). Genotyping for 5 primers completed.

Microbial management of major foliar fungal diseases of groundnut and Variability analysis in pathogens

Hybrid identification for the cross TG 37A x RHRG 06083 was undertaken. 148 seeds were sown in the glass house and out of which 112 F_1 plants were found to be positive.

Identification of homozygous double mutant for AhFAD2 gene in F_2 population of cross GJG 22 X Sunoleic 95R

A total of 100 F_2 seeds were sown in glass house and 87 plants germinated. DNA isolation was carried out in all the 87 samples. PCR assay was carried out by using allele specific markers. Out of 87, 38 plants were identified as positive.

Table 5.1: List of varieties used for screening SSR markers

Varieties (96 No.)
JGN 3, VRI 4, JGN 23. JCG 88. TLG 45, GJG 32, CO 1, LGN 1, Dharni, GJG 9, GJG 6, TMV 7, CO 2, ICG 511, GG 3, JL 220, TG 37A, ICGV 91114, VRI 2, SB 11, Pratap mungphali 1, ALR-2, Kisan, GJG 31, AK 12-24, R 8808, TG 17, Jawan, Kadiri 4, Kadiri 9, Prasuna, DRG12, ICGV 86590, Tirupati 3, TMV 12, TKG 19A, Kadiri 6, VRI 3, GG 7, ALR 3, Abhaya, JL 24, Vemana (K 134), MH 1, TAG 24, TPG 41, DH 3 -30, GJG 33, GG 2, JL 50 1, KRG 1, ALG O6 -320, TG 38, Spanish improved 1, TG 22, R 9251, Dh 101, Jyoti, Girnar 3, Girnar 1, Narayani, GG 5, Kadiri 5, Dh 8, Co 3, J 11, G 34, GPBD 4, ICG(FDRS) 10, ICGS 37, AK 15TMV 2, G 2 -52, ICGV 00350, S 206, R 2001-2, TMV 9, OG 52-1, TG 26, Pratap Rajmungphali, GG 8, Pratap mungfali 2, K 1319, Tirupati 2, SG 84, JL 286, Tirupati 4, GPBD 5, R 2001 -3, Dh 86, RG 141, TG 51, VRI(GN) 6, ICGS 1, JL 7769, Co(Gn) 4.

Table 5.2: List of varieties used in this study.

Varieties (50 No.)
HNG 10, Girnar 3, TAG 26, TG 37A, Girnar 2, Tirupati 3, ICGS 76, FDRS 4, LGN 2, VRI -6, Dh 86, Dh 8, GPBD 5, GPBD 4, GG 5, RS 138, VRI 5, ALR 3, ALR 2, SG 99, GG 20, KDG 128, TMV 2, HNG 69, ICGV 86590, GG 8, JL 776, KDG 123, GJG 9, GJG 32, GAUG 10, TAG 24, ICGV 1114, J 88, JL 24, K 7-Bold, ALR 1, GJG 17, R 2001-2, Dh 4-3, ICGV 00350, ICGV 86031, FDRS 79, K 1812, JSP 19, FDRS-10, J 11, ICGV 00348, RHRG 6083, Kadiri 3

2 Crop Production

Project 6: Development of groundnut production technologies for arid region of Rajasthan

PI: *Narendra Kumar*

Co-PI: *Rajaram Choudhary, MK Mahatma*, BDS Nathawat*

*Associated up to 8th October 2021

1. Hybridization

Ten crosses were effected to develop improved groundnut varieties resistant to collar rot during *kharif* 2021. The number of harvested crossed pods varied from 11 (HNG 69 × SGL 4233) to 50 (RG 510 × SGL 4233). The mean success rate (%) of the hybridization programme was 17.5, which ranged from 7 to 27.7%.

2. Identification of hybrids

Fourteen different crosses were raised in summer 2021 to identify F_1's effected for high yield with stem rot and collar rot resistance. A total of 234 single plants have been identified as hybrids, with the range of 5-28 plants/ cross. Highest number of F_1's have been identified in the cross OG 52-1× Girnar 2(28) followed by Girnar 2 × J 11, K 1812 × Dh 257 and GJG 31 × PBS 22040 (27).

Four different crosses were raised in *kharif* 2021 to identify F_1's with high yield and stem rot resistance. A total of 27 single plants have been identified as hybrids, which ranged from 5-9 plants/ cross. Highest number of F_1's have been identified in the cross GG 20 × PBS 18037.

3. Advancement of different filial generations

A total 75 progenies of four crosses in F_2 generation of stem rot resistance were advanced to next filial generation in summer 2021.A total 400 progenies of 19 crosses were advanced in *kharif* 2021 to different filial generations (F_3:4, F_3:10, F_4: 5) at DGR, Junagadh. All the crosses were in early generations (up to F_4).The breeding materials of collar rot resistance generated earlier were further advanced to next filial generation at RRS, Bikaner during *kharif* 2021. Thus, a total 57 progenies of six crosses (F2 and F3) were advanced to next filial generations in *kharif* 2021 and out of which 13 progenies were rejected at the time of harvesting due to large proportion of poor recombinants and absence of desirable trait in the recombinants.

4. Yield evaluation of advanced breeding lines

A. Summer 2021

A total fifteen Spanish bunch advanced breeding lines with four checks (TG-37A, Dh 86, GJG31, GG34) were evaluated in RBD with three replications for yield and its component traits during summer 2021. The results revealed that an advanced breeding line PBS-12235 was found at par with the best check, GJG 31 for pod and kernel yield and GG 34 for SOT. This breeding line is being evaluated/ confirmed further.

B. *Kharif* 2021

Spanish bunch: A total of ten Spanish bunch genotypes including one high yielding check, TG 37A were evaluated in 5m row length for yield and its component traits in a RBD with three replications during *kharif* 2021. The results revealed that two advanced breeding line PBS 12243 and PBS 12247 was found at par with the best check, for pod, kernel yield (kg/ha) and SOT (%). The breeding line PBS 12242, was found significantly superior over the best check. Further evaluation of these genotypes are in progress.

Spanish bunch: A total nine Spanish bunch genotypes including one high yielding check TG-37A were evaluated in 5m row length for yield and its component traits in a RBD with three replications during *kharif* 2020 and *kharif* 2021. The results revealed that advanced breeding line PBS 12231 (pod yield: 2289 kg/ha, kernel yield: 1658 kg/ha, SOT: 68%) and PBS 12232 (pod yield: 2547kg/ha, kernel yield: 1752kg/ha, SOT: 69%) was found significantly superior over the best check for pod and kernel yield (1646 & 1040 kg/ha). Breeding line PBS 12231 and PBS 12232 had 39 and 55% superiority in

Fig. 6.1. PBS 12131- Elite breeding line identified for *kharif* AICRP-G trials

Fig. 6.2. PBS 12132-Elite breeding line identified for *kharif* AICRP-G trials

pod yield over the best check. Therefore, it would be proposed for multi-location testing under AICRPG Spanish bunch trials during *kharif* season. PBS 12131 and PBS 12132 are identified for *kharif* 2022 AICRPG (Fig 6.1 and 6.2).

Virginia bunch: A total fourteen genotypes of Virginia bunch including four high yielding recommended checks *viz*. GG-20, KDG 123, KDG 128 and GJG 22 were evaluated in 5m row length for yield and its component traits in RBD with three replications during *kharif* 2021. The results revealed that two breeding lines viz., PBS 22164 and PBS 22170 were found at par with the best check, KDG 128 for pods/plant, pod yield and kernel yield. These breeding lines need further evaluation under AICRPG.

Virginia bunch: A total sixteen genotypes of Virginia bunch including four high yielding recommended checks *viz*. GG 20, KDG 123, KDG128 and GJG 22 were evaluated in 5m row length for yield and its component traits in RBD with three replications duirng *kharif* 2020 and *kharif* 2021. The results revealed that none of the genotype significantly surpass the best check, KDG123 for number of pods/plant, kernel yield and SOT and KDG 128 for pod yield.

5. Development, multiplication, maintenance and distribution of breeding materials to different AICRPG centres

I. Development of new advanced breeding lines

Development of advanced breeding lines from advanced generations are in progress.

II. Multiplication and maintenance of breeding materials

A. Summer 2020: A total 45 advanced breeding lines (new and existing), germplasm lines and cultivars were mass multiplied during summer-2020 to get sufficient seeds for conducting yield and screening trials.

B. *Kharif* 2020: A total 27 advanced breeding lines (new and existing), cultivars, germplasm lines and AICRPG proposed lines were mass multiplied during *kharif* 2021 to get sufficient seeds for conducting yield and screening trials.

III. Multiplication and status of AICRPG lines

During *kharif* 2021, seeds of six elite breeding lines (PBS12200, PBS12217, PBS 12218, PBS 12221, PBS 12223, and PBS12228) were mass multiplied to get sufficient seed required for AICRPG trials. An elite breeding line, PBS 12201 was tested under IVT-II (SB) of AICRP-G trials in *kharif* 2019-2020 which failed to surpass the best checks in all the zones.

6. Screening of genotypes for resistance of collar rot

A total 15 groundnut cultivars were screened in a replicated trial under sick plot for resistance to collar rot at Bikaner during *kharif* 2020-21. Data were

Collar rot incidence in trial at Bikaner

recorded on plant mortality up to 45 DAS. The maximum collar rot incidence was 61.5% in cultivar

TBG 39 during *kharif* 2020 and 55% in cultivar Utkarsh in *kharif* 2021.Results revealed that none of the cultivars having disease incidence less than the check variety, OG52-1 (30%) except Mallika (30%) and HNG 69 (28.5%). These cultivars will be tested 2 more years to ascertain their resistance to collar rot.

7. Screening of genotypes for resistance of fusarium blight

A total 26 groundnut advanced breeding lines and cultivars were screened in a replicated trial under sick plots during last two years against resistance to

Fusarium leaf blight incidence at Bikaner

fusarium leaf blight at Bikaner during *kharif* 2021. Data were recorded on plant mortality from 50 DAS to harvesting. Maximum disease mortality was 100% in cultivars *viz*., RG 425 and RG 559-3. Results revealed that 16 breeding lines and cultivars had less than 20% plant mortality. These genotypes need to be tested three more years to ascertain the resistance to fusarium leaf blight.

8. Optimization of P doses for *kharif* groundnut (Bikaner)

An experiment was conducted during *kharif* 2021 at Bikaner in a randomized complete block design (RCBD) having six treatments viz. T1-control, T2-30 kg P_2O_5/ha, T3-40 kg P_2O_5/ha, T4-50 kg P_2O_5/ha, T5-60 kg P_2O_5/ha and T6-70 kg P_2O_5/ha, and four replications to know the effect of different phosphorus doses on groundnut yield. Girnar 2 variety was sown on 29th June, 2021 at 45x10 cm spacing. Pod yield increased with increasing level of phosphorus doses and the highest significant pod yield was recorded at 60 kg P_2O_5/ha (3535 kg/ha which was at par with 70 kg P_2O_5/ha). Significantly

Field view of experimental trial

higher haulm yield, however, was recorded at 70 kg P_2O_5/ha (at par with 60 kg P_2O_5/ha). Branches per plant was significantly higher with 50 kg P_2O_5/ha (at par with 60 kg P_2O_5/ha). Significantly higher number of mature pods per plant was recorded at 60 kg P_2O_5/ha. Different levels of phosphorus doses failed to create significant variation in hundred kernel weight.

9. Optimization of potassium doses for *kharif* groundnut (Bikaner)

An experiment was conducted during *kharif* 2021at Bikaner in a randomized complete block design (RCBD) having six treatments viz. T1-control, T2-20 kg K_2O/ha, T3-30 kg K_2O/ha, T4-40 kg K_2O/ha, T5-50 kg K_2O/ha and T6-60 kg K_2O/ha, and four replications to know the effect of different potassium doses on groundnut yield. Girnar-2 variety was sown on 29th June, 2021 at 45x10 cm spacing. Pod yield increased with increasing level of potassium doses and significantly higher pod yield was recorded at 60 kg K_2O/ha (3610 kg/ha), which was at par with 50 kg K_2O/ha. Similarly, significantly higher haulm yield was recorded at 60 kg K_2O/ha.

Project 7: Climate Resilient Sustainable Agriculture Through Low- Cost Natural Farming in Groundnut Based Cropping System

PI: *Praharaj CS*

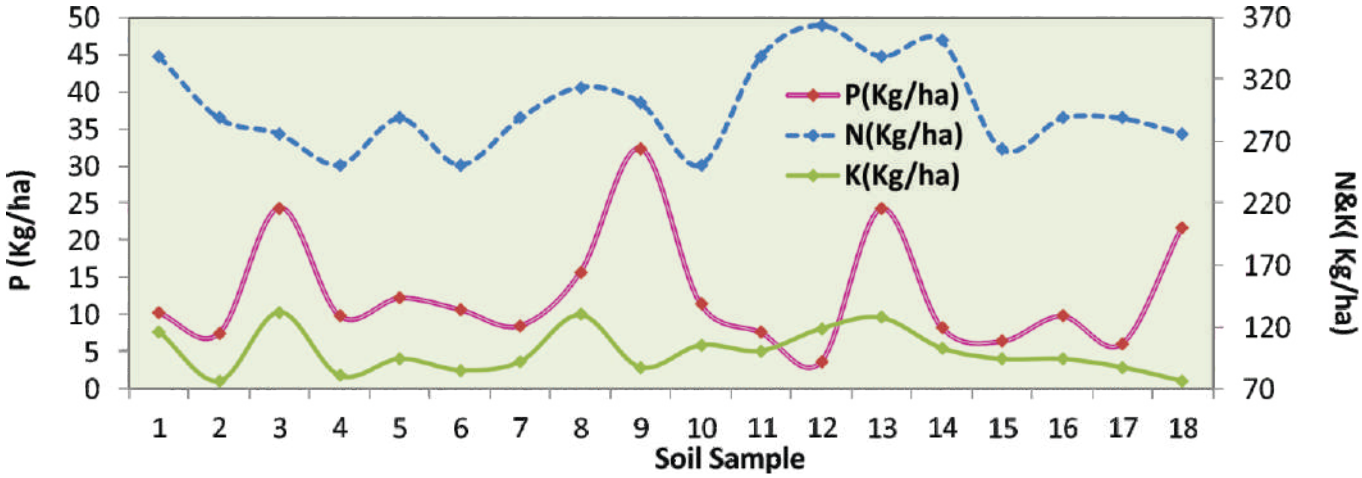
Co-PI: *Reddy KK, Pal KK and Singh Sushmita*

1. Natural farming vis-à-vis conventional farming

Zero budget natural farming (ZBNF) - a sustainable agricultural system - is one such alternative to chemical fertilizer-based agriculture and high input-cost agriculture. It exemplifies agro-ecological principles giving emphasis on “enhanced soil conditions by managing organic matter and soil biological activity; diversification of genetic resources; enhanced biomass recycling; and enhanced biological interactions”. The practice advocates 100 % elimination of synthetic chemical inputs (fertilizer and pesticides) and encourages the application of natural mixtures made using cow dung, cow urine, jaggery, pulse flour etc., mulching practices, and symbiotic intercropping. ZBNF practices have four aspects/pillars viz., *Jeevamrutha* (cow dung based crop nutrition), *Bijamrita* (seed treatment), *Acchadana* (mulching) and *Whapasa* (efficient and less irrigation) are integral to it (ZBNF). 'Zero budget' does not literally mean that costs are 'zero', but it implies that the need for external financing is zero, and that any costs incurred can be offset by a diversified source of income which comes *via* farm diversification rather than dependence on monoculture.

This above experiment has been initiated at ICAR-DGR, Junagadh from summer/spring 2022 following sowing of exhaustive crop of pearl millet to have a uniformity at the start of the experiment (**Fig 7.1**). Soil samples were taken before sowing in various plots and analyzed (**Fig. 7.2**). This will be followed by groundnut-wheat cropping system from *Kharif* 2022 involving three farming systems viz., 1) Conventional Farming (Control); 2) *Natural Farming* (Seed treatment with *Beejamrutha* / *Bijamrita* + application of *Jeevamrutha* at fortnightly intervals + mulching with organic residues +plant protection with natural pesticides

Fig 7.1. Fodder Bajra sown in experimental plots



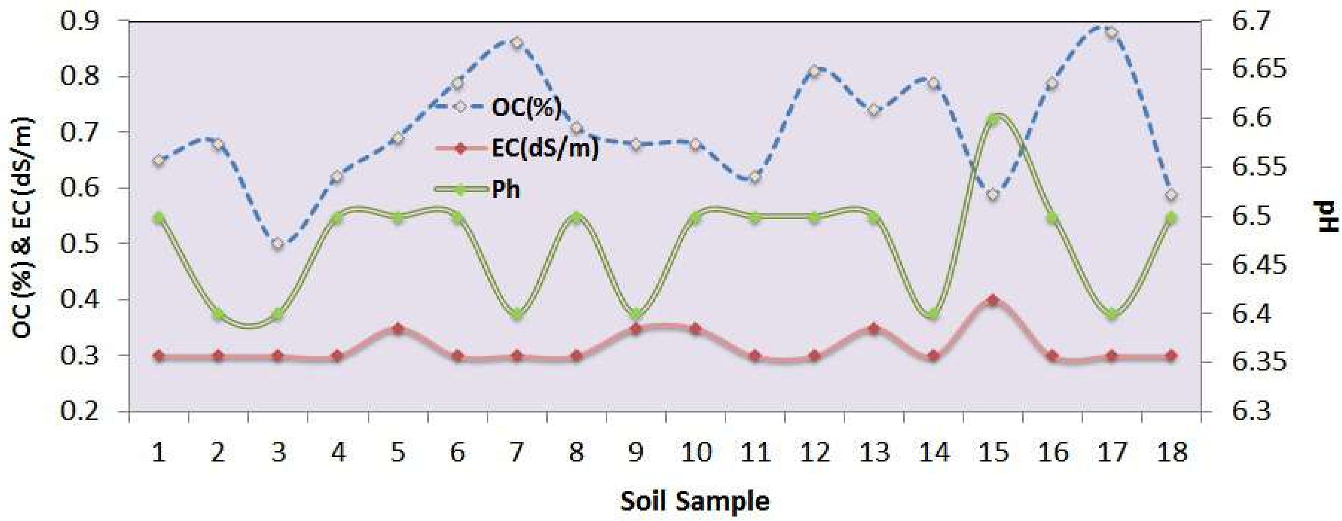


Fig. 7.2. Available NPK, Organic carbon (%), pH and EC in 0-15 cm depth before sowing in experimental plots

/fungicides like *Neemastra, Agniastra* etc.); and 3) Organic Farming (Use of FYM, Vermicompost, Bio fertilizer and plant protection with organic products etc.). This will later involve precision irrigation and minimum/zero tillage. Experimentation will be continued for 2-3 years for initial stabilization for farming & tillage treatments, and later irrigation (line-source sprinklers) treatments will be superimposed. Both Habit group (Spanish TG37A & Virginia bunch GJG 22) varieties will be tried. This experiment has been taken up in prevailing agro-ecosystem involving medium black calcareous soil under Southern Saurashtra Agro-climatic Zone of Gujarat.

2. Bridging the yield gap (yield maximization):

Another experiment involving yield maximization

Fig. 7.3. Field view of the treatments

Table 7.1. Soil test data rating chart

Interpretation	N (kg/ha)	P(kg/ha)	K (kg/ha)	OC (%)	EC (dS/m)	pH
low	<272	<11	<110	<0.40	< 0.8- normal-suitable for all crops	<6.5- Acidic
medium	272-544	11-22	110-280	0.40-0.75	0.8-1.6- Critical for salt sensitive crops	6.5-8.7- normal
high	>544	>22	>280	>0.75	1.6-2.5- Critical for salt tolerant crops	8.8-9.3- Alkaline
					> 2.5- injurious to all crops	>9.3- alkali

Table 7.2: Available NPK, Organic carbon (%), pH and EC (dS/m) at two different depths before sowing

Sr no.	Depth (cm)	N(Kg/ha)	P (kg/ha)	K (kg/ha)	OC (%)	EC (dS/m)	pH
1	0-15 (TG-37A)	270	4.9	141	0.81	0.39	6.6
2	15-30 (TG-37A)	295	5.7	125	0.77	0.38	6.7
3	0-15 (KDG-128)	263	8.9	112	0.8	0.31	6.7
4	15-30 (KDG-128)	263	10.4	130	0.70	0.32	6.6
Result	0-15, 15-30 cm	Low to medium	Low	Medium	High	Normal	Acidic

in groundnut has been taken up during summer/spring 2022 at ICAR-DGR, Junagadh. Here, three distinct treatments viz., control (Farmer practice), practice adopted by progressive farmers, and improved practice for yield maximization (**Fig. 7.3**). Here, recently released/notified variety belonging to both Spanish and Virginia habit groups have been taken up during spring/summer season. Soil samples were taken before sowing and analyzed for nutrient status using soil rating chart and categorized into different groups based on nutrient availability (**Table 7.1 and 7.2**)

3 Crop Protection

Project 8: Studies on White Grub and Bruchid Beetle and their management in Groundnut

PI: *Harish G*

Co-PI: *Nataraja MV and R Dey*

Seasonal incidence of insect pests of groundnut

Seasonal incidence of insect pests of groundnut was studied by sowing groundnut every month under unprotected condition. Sucking pests and natural enemies were estimated using sweep net catches. Thrips and leafhopper population was found throughout the year, but one significant peak of thrips population was observed during 10th Standard week and leafhopper population had its peak at 11th Standard week during *rabi*-summer. In *kharif* thrips population was low due to rainfall however leafhopper population was high at 41st standard week. Natural enemies like spider and lady bird beetles were observed. Spider population was high during *kharif* at 44th standard week.

Biorational management of groundnut defoliator pests

An experiment was conducted to know the efficacy of bio-rational insecticides on defoliators. Helicoverpa population was the lowest in the treatment involving Chlorantraniliprole 18.5 SC @ 0.3 ml/l (2.5 larva per meter row length) and was followed by Quinalphos 25 EC @ 2 ml/l and Bt-127 SC formulation @ 3 ml/l. The treatment Chlorantraniliprole 18.5 SC @ 0.3 ml/l, recorded the highest pod yield (1638 kg/ha).

Effect of different types of stickers and systemic insecticides in management of groundnut sucking pests

An experiment was conducted in Entomology experimental plots to manage sucking pests using three stickers (spreaders, wetting agent and surfactants) along with two systemic insecticides (Imidacloprid 17.8 SL and Thiamethoxam 25% WG) and an absolute control. Imidacloprid + Spreaders were found to be effective in managing sucking pests over control. The highest pod yield of 2623 kg/ha was also obtained from the same treatment.

Effect of combination insecticide in management of groundnut sucking pests

An experiment was conducted in Entomology experimental plots to manage sucking pests using three combination insecticides along with two systemic insecticides (Imidacloprid 17.8 SL and Thiamethoxam 25% WG) and an absolute control. Imidacloprid 17.8 SL was found to be effective in managing sucking pests over control. Among combination insecticide, "Acephate 50% + Imidacloprid 1.8% SP" was effective in managing the sucking pests. The highest pod yield of 2067 kg per ha was also obtained from the treatment with two sprays of Imidacloprid 17.8 SL.

Project 9: Development of Rapid Detection Techniques of Peanut Bud Necrosis and Tobacco Streak Viruses in Groundnut

PI: *Nataraja MV and Ananth Kurella*

Co-PI: *Harish G and Papa Rao V*

PBNV and TSV sample collection

PBNV and TSV were mechanically sap-transmitted with the samples obtained from ICAR-DGR, Junagadh and ARS-Kadiri on the indicator hosts namely, Pusa Komal (cowpea) and K-6 (groundnut) in the net-house. Small chlorotic spots were observed on the indicator hosts within 48-72 hours. Symptoms were observed systemically. 10 PBNV samples were collected from ICAR-DGR farm,while 10 TSV samples were collected from ARS-Kadiri. These samples were validated with the existing RT-PCR protocol showing positive reaction for PBNV and TSV infection.

Similarly, *PBNV* and *TSV* were mechanically sap-transmitted with the samples obtained from Raichur and ARS-Kadiri on the indicator hosts namely, Pusa

Komal (cowpea) and K 6 (groundnut) in the net-house. No symptom however, was observed on the indicator hosts even after repeated transmissions.

Project 10: Microbial management for major foliar diseases of groundnut and variability analysis of pathogens

PI: *Rinku Dey*

Co-PI: *Ananth Kurella, Chandramohan S., Narendra Kumar, and Raja Ram Choudhary*

Evaluation of epiphytes for management of *Alternaria* leaf blight in groundnut

Phyllosphere or epiphytic bacteria can be used as potential biological control agents for air-borne fungal pathogens. Five epiphytic bacteria viz., *Bacillus amyloliquefaciens* 13S3, *Bacillus subtilis* 1S1, *Bacillus subtilis* 5S1, *Bacillus subtilis* 7S2 and *Bacillus amyloliquefaciens* 9S2 were evaluated for their efficiency in minimizing the incidence of Alternaria leaf blight in groundnut. Evaluation of epiphytes during summer 2021 for management of Alternaria leaf blight indicated that the severity of leaf blight reduced from a score of 3.0 (1-9 scale) in uninoculated control to 2.0 when sprayed with *Bacillus subtilis* 5S1, *Bacillus subtilis* 7S2, and *Bacillus amyloliquefaciens* 9S2 (**Table 10.1**). The bacteria were sprayed onto the leaf of groundnut with the epiphytes five times at 15 days interval beginning 15 days after emergence (DAE). Application of *Bacillus amyloliquefaciens* 13S3 enhanced the pod yield by 13.7%, which was at par with that of *Bacillus amyloliquefaciens* 9S2. Inoculation with these two epiphytes also resulted in enhancement of haulm yield, shelling outturn and hundred kernel weight.

Table 10.1: Effect of application of epiphytes on growth, yield and control of *Alternaria* leaf blight of groundnut (cv TG 37A) during summer 2021

Treatment	PY (kg/ha)	HY (kg/ha)	SOT (%)	HKW (g)	Disease score (1-9 scale)
Control	2170	3133	62.59	38.80	3
Bacillus subtilis 1S1	2077	3200	63.50	39.13	3
Bacillus subtilis 5S1	2263	3183	62.61	39.75	2
Bacillus subtilis 7S2	2210	3230	62.35	40.22	2
Bacillus amyloliquefaciens 9S2	2433	3600	66.08	41.92	2
Bacillus amyloliquefaciens 13S3	2468	3717	66.52	42.82	3
CD (0.05)	**222**	**420**	**2.36**	**1.87**	

Note: Disease score in infector row was 8, 9, and 9 for ELS, LLS and rust respectively

PY: Pod Yield; HY: Haulm Yield; SOT: Shelling Out Turn: HKW: Hundred Kernel Weight

Evaluation of epiphytes for management of leaf spots in groundnut

Five epiphytic bacteria viz. *Bacillus subtilis* 1S1, *Bacillus subtilis* subsp. *inaquosorum* 4S4, *Bacillus subtilis* subsp. *velezensis* 14E1, *Bacillus subtilis* 19S5 and *Bacillus* sp. 42S1were evaluated for their efficiency in minimizing the incidence of leaf spots in groundnut. Evaluation of epiphytes during *kharif* 2021 for management of early leaf spot, late leaf spot and rust indicated that application of epiphytes, reduced disease severity of ELS from a score of 6.0 (1-9 scale) in un-inoculated control to 4.0 in isolate 1S1, 19S5 and 42S1, respectively (**Table 10.2**). In case of LLS, it was 8.0 in un-inoculated control to 7.0 in treatments with epiphyte isolates 1S1, 4S4, 14E1 and 19S5. In case of rust, the disease score was 7.0 in un-inoculated control and reduced to 5.0 with isolate 1S1 and 19S5. The disease score of ELS, LLS and rust in infector row was 8.0, 9.0 and 9.0, respectively. Simultaneously, there was improvement in pod (12%) and haulm yield of groundnut (cv TG 37A) significantly when inoculated with *Bacillus subtilis* 19S5 and *Bacillus subtilis* 1S1.

In another set of epiphytes, application of epiphytes, reduced disease severity of ELS from a score of 6.0 (1-9 scale) in un-inoculated control to 4.0 in isolate 7S2 and 16E1 (**Table 10.3**). In case of LLS, it was 8.0 in un-inoculated control to 7.0 in treatments with

Table 10.2: Evaluation of epiphytes for management of foliar fungal diseases in groundnut (cv TG 37A) during *kharif* 2021

Treatment	PY (kg/ha)	HY (kg/ha)	SOT (%)	HKW (g)	Disease score (1-9 scale)		
					ELS	LLS	Rust
Control	2619	3807	57.35	35.13	6	8	7
*Bacillus subtilis*1S1	2938	4293	61.00	37.07	4	7	5
Bacillus subtilis subsp. *inaquosorum* 4S4	2751	3767	58.60	35.79	5	7	6
Bacillus subtilis subsp. *velezensis* 14E1	2641	3633	57.50	36.80	5	7	6
Bacillus subtilis 19S5	2943	4353	60.25	37.60	4	7	5
Bacillus sp. 42S1	2616	3982	58.67	35.29	4	8	6
CD (0.05)	225	325	1.69	NS			

Note: Disease score in infector row was 8, 9, and 9 for ELS, LLS and rust respectively
PY: Pod Yield; HY: Haulm Yield; SOT: Shelling Out Turn: HKW: Hundred Kernel Weight

Table 10.3: Evaluation of epiphytes for management of foliar fungal diseases in groundnut (cv TG37A) during *kharif* 2021

Treatment	PY (kg/ha)	HY (kg/ha)	SOT (%)	HKW (g)	Disease score (1-9 scale)		
					ELS	LLS	Rust
Control	2530	3433	62.69	37.0	6	8	7
7S2	2480	3495	62.45	33.8	4	8	6
16E1	2470	3460	62.62	37.5	4	8	7
19S3	2581	3277	61.92	38.3	5	7	7
24E1	3023	3997	64.71	38.3	5	7	6
49S2	2483	3660	61.58	35.3	6	8	6
CD (0.05)	240	278	1.75	2.7			

Note: Disease score in infector row was 8, 9, and 9 for ELS, LLS and rust respectively
PY: Pod Yield; HY: Haulm Yield; SOT: Shelling Out Turn: HKW: Hundred Kernel Weight

epiphyte isolates 19S3 and 24E1. In case of rust, the disease score was 7.0 in un-inoculated control and reduced to 6.0 with isolate 7S2, 24E1, and 49S2. The disease score of ELS, LLS and rust in infector row was 8.0, 9.0 and 9.0, respectively. Simultaneously, there was improvement in pod (19.5%) and haulm yield of groundnut (cv TG 37A) significantly when inoculated with epiphyte isolate 24E1.

Evaluation of DAPG-producing fluorescent pseudomonads and epiphytes for antagonistic activity against *Fusarium* (*in vitro*)

Twenty-eight bacterial isolates (including DAPG-producing fluorescent pseudomonads, epiphytes, endophytes, *etc.*) were screened *in vitro* for antifungal activity against Fusarium wilt pathogen. Among the 8 isolates of epiphytes, the percentage inhibition (PI) ranged from 17 to 43%; in case of 5 DAPG- producing fluorescent pseudomonads, the PI ranged from 9 to 17%; and in case of 15 endophytes screened, the PI ranged from 11 to 58%.

Evaluation of endophytes and epiphytes for management of wilt disease of groundnut at Bikaner

Fusarium wilt is emerging as a serious concern to groundnut cultivation in parts of Rajasthan as it imparts huge losses to groundnut cultivation. Field trials were conducted during *kharif* 2021 to screen endophytes and epiphytes for management of Fusarium wilt of groundnut. Among ten isolates of endophytes screened, isolate S19 reduced mortality percentage to 11% from 48% in control. Among nine epiphytes screened, four isolates reduced the mortality percentage to 17-23% as compared to 34% in control. These isolates will be tested further in field trials.

Identification of hybrids for foliar disease resistance

Eight different crosses were raised in summer 2021 to identify F_1's effected for developing genotypes having high yield with foliar disease resistance (*Alternaria* leaf blight, leaf spot and rust). A total of 125 single plants have been identified as hybrids, which ranged from 10-30. Highest number of F_1's have been identified in the cross RHRG 6083 × GG-20(30) followed by GG-20 × RHRG 6083 (16) (**Table 10.4**).

Table 10.4: Details of F_1's raised and hybrids isolated in summer 2021

SN	Name of cross	Purpose of cross	Hybrids identified (no.)
1	TG 37A × KDG 128	High yield with resistance of leaf spot and rust	10
2	KDG 128 × TG 37A	High yield with resistance of leaf spot and rust	10
3	GG 20 × RHRG 6083	High yield with resistance of leaf spot and rust	16
4	RHRG 6083 × GG 20	High yield with resistance of leaf spot and rust	30
5	GJG 31 × NRCGCS 298	High yield with resistance of *Alternaria* leaf blight	16
6	Kadiri 6 × NRCGCS 298	High yield with resistance of *Alternaria* leaf blight	13
7	GJG 31 × PBS 22131	High yield with resistance of *Alternaria* leaf blight	15
8	Kadiri 6 × PBS 22131	High yield with resistance of *Alternaria* leaf blight	15
			125

Generation advancement of different filial generations

A total of 268 progenies of 8 crosses (F_2:4, F_3:4) of *Alternaria* leaf blight resistance were advanced to next filial generation in summer 2021. Among them 132 progenies were rejected at the time of harvesting due to large proportion of poor recombinants and absence of desirable trait in the recombinants and rest 136 progenies were forwarded in next filial generation.

A total of 728 progenies of 61 crosses (F_2:4, F_3:4, F_4:19, F_5:27, F_6:7) of *Alternaria* leaf blight, leaf spot and rust resistance were advanced to next filial generation in *kharif* 2021. Among them 146 progenies were rejected at the time of harvesting due to large proportion of poor recombinants and absence of desirable trait in the recombinants. A total of 27 crosses were in early generations (up to F_4) and 34 in advanced generation. Individual plant progenies of seven crosses were raised in F_6 generation (**Table 10.5 a,b,c**).

Disease reaction of pathogens on genotypes for identification of differential sets

Summer 2021

A set of 40 genotypes were sown in field to see their disease reaction(rust especially), but due to less disease pressure rust scoring was recorded <3 in all the genotypes. Besides rust recorded data of ALB(<3in all the genotypes) and soil-borne diseases(Collar rot recorded lowest 7% in ALR-2 and highest 22% in VRI-6 and Stem rot recorded lowest 0% in RHRG-6083 andICGS-76; and highest 18% in GJG-17) were also recorded.

Table 10.5a. Details of segregating materials forwarded and rejected in summer2021

SN	Cross	Generation	SPP sown	Rejection	Selection
1	GJG 31 × NRCGCS 298	F_2	24		52
2	Kadiri 6 × NRCGCS 298		16		56
3	GJG 31 × PBS 22131		22		53
4	Kadiri 6 × PBS 22131		22		54
			84		**215**
1	GJG 31 × NRCGCS 298	F_3	43	31	12
2	Kadiri 6 × NRCGCS 298		36	29	7
3	GJG 31 × PBS 22131		48	34	14
4	Kadiri 6 × PBS 22131		57	38	19
			184	**132**	**52**

Table 10.5b. Details of segregating materials forwarded and rejected in *kharif* 2021

SN	Cross	Harvested pod Generation	Sown SPP	Rejected SPP	Selected SPP
1	GJG 22 × KDG 128	F_2	5	0	5
2	RG 559-3 × KDG 128		2	0	4
3	TG 37A × KDG 123		2	0	11
4	RG 559-3 × KDG 123		3	0	4
			12	**0**	**24**
1	TG 37A × KDG 128	F_3	10	0	39
2	KDG 128 × TG37A		10	0	28
3	GG 20 × RHRG 6083		16	0	11
4	RHRG 6083 × GG 20		30	0	40
			66	**0**	**118**
1	ICGV 00351× NRCGCS 298	F_4	6	0	10
2	GJG 34 × NRCGCS 298		6	0	11
3	KDG 128 × GJG 22		31	0	40
4	JL 776 × Dh 256		8	0	19
5	KDG 123 × GJG 19		18	0	19
6	TG 37A × NRCGCS 298		4	6	10
7	TPG 41 × NRCGCS 298		3	6	9
8	TG 37A × PBS 22131		2	0	3
9	TPG 41 × PBS 22131		4	2	2
10	GG 20 × (TG 37 A × GPBD 4)	$BC_2 F_4$	12	1	11
11	TG 37 A × (GG 20 × GPBD 4)	$BC_2 F_4$	11	2	9
12	TG 37 A × CS 298	F_4	32	2	30
13	TPG 41 × CS 298	F_4	8	1	7
14	TG 37 A × PBS 22131	F_4	17	3	14
15	TPG 41 × PBS 22131	F_4	7	0	8
16	GG 20 × GPBD 4	F_4	9	1	8
17	TG 37 A × GPBD 4	F_4	33	5	28
18	GG20 × (GG 20 × GPBD 4)	BC_1F_4 P_1	27	11	16
19	TG 37 A × (TG 37 A × GPBD 4)	BC_1F_4 P_1	10	2	8
			248	**42**	**262**
1	TG 37 A x KDG 128	F_5	4	0	8
2	GG 20 x GPBD 4	F_5	13	3	10
3	TG 37 A x GPBD 4	F_5	7	0	9
4	GG 20 × GPBD 4	F_5	7	2	5
5	TG 37 A × GPBD 4	F_5	1	0	1
6	GG 7 × KDG 128	F_5	7	0	13
7	GG 2 × CS 298	F_5	7	0	7
8	Dh 86 × CS 298	F_5	2	0	4
9	GJG 31 × CS 298	F_5	5	0	7
10	Kadiri 6 × CS 298	F_5	4	0	5
11	Kadiri 6 × PBS 22131	F_5	3	0	3
12	GG 20 × (GG 20 × GPBD 4)	BC_2F_5	3	0	3
13	TG 37 A × (TG 37 A × GPBD 4)	BC_2F_5	3	0	3
14	GG20 × F1 (TG 37 A × GPBD 4)	F_5	2	0	5
15	TG 37 A × F1 (GG 20 × GPBD 4)	F5	3	0	3
16	TG 37 A × CS 298	F5	26	9	17
17	TPG 41 × CS 298	F5	26	12	14
18	TG 37 A × PBS 22131	F5	26	11	15
19	TPG 41 × PBS 22131	F5	11	0	13
20	GG 20 × GPBD 4	F5	36	12	24

SN	Cross	Harvested pod Generation	Sown SPP	Rejected SPP	Selected SPP
21	TG 37 A × GPBD 4	F5	38	5	33
22	TG-37A × GPBD 4 A Hetro	$BC_2 F_5$	7	0	7
23	TG-37A × GPBD 4 B Homo	$BC_2 F_5$	4	0	6
24	GG 20 × GPBD 4 A Hetro	$BC_2 F_5$	7	0	8
25	GG 20 × GPBD-4 B Homo	$BC_2 F_5$	3	0	3
26	TG 37A × (TG 37A × GPBD 4)	$BC_2 F_5$	37	13	24
27	GG 20 × (GG 20 × GPBD 4)	$BC_2 F_5$	55	21	34
			347	**88**	**284**
1	GG 20 × GPBD 4	F_6	3	0	3
2	TG 37 A × GPBD 4	F_6	5	0	5
3	GG 7 × KDG 123	F_6	7	1	6
4	TG 37 A × CS 186	F_6	10	3	7
5	TPG 41 × CS 74	F_6	1	0	1
6	GG 20 × GPBD 4	F_6	17	10	7
7	TG 37 A × GPBD 4	F_6	12	2	10
			55	**16**	**39**

Table 10.5c: Summary of number of crosses, SPP/row sown, rejected and selected SPPs in different generations

SN	Crosses (no.)	Generation	SPP/row sown	Rejection	SPP Selection (no.)
1.	4	F2	12	0	24
2.	4	F3	66	0	118
3.	19	F4	248	42	262
4.	27	F5	347	88	284
5.	7	F6	55	16	39
	61		**728**	**146**	**727**

Kharif 2021

A set of 42 genotypes along with 4 checks (2 susceptible and 2 resistant) were sown in field to see their disease reaction (LLS and rust). All the genotypes recorded scores in the range of 5-8 (LLS and rust). Susceptible checks TG37A and TMV-2 recorded a maximum score of 8 for both LLS and rust, similarly resistant checks KDG-123 and RHRG-6083 recorded 5 for LLS and 4 for rust on a scale of 1-9. The experiment will be taken up in glasshouse conditions with artificial inoculation.

4 Basic Sciences

Project 11: Management of salinity stress in groundnut

PI: *K. K. Pal*

Co-PIs: *Sushmita Singh, K. K. Reddy, M. K. Mahatma, Praveen Kona and Papa Rao V*

In vitro characterization of available PGPR, PSB, archaea, and DAPG-producers

Twenty-nine well characterised cultures comprising of PGPR, PSB and DAPG-producing fluorescent pseudomonads were screened for level of salinity tolerance. Out of these cultures, three, four, one, thirteen, and eight cultures were tolerant to 2.5M, 2.0M, 1.5M, 1.0M and 0.5M of NaCl in growth medium *in vitro*.

Understanding the role of Ca in salinity stress signalling

A pot experiment was undertaken to evaluate the influence of foliar application of calcium chloride ($CaCl_2$) in alleviation of salinity stress utilizing the role of Ca in salinity stress signalling. Four cultivars comprising of two relatively tolerant (GG2 and GG7) and two susceptible cultivars (TG 37A and GJG 31) with two levels of salinity (2 ECe and 4 ECe) were treated with $CaCl_2$ (50 mM), 10 days after imposition of salt stress. Chlorophyll content, photochemical maximum quantum yield and leaf relative water content were improved with greater percentage increase for sensitive cultivars upon $CaCl_2$ application. There was a significant decline in net photosynthetic rate (P_n) for susceptible cultivars with GJG 31 showing greater percentage of reduction (**Fig. 11.1**). The Ca treated cultivars were superior in their performance over the untreated ones with TG 37A being the most responsive cultivar. The accumulation of proline was considerably high during salt stress but the Ca application caused decline in the proline level in leaves with greater percentage reduction in tolerant cultivars (**Fig. 11.2**).

Evaluation of the effect of endophytes and mulching on yield parameters of groundnut

The experiment was set up with two endophytes and 10t wheat straw mulch in different combinations at Junagadh with external application of salts for induced salinity. The soil salinity measured at harvest was 3.82 dS/m as against 0.35 dS/m before sowing. Application of endophytes (*Bacillus firmus* J22N and *Bacillus subtilis* REN51N) along with application of wheat straw @10t/ha significantly improved pod and haulm yield of groundnut (cv.

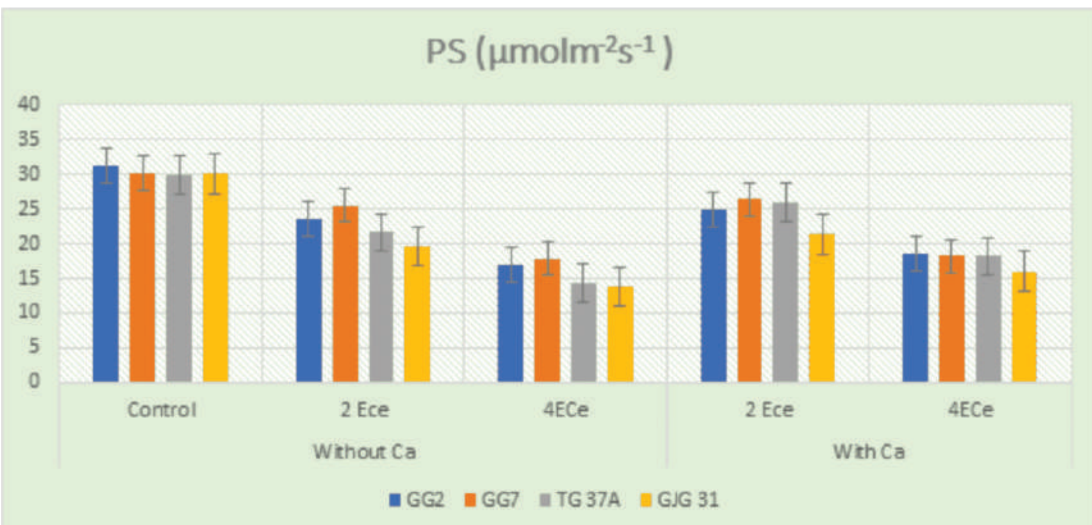


Fig.11.1: Effect of foliar application of $CaCl_2$ on net photosynthesis (Pn) under salinity in groundnut

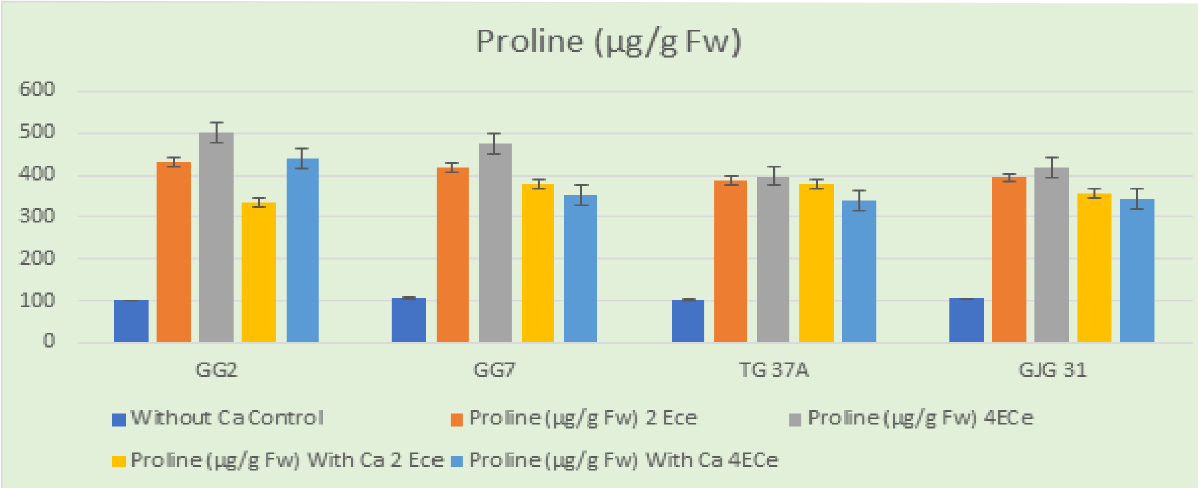


Fig. 11.2 Effect of salinity on proline content in groundnut

GG7). Mulching in combination with endophytes improved the peanut yield by 600-700 kg/ha over endophytes alone treatments (**Table 11.1**). Application of endophytes alone also improved the yield of groundnut significantly over uninoculated control. The experiment will be repeated again for confirmation of the finding as well as improvement in soil properties due to mulching. The same experiment was conducted at CCSRI, Mandvi at salinity of 3.97 EC at harvest with cultivar GG7. However, no significant impact of any treatment combination was noticed on pod yield of groundnut.

Table 11.1. Evaluation of endophytes in alleviation of salinity stress with organic mulch

Treatments	Details	NN/p	PY (kg/ha)	HY (kg/ha)
T1	Uninoculated control	55.8	970	3812
T2	*Bacillus subtilis* REN51N (seed treatment at sowing+ furrow soil application at 45 DAS)	66.3	1159	4494
T3	*Bacillus firmus* J22N (seed treatment at sowing+ furrow soil application at 45 DAS)	84.3	1287	4238
T4	T1 + Wheat straw mulch @ 10 t/ha	78.8	1374	4554
T5	T2 +Wheat straw mulch @ 10 t/ha	72.3	1843	4451
T6	T3 +Wheat straw mulch @ 10 t/ha	74.2	2088	5079
CD (0.05)		**5.3**	**102**	**163**

Evaluation of mini-core germplasm for identification of sources of tolerance

Minicore germplasm accessions of groundnut along with standard checks (TG37A, GG2, GG5 and GG7) were screened at three locations at KVK, Khapat, Porbandar; CCSRI, Mandvi; and ARS, Kothara) of Gujarat for identifying the sources of tolerance. There was variation in soil salinity among the location (**Table 11.2 a&b**). While soil salinity (EC) before sowing was 0.96, 0.42 and 0.39 at Mandvi, Kothara and Porbandar, respectively, the salinity at the time of harvest was 4.85, 4.29 and 1.52, respectively at Mandvi, Kothara and Porbandar. This has reflected in the pod yield of groundnut germplasm across locations. At Porbandar, as salinity level was low, pod yield/plant was higher. At Mandvi, NRCG-14446 (10.98 g), NRCG-14461(10.77 g), NRCG-14452 (9.85 g) found superior over the best check GG 5 (5.39 g) in terms of pod yield/plant. Similarly, at Kothara, NRCG14493 (14.05 g), NRCG14426 (13.06 g), NRCG14500 (12.97 g), NRCG14424 (12.56 g) and NRCG14461 (11.18 g) were found superior over the best check GG 2 (8.38 g) in terms pod yield/plant. However, overall comparison of the results of all the three locations indicated that only five genotypes gave consistent pod yield. On the basis of results, eleven genotypes identified on the basis of screening will

Table 11.2a. Variation in soil salinity and pH in different locations of experiment

	Before sowing		At harvest	
Location	**EC (dS/m)**	**pH**	**EC (dS/m)**	**pH**
KVK, Khapat, Porbandar	0.39 (±0.04)	8.04 (±0.22)	1.52 (±0.12)	8.28 (±0.12)
CCSRI, Mandvi, Bhuj	0.96 (±0.10)	8.05 (±0.22)	4.85 (±0.13)	8.04 (±0.06)
ARS, Kothara, SDAU, Bhuj	0.42 (±0.04)	8.84 (±0.16)	4.30 (±0.11)	8.19 (±0.09)

Table 11.2b. Performance (pod yield in g/p) of germplasm accessions and CAM variants at different locations evaluated for salinity tolerance during summer 2021

Porbandar (EC: 1.52)		Mandvi (EC: 4.85)		Kothara (EC: 4.30)	
Accession No.	**Pod yield (g/p)**	**Accession No.**	**Pod yield (g/p)**	**Accession No.**	**Pod yield (g/p)**
NRCG14343	3.85	NRCG14343	6.58	NRCG14343	8.29
NRCG14344	4.57	NRCG14344	6.83	NRCG14344	9.44
NRCG14381	10.0	NRCG14381	6.29	NRCG14381	6.86
NRCG14424	8.81	NRCG14424	6.36	NRCG14424	12.56
NRCG14429	6.75	NRCG14429	6.32	NRCG14429	10.37
NRCG14434	5.00	NRCG14434	9.75	NRCG14434	6.09
NRCG14461	8.04	NRCG14461	10.77	NRCG14461	11.18
NRCG14468	7.62	NRCG14468	8.13	NRCG14468	8.24
NRCG14485	7.87	NRCG14485	6.43	NRCG14485	8.00
DGRMB5	8.59	DGRMB5	7.83	DGRMB5	9.66
DGRMB19	8.97	DGRMB19	7.22	DGRMB19	8.39
GG5	8.18	GG5	5.39	GG5	6.84
GG7	10.30	GG7	3.94	GG7	6.29
GG2	6.68	GG2	2.83	GG2	8.38

now be evaluated in replicated trial at Kothara and Mandvi with GG2, GG5, GG7 and TG37A as checks to identify the sources of tolerance, if any.

Evaluation of CAM variants for salinity tolerance and expression of CAM

To understand the phenomenon of CAM involved in imparting salinity tolerance, an experiment was undertaken with TG37A and two of its C3-CAM transited and drought tolerant variants with soil salinity level of around 3.89 at harvest. It was found that while imposition of salinity at 3.89 of soil EC reduced the biomass production in the cultivar TG37A by almost 44% (6115 kg/ha in normal soil condition to 3113 kg/ha in around 3.89 soil EC in TG37A), the over-expressive C3-CAM transited

Table 11.3. Evaluation of CAM variants under salinity stress

Treatments	HY (kg/ha)			PY (kg/ha)			Biomass reduction (%)		
	Normal	**Salinity**	**Mean**	**Normal**	**Salinity**	**Mean**	**Normal**	**Salinity**	**Reduction (%)**
TG37A	3870	1953	2912	2245	1160	1703	6115	3113	44
DGRMB19	4113	3202	3658	2575	1797	2186	6688	4999	25
DGRMB5	4190	2943	3567	2527	1817	2172	6717	4760	29
Mean	**4058**	**2700**	**3379**	**2449**	**1591**	**2020**			
LSD (0.05)									
Treatments (T)	355			183					
Level of salinity (S)	203			153					
TXS	352			265					

Certificate
Plant Germplasm Registration

ICAR

It is certified that germplasm DGRMB5 of Groundnut (INGR21060) developed by

KK Pal, Rinku Dey, K Chakraborty, R Bhadania, M K Mahatma, AL Rathnakumar, B Nawade, P Dash, Ajay BC, Suhail Ahmad, Narendra Kumar, S Acharya and Radhakrishnan T
ICAR-Directorate of Groundnut Research, Junagadh, Gujarat

has been registered by Plant Germplasm Registration Committee (PGRC) of Indian Council of Agricultural Research on March 18, 2021.

Member-Secretary
PGRC

Chairman, PGRC
DDG (CS) ICAR

Certificate
Plant Germplasm Registration

ICAR

It is certified that germplasm DGRMB 19 of Groundnut (INGR21061) developed by

KK Pal, Rinku Dey, K Chakraborty, R Bhadania, MK Mahatma, AL Rathnakumar, B Nawade, Ajay BC, Suhail Ahmad, S Acharya, Narendra Kumar, P Dash and Radhakrishnan T
ICAR-Directorate of Groundnut Research, Junagadh, Gujarat

has been registered by Plant Germplasm Registration Committee (PGRC) of Indian Council of Agricultural Research on March 18, 2021.

Member-Secretary
PGRC

Chairman, PGRC
DDG (CS) ICAR

variants of TG37A, like DGRMB19 minimized the biomass reduction (6688 kg/ha on normal condition to 4999 kg/ha) and maintained at 25% level of reduction. In terms of pod yield, whereas pod yield of TG37A was reduced by 48%, it was restricted to 29% in case of DGRMB5 (**Table 11.3**). Both the CAM transited genotypes performed significantly superior than TG37A.

The six CAM variants of TG37A was evaluated at CCSRI, Mandvi with TG37A and GG7 with soil salinity (EC 0.85 before sowing and EC 4.65 at harvest). Three CAM variants viz., DGRMB5, DGRMB19 and DGRMB32 significantly enhanced the pod yield of groundnut over GG7. Yield enhancement was 27-33% in these variants (**Table 11.4**).

Table 11.4. Evaluation of CAM variants at CCSRI, Mandvi during summer 2021

Treatment	PY (kg/ha)	Improvement in pod yield over GG7 (%)
TG3A	2136	-33.82
DGRMB5B	3508	8.70
DGRMB5	4095	26.87
DGRMB19	4290	32.92
DGRMB24	3789	17.40
DGRMB32	4170	29.20
DGRMB41	2516	-22.04
GG7	3227	
CD (0.05)	**630**	

Effecting fresh crosses for salinity tolerance in groundnut

Total two crosses were effected during *kharif* 2021 to develop salinity tolerance in groundnut using two donor sources, DGRMB 5 and DGRMB 19. Total 56 mature crossed pods were harvested from two crosses. The mean success rate of the hybridization programme is 29.4% (**Table 11.5**).

Registration of germplasm

Two facultative C3-CAM transited variants of TG 37A viz., DGRMB5 (INGR 21060) and DGRMB19 (INGR21061) were registered with NBPGR as a novel source of salinity tolerance in groundnut.

Project 12: Optimization of mineral nutrition in Groundnut for better human and soil health

PI: *Sushmita Singh*

Co-PIs: *KK Pal, Rinku Dey, Kiran Reddy, Rajanna G.A. and Rajaram Choudhary*

Sub Project 1: Micronutrient nutrition and their biofortification in groundnut

Phytate reduction in kernels of groundnut cultivars through external Zn sources

Application of commercial ($ZnSO_4$) and microbial Zn sources (FP 82 and BM 6) was evaluated in 10 groundnut cultivars during summer 2021wherein Zn enrichment was found to be at par for both the sources, with 16- 20% increase over control. However, phytic acid (PA) reduction was recorded only with microbial Zn sources treatment causing an average reduction of 10% and 18% in phytic acid content of kernels through FP 82 and BM 6 treatments respectively (**Fig 12.1**). The cultivars showing maximum reduction in PA content were GJG 9 (12- 23%), GG 7 (7-16%), SG 99 (8- 20%), GJG 32 (7- 22%) and Dh 86 (26-40%).

Identification and characterization of Iron chlorosis tolerant advanced breeding lines (ABLs) of Groundnut

PBS 22040 and PBS 29192 were identified and characterized as Iron chlorosis tolerant advanced breeding lines, using NRCG 7472 and ICGV 86031 as the susceptible and tolerant checks, respectively during *kharif* 2020 and *kharif* 2021. Higher chlorophyll a & b content and carotenoid content was recorded for the tolerant lines with PBS 22040 showing maximum values; and PBS 29192 performing at par with ICGV 86031. The

Table 11.5. List of crosses undertaken for salinity tolerance

S. No.	Name of Cross	Purpose	Buds pollinated	No. F_1 pods	Success (%)
1	DGRMB 5 X K 1812	Salinity tolerance with high yield	98	24	24.4
2	DGRMB19 X K 1812	Salinity tolerance with high yield	93	32	34.4

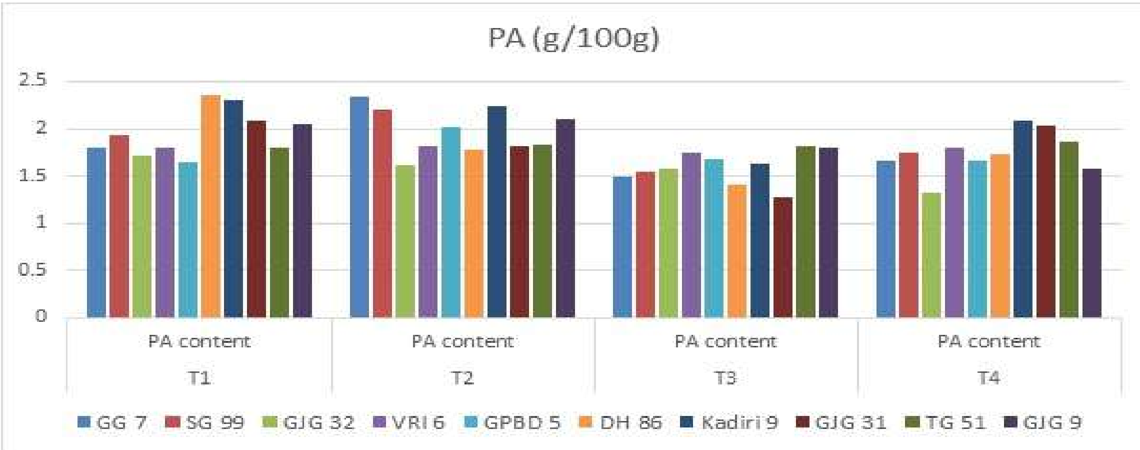


Fig 12.1 : Reduction in PA content upon external application of different Zn sources

malondialdehyde content (MDA) values were higher for sensitive lines NRCG 7472, PBS 12215 and PBS 12185, along with greater ROS scavenging enzyme ascorbate peroxidase (APX) and peroxidase (POX) accumulation in their leaves (**Fig 12.2**).

and GJG 32 showed the highest Fe content. The phytic acid content varied in the range 0.4- 1.6 g/100g with TMV 10, VRI7 and ICGV 00350 showing highest values. The seasonal influence on PA accumulation in 10 groundnut cultivars was also

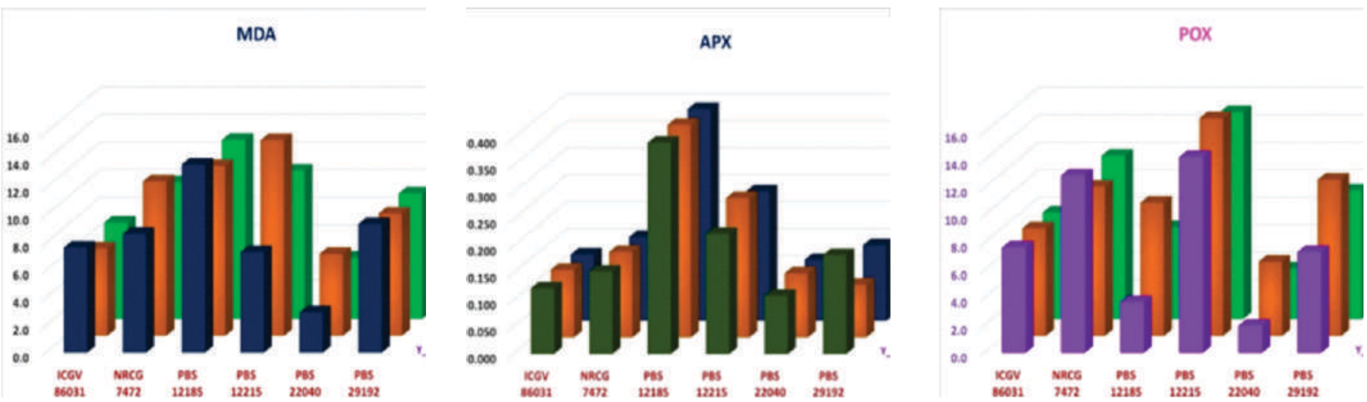


Fig 12.2: Malondialdehyde content and ROS scavenging enzyme activity in tolerant and susceptible ABLs

The phenolics profiling revealed significant increase in resveratrol (> 5 ppm) and Ferulic acid content (> 250 ppm) in tolerant ABLs (PBS 22040 and PBS 29192), while the susceptible ABLs (PBS 12185 and PBS 12215) recorded lower resveratrol (3- 3.6 ppm) and ferulic acid content (103- 124 ppm) in kernels **(Fig 12.3)**.

Screening of micronutrient (Fe and Zn) dense groundnut cultivars

One hundred groundnut cultivars were screened during *kharif* 2021 to identify cultivars with high zinc (Zn), iron (Fe) and low phytate content (PA) in their kernels. Twenty three out of 100 cultivars were found to have high Zn and 14 with high Fe. GG7, Tirupati 4 and JL 220 were among the highest Zn containing groundnut cultivars while GG7, GJG 18

studied wherein the PA accumulation during *rabi* summer 2021 ranged from 1.7- 2.35 g/ 100g, while during *kharif* 2021, PA content in the kernels of same groundnut cultivars ranged from 0.4- 1.6 g/ 100g.

Effect of foliar applied micronutrients on mitigating drought induced nutrient stress in groundnut

The experiment consisted of ten treatments having 4 nutrients [calcium EDTA (CaEDTA), iron-sulphate (FeSO4), zinc (Zn) and Boron] used for foliar application with two levels of application (0.5 and 1.0%) along with control and water spray plots. The experiment was designed using RBD with three replications. Sowing was done on 04th July 2021 using groundnut variety 'Kadari Amaravathi' planted at 30×10 cm in a gross plot area of 27m^2.

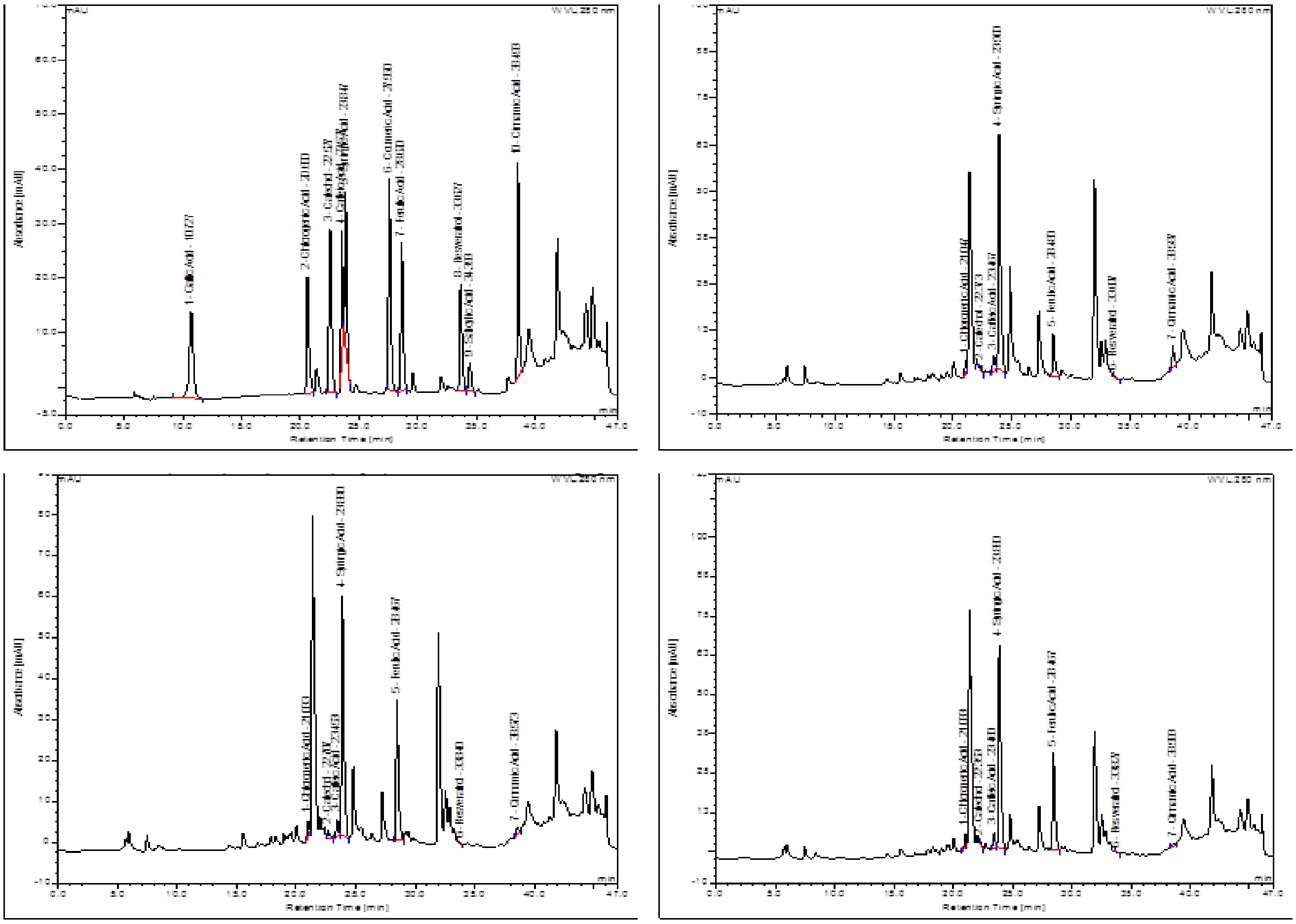


Fig. 12.3: Phenolics profiling of IDC tolerant ABLs (PBS 22040 and 29192) versus sensitive check (NRCG 7472)

Harvesting was done on 25.10.2021. The recommended rate of fertilizer used was 20:40:50 kg NPK/ha along with gypsum application (500 kg/ha) at 25 DAS. Foliar application of FeSO4 @ 0.5% recorded significantly higher pod yield (1323 kg/ha), haulm yield (3139 kg/ha), kernel yield (945 kg/ha),

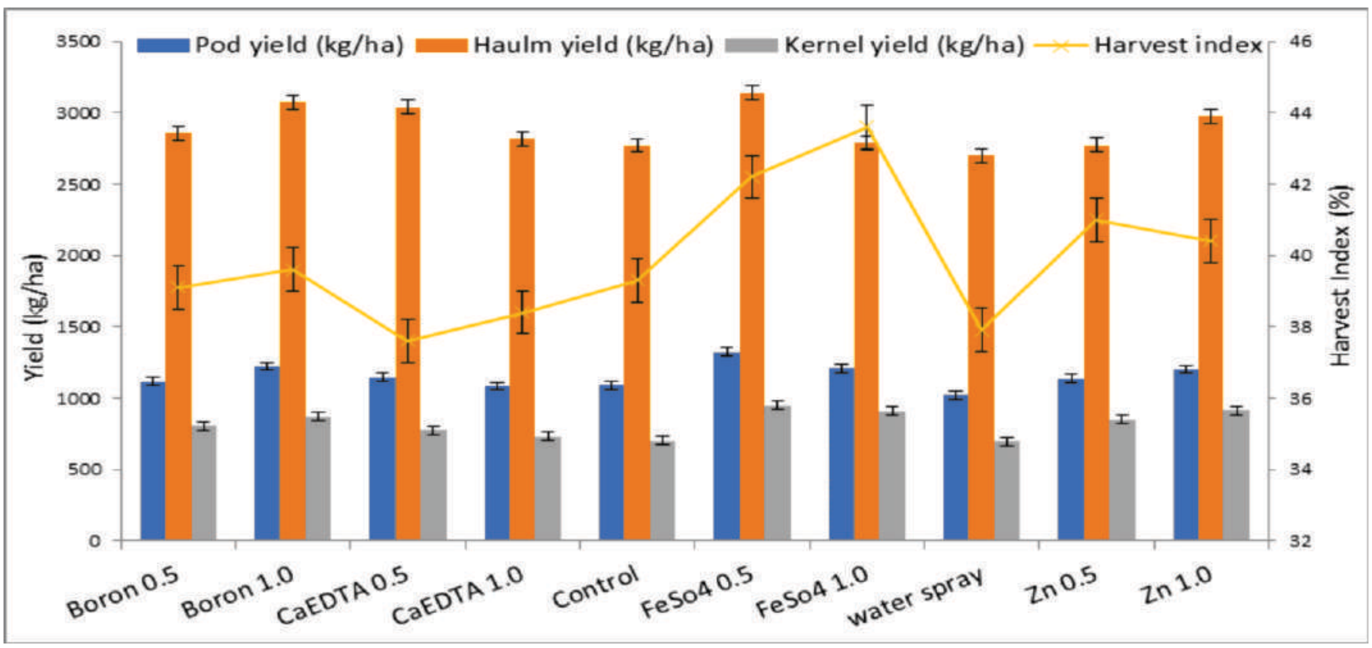


Figure 12.4: Effect of micronutrient foliar application on mitigating drought and nutrient stress in groundnut

shelling percentage (75 %) and 100 kernel weight (53.9 g) as compared to control plots, water sprayed plots and other foliar nutrients applied plots. However, boron and zinc application @ 1.0% showed higher yields compared to 0.5% level. Calcium EDTA @ 0.5% level exhibited higher yields than that of 1.0 % **(Fig 12.4).**

Sub Project 2: Nutrient management in groundnut through microbial solubilization and mobilization

Improving Zn, Mn and K availability and yield of groundnut

Performance of Zinc solubilizing bacteria (ZSB) in field

Five efficient Zn-solubilizing microbial cultures were evaluated in a field trial during summer 2021 to study the effects of inoculation of groundnut with Zn-mobilising bacterial cultures on growth, yield and Zn uptake. Seed inoculation with three of the isolates *Enterobacter cloacae* subsp. *dissolvens* strain ZM 7, *Enterobacter cloacae* subsp. *dissolvens* strain ZM 9 and *Acinetobacter oleivorans* strain ZM-12 resulted in significant increase **(Table 12.1)** in pod yield (23% with ZM 12 which was at par with that of ZM 7 and ZM 9). Inoculation with zinc solubilizing bacteria also resulted in increase in zinc content of shoot and seeds of groundnut. The average Zn content in shoot ranged from 43 to 92 ppm in different treatments with ZSB (30 ppm in control), while it ranged from 64 to 81 ppm with ZSB (55 ppm in control) in seeds. In a similar field trial conducted during *kharif* 2021, seed inoculation with these three isolates resulted in significant increase **(Table 12.2)** in pod yield (21% with ZM 9 which was at par with ZM 12 and ZM 7).

Thus, these zinc-solubilising bacterial cultures can be used for enhancing yield and Zn uptake in groundnut.

Performance of potassium solubilizing bacteria (KSB) in field

Five efficient K-solubilizing bacterial cultures were evaluated in a field trial during summer 2021 to study the effects of inoculation of groundnut with K-mobilizing bacterial cultures on growth, yield and K

Table 12.1: Effect of inoculation of Zn- solubilizing bacteria on the growth and yield of groundnut in field condition during summer 2021 (cv TG37A)

Treatment	PY (kg/ha)	HY (kg/ha)	SOT (%)	HKW (g)
Control	2053	3260	63.00	40.19
Acinetobacter oleivorans ZM12	2525	3801	66.96	42.49
Enterobacter cloacae ZM3	2163	3520	63.76	41.26
Enterobacter cloacae subsp. *dissolvens* ZM6	2115	3470	64.73	41.23
Enterobacter cloacae subsp. *dissolvens* ZM7	2494	3780	67.02	43.12
Enterobacter cloacae ZM9	2395	3710	67.28	42.59
CD (0.05)	**262**	**234**	**1.85**	**1.25**

PY: Pod Yield; HY: Haulm Yield; SOT: Shelling Out-turn: HKW: Hundred Kernel Weight

Table 12.2: Effect of inoculation of Zn- solubilizing bacteria on the growth and yield of groundnut in field condition during *kharif* 2021 (cv TG37A)

Treatment	PY (kg/ha)	HY (kg/ha)	SOT (%)	HKW (g)
Control	2151	3903	62.20	35.53
Acinetobacter oleivorans ZM12	2465	4317	63.30	38.63
Enterobacter cloacae ZM3	2315	3980	62.00	36.27
Enterobacter cloacae subsp. *dissolvens* ZM6	2188	4128	62.77	36.02
Enterobacter cloacae subsp. *dissolvens* ZM7	2452	4375	63.91	38.33
Enterobacter cloacae ZM9	2606	4405	65.28	38.74
CD (0.05)	**294**	**344**	**2.10**	**1.54**

PY: Pod Yield; HY: Haulm Yield; SOT: Shelling Out-turn: HKW: Hundred Kernel Weight

Table 12.3: Evaluation of K- solubilizing bacteria on growth and yield of groundnut (cv TG37A) during summer 2021 (field trial)

Treatment	PY (kg/ha)	HY (kg/ha)	SOT (%)	HKW (g)
Control	2117	3850	63.92	40.52
Acinetobacter lactucae strain KM5-2	2270	4075	64.99	40.82
Acinetobacter oleivorans strain KM6-1	2192	3973	65.45	41.53
Acinetobacter lactucae strain KM8-1	2220	4035	64.38	41.77
Acinetobacter lactucae strain KM8-2	2483	4388	67.93	43.35
Pseudomonas taiwanensis strain KM-9	2494	4417	67.70	43.57
CD (0.05)	**266**	**341**	**2.13**	**1.06**

PY: Pod Yield; HY: Haulm Yield; SOT: Shelling Out-turn: HKW: Hundred Kernel Weight

Table 12.4: Evaluation of K- solubilizing bacteria on growth and yield of groundnut (cv TG37A) during *kharif* 2021 (field trial)

Treatment	PY (kg/ha)	HY (kg/ha)	SOT (%)	HKW (g)
Control	2120	4133	58.77	34.90
Acinetobacter lactucae strain KM5-2	2665	4387	62.17	38.00
Acinetobacter oleivorans strain KM6-1	2258	4100	58.33	34.93
Acinetobacter lactucae strain KM8-1	2397	4242	59.47	35.97
Acinetobacter lactucae strain KM8-2	2471	4513	62.73	37.17
Pseudomonas taiwanensis strain KM-9	2560	4630	62.88	39.03
CD (0.05)	**304**	**318**	**1.32**	**1.94**

PY: Pod Yield; HY: Haulm Yield; SOT: Shelling Out-turn: HKW: Hundred Kernel Weight

uptake. Seed inoculation with two of the isolates, *Acinetobacter lactucae* strain KM8-2 and *Pseudomonas taiwanensis* strain KM 9 resulted in significant increase in pod yield **(Table 12.3)**, the maximum was with KM 9 (17.8%). The isolates KM8-2 and KM 9 also resulted in enhancement of haulm yield, shelling outturn, and hundred kernel weight. Inoculation with KSB also resulted in increase in K content of shoot, ranging from 0.93% to 1.29% in different treatments (0.87% in control). During *kharif* 2021, seed inoculation with *Acinetobacter lactucae* strain KM5-2 resulted in significant increase **(Table 12.4)** in pod yield of groundnut (25%, at par with KM-9 and KM8-2). These K-solubilizing bacterial isolates can be used for seed inoculation for improving mobilization of potassium, along with yield enhancement.

Performance of Zn and potash solubilizing bacteria in potted conditions

Twenty-four Zn-solubilising microbial cultures were tested in a pot trial to study the effects of inoculation of groundnut with Zn-mobilising bacterial cultures on growth, yield and Zn uptake. All the zinc solubilizers were identified by 16S rRNA sequencing and found to be different species of the genus *Enterobacter, Pseudomonas, Acinetobacter* and *Microbacterium*. Inoculation with 15 of the Zn-solubilising bacterial cultures resulted in significant increase **(Fig 12.5)** in pod yield (g/pl), ranging from 18-22%. The maximum increase in pod yield was obtained with strain *Acinetobacter calcoaceticus* strain ZM 35. Fourteen of the isolates also resulted in significant increase in plant biomass (g/pl), ranging from 9.4 to 18.4%. Seed inoculation with ZSB also resulted in significant increase in uptake of Zn in shoot and seed of groundnut. The ZSB isolates ZM 31, ZM 35, ZM 34, ZM 19, ZM 16, etc resulted in enhanced content of Zn in shoot samples, ranging

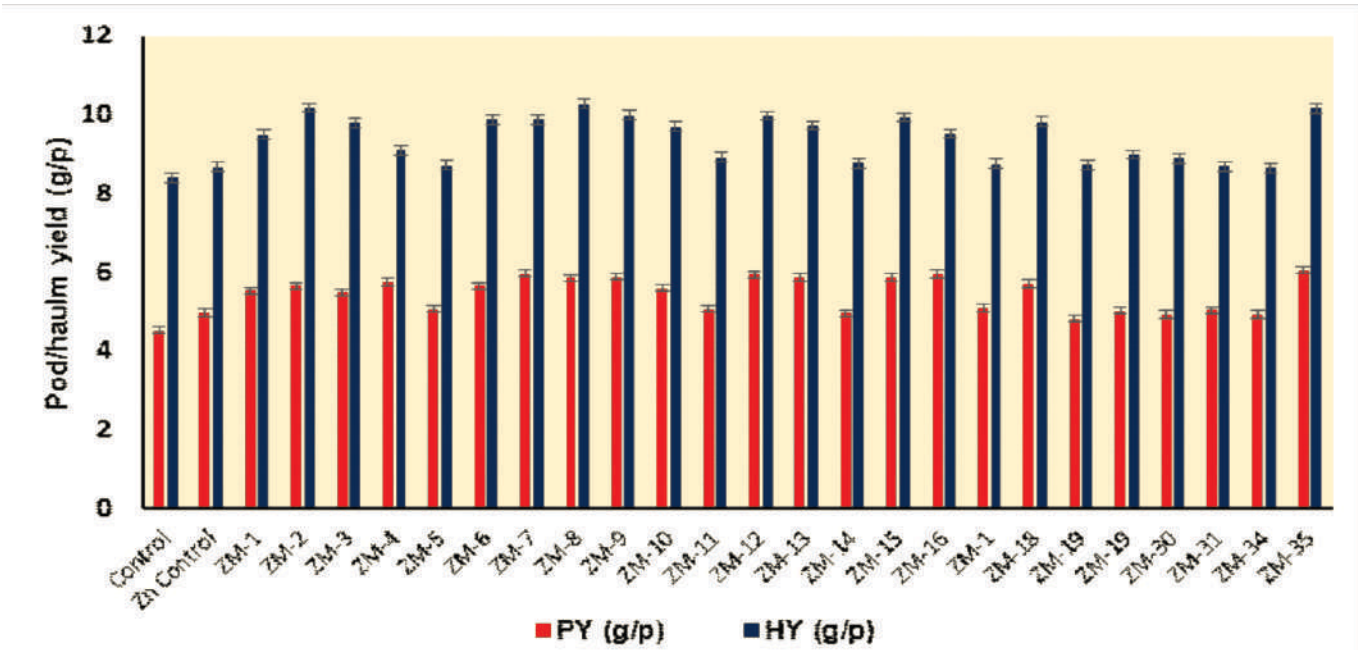


Fig 12.5: Zinc- solubilizing bacteria in potted conditions (summer 2021)

Table 12.5: Evaluation of potassium-solubilizing bacteria in potted conditions (summer 2021)

Treatment	PY (g/plant)	HY (g/plant)
Control	4.47	8.44
Control K	4.47	8.76
Acinetobacter calcoaceticus strain KM-1	4.76	9.04
Enterobacter cloacae subsp. *dissolvens* strain KM-2	5.12	8.87
Streptomyces roseofulvus KM3	4.82	9.16
Pseudomonas boreopolis strain KM5-1	4.92	9.03
Acinetobacter lactucae strain KM5-2	4.84	9.16
Acinetobacter oleivorans strain KM6-1	5.75	10.96
Acinetobacter oleivorans strain KM6-2	5.84	10.69
Acinetobacter lactucae strain KM8-1	5.17	9.19
Acinetobacter lactucae strain KM8-2	6.13	10.89
Pseudomonas taiwanensis strain KM-9	5.72	11.09
Pseudomonas plecoglossicida strain KM-10	4.76	9.15
Flavobacterium anhuiense strain KM-11	5.07	9.47
Sinorhizobium meliloti strain KM-12	6.11	10.36
Bacillus wiedmannii strain Af-4	6.49	11.33
CD (0.05)	**0.31**	**0.63**

PY: Pod Yield; HY: Haulm Yield

from 44 to 60 ppm (33 ppm in control). Inoculation with ZSB (ZM 1, ZM 15, ZM 18, ZM 6, ZM 7, etc) also resulted in enhancement of Zn content in seeds of groundnut, ranging from 45 to 72 ppm (45 ppm in control).

Application of 12 isolates, out of 14 tested, resulted in significant increase in pod yield (g/p), ranging from 8.0 to 45% (**Table 12.5**). The maximum increase was obtained with *Bacillus wiedmannii* strain Af-4, which also recorded maximum haulm yield. Inoculation with 7 of the isolates also resulted in significant increase in haulm yield of groundnut.

Inoculation with KSB also resulted in increase in K content of shoot, ranging from 1.02% to 1.38% in different treatments (0.83% in control).

Performance of Mn solubilizing bacteria in potted condition

Evaluation of 19 Mn-mobilizing bacterial isolates resulted in significant increase in pod yield (g/pl), ranging from 11.0 to 24% **(Fig 12.6).** The maximum increase was obtained with isolates, Mn12-2 and Mn2-1. Inoculation with 3 other isolates also resulted in significant increase in haulm yield of groundnut.

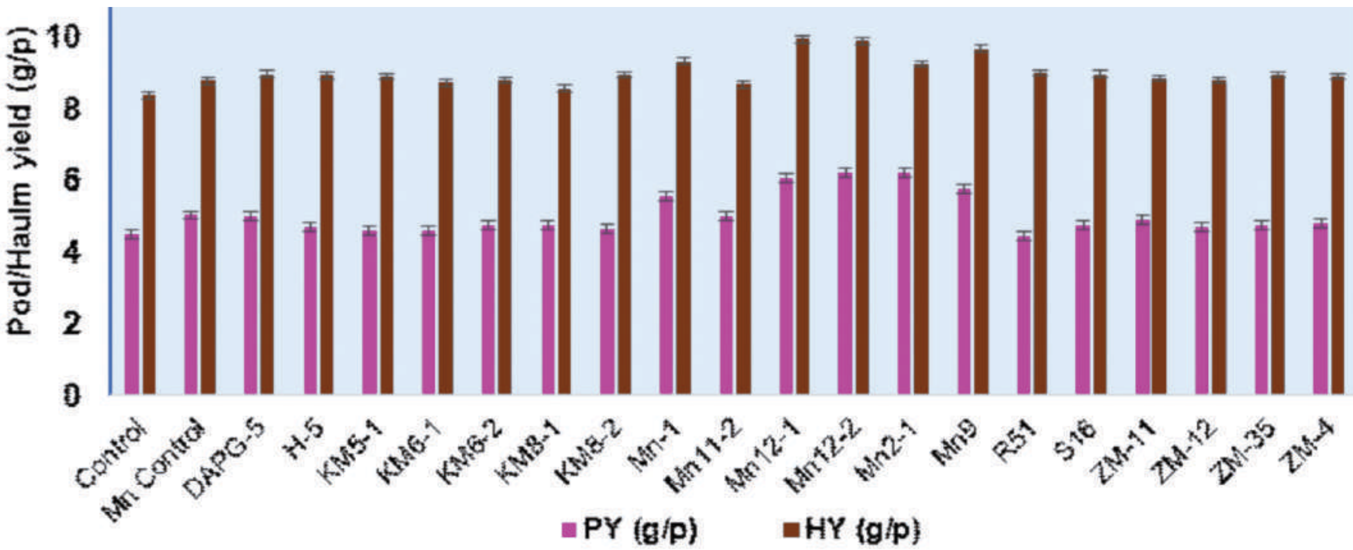


Fig 12.6: Effect of Mn solubilizing bacteria on growth and yield of groundnut (Summer 2021) in potted conditions

Inoculation with manganese-solubilizing bacteria also resulted in increase in Mn content of shoot, ranging from 76 ppm to 133 ppm in different treatments (68 ppm in control). Inoculation with Mn-solubilizing bacterial isolates will improve the Mn mobilization in groundnut, along with growth and yield.

Groundnut rhizobia for enhancing BNF and yield in groundnut

Eleven new isolates of groundnut rhizobia, along with standard culture TAL 1000 were tested for their efficiency in increasing BNF and yield in groundnut in a field trial with cultivar TG37A during summer 2021. Seed inoculation with 5 of the isolates (DGR 23, DGR 24, DGR 25, DGR 26, and DGR 35) resulted in significant enhancement of pod yield (Table 12.6), the maximum with DGR 26 (21.8%). In general, these isolates also resulted in increase in haulm yield, shelling out-turn, and hundred kernel weight.

Twenty-one new isolates of groundnut rhizobia were

Table 12.6: Evaluation of competitive strains of groundnut rhizobia for enhancing BNF and yield of groundnut (cv TG37A) during summer 2021

Treatments	PY (kg/ha)	HY (kg/ha)	SOT (%)	HKW (g)
Control	2095	3603	63.82	39.16
DGR10	2133	3710	65.12	39.91
DGR11	2100	3647	64.16	40.53
DGR17	2043	3843	64.54	39.66
DGR18	2313	3833	63.56	40.11
DGR19	2220	3847	63.96	38.76
DGR20	2220	3690	64.41	39.68
DGR23	2440	4190	67.02	42.18
DGR24	2513	4263	67.59	41.69
DGR25	2485	4277	67.60	42.67
DGR26	2553	4187	67.13	41.42
DGR35	2480	3903	67.31	42.14
TAL1000	2178	3883	64.08	40.04
CD (0.05)	**222**	**321**	**1.27**	**1.53**

PY: Pod Yield; HY: Haulm Yield; SOT: Shelling Out-turn: HKW: Hundred Kernel Weight

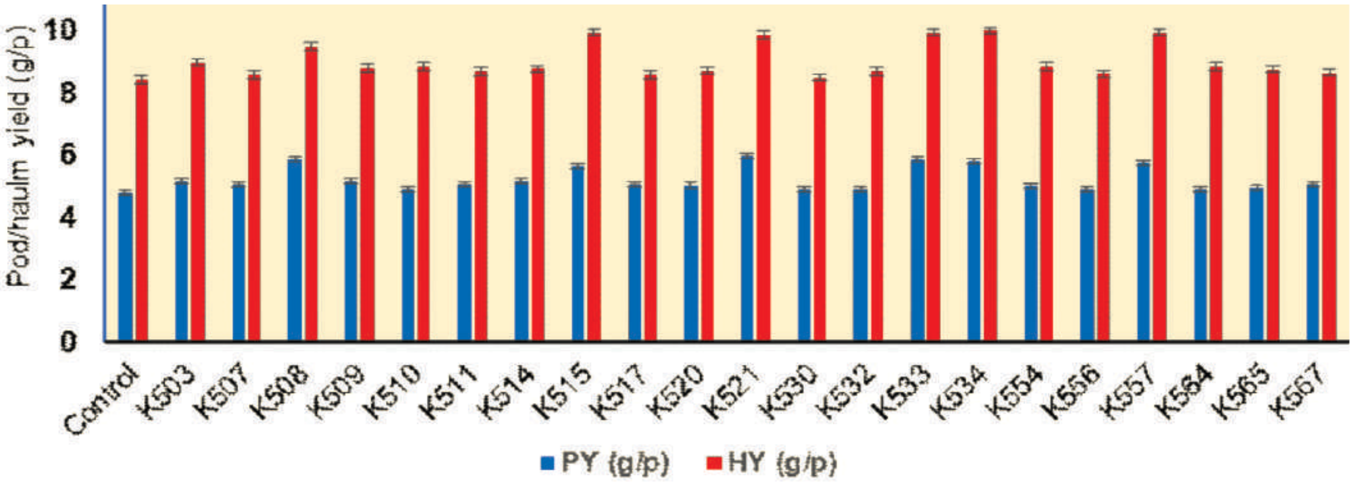


Fig 12.7: Effect of inoculation of efficiently nodulating and nitrogen fixing strains of groundnut rhizobia on yield of groundnut (cv. TG37A) in potted conditions, summer 2021

evaluated in a pot trial during summer 2021 for their efficiency in increasing yield in groundnut. Seed inoculation with 6 isolates (K508, K515, K521, K533, K534, and K557) resulted in significant enhancement of yield **(Fig 12.7)**, the maximum with K521 (24.2%).

Sub Project 3 : Improving nutrient use efficiency in groundnut and its cropping systems

Effect of different doses of P and seed treatment with DGRC culture on peanut yield and P fractions in soil

The experiment was conducted in summer 2021, with six treatments (T1-0 kg P_2O_5/ha; T2-25 kg P_2O_5/ha; T3-50 kg P_2O_5/ha; T4-0 kg P_2O_5/ha+ DGRC culture; T5-25 kg P_2O_5/ha+ DGRC culture; T6-50 kg P_2O_5/ha + DGRC Culture) and 3 replications in RBD. N, P and K (25 kg N: P as per treatment and 30 kg K_2O/ha) was supplied through Urea, DAP and Muriate of potash. Higher pod yield (2218 kg/ha) and Pod P (12.8 kg P/ha) uptake was significantly obtained with T6 (50 kg P_2O_5/ha + DGRC Culture). There is 13.3% pod yield increase when DGRC is applied with 25 kg P_2O_5/ha compared to 25 kg P_2O_5/ha alone and 10.5 % pod yield increase when DGRC is applied with 50 kg P_2O_5/ha compared to 50 kg P_2O_5/ha alone.

P fractions were analyzed using Hedley-type fractionation scheme used by Li *et al.* (2015)

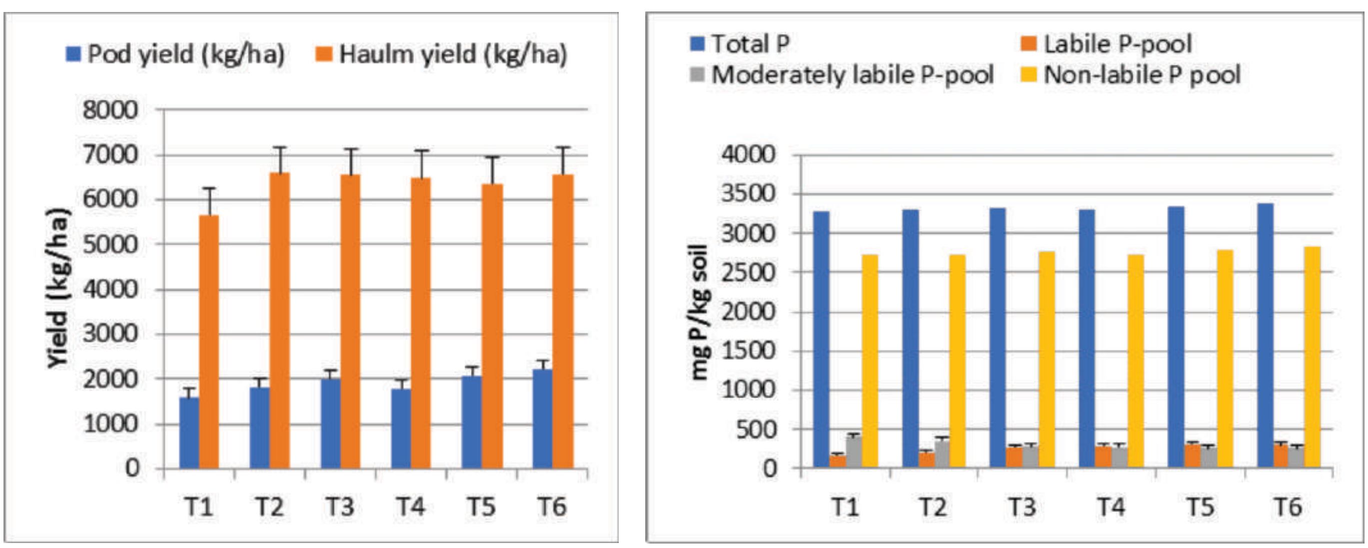


Fig 12.8: Effect of different treatments on yield and P fractions in soil

(T1-0 kg P_2O_5/ha; T2-25 kg P_2O_5/ha; T3-50 kg P_2O_5/ha; T4-0 kg P_2O_5/ha+ DGRC culture; T5-25 kg P_2O_5/ha+ DGRC culture; T6-50 kg P_2O_5/ha + DGRC Culture) andNegassa and Leinweber (2009).Different fractions analyzed included labile P-pool (Resin-Pi, $NaHCO_3$-Pi, and $NaHCO_3$-Po), moderately labile P-pool (NaOH-Pi and NaOH-Po), and non-labile P-pool (HCl-Pi and Residual P). Labile-P consists of P in soil solution and easily exchangeable P from soil lattices. Moderately labile P-pool consists of Fe and Al bound P. Non-labile-P pool consist of Ca and Mg bound P. Before sowing, average total-P pool in soil is 3214 mg P_2O_5/kg, labile-P pool is 162 mg P_2O_5/kg soil, moderately labile P pool is 312 mg P_2O_5/kg soil and non-labile-P pool is 2798 mg P_2O_5/kg soil.At harvest, in different treatments total-P pool in soil ranged from 3284-3391 mg P_2O_5/kg, labile-P pool ranged from 168-312 mg P_2O_5/kg soil, moderately labile P pool ranged from 257-401 mg P_2O_5/kg soil and non-labile P-pool ranged from 2715-2822 mg P_2O_5/kg soil. A 47 % increase in labile-P pool is noted when DGRC culture is applied along with 25 kg P_2O_5/ha, compared to 25 kg P_2O_5/ha alone (T5 vs T2) and 13% increase in labile-P pool is noted when DGRC culture is applied along with 50 kg P_2O_5/ha, compared to 50 kg P_2O_5/ha alone **(Fig. 12.8)**

Effect of different source of P, varying P doses and seed treatment (DGRC and Bio-stimulants) on peanut yield and soil P pools

The experiment was conducted in *kharif*2021, with 12 treatments (T1- 12-32-16 (25 kg P_2O_5/ha); T2-12-32-16 (37.5 kg P_2O_5/ha); T3-12-32-16 (50 kg P_2O_5/ha); T4- 18-46-0 (25 kg P_2O_5/ha); T5-18-46-0 (37.5 kg P_2O_5/ha); T6-18-46-0 (50 kg P_2O_5/ha); T7-12-32-16 (25 kg P_2O_5/ha) + DGRC +Biostimulant; T8-12-32-16 (37.5 kg P_2O_5/ha) + DGRC +Biostimulant; T9-12-32-16 (50 kg P_2O_5/ha)+ DGRC +Biostimulant; T10-18-46-0 (25 kg P_2O_5/ha) + DGRC +Biostimulant; T11-18-46-0 (37.5 kg P_2O_5/ha)+ DGRC +Biostimulant; T12-18-46-0 (50 kg P_2O_5/ha)+ DGRC +Biostimulant) and 3 replications in a RBD design. Biostimulant used was Dhanzyme gold (Dhanuka) having sea weed extract and humic acids. Significantly higher pod yield (2304 kg/ha) and haulm (6952 kg/ha) yield were obtained with T12-18:46:0 (50 kg P_2O_5/ha) + DGRC + Bio stimulants application. Fertilizer source 18-46-0 performed well in terms of pod yield compared to 12-32-16 (T7). No. of nodules per plant ranged from 60-104/plant with the highest in T7. Nodule weight per plant ranged from 139 to 619 mg/plant, with maximum in T7. An increase of 14% pod yield is observed when DGRC1+Biostimulants are used in T7 over T1 (25kg P_2O_5/ha with 12-36-16). An increase of 15% pod yield is noted when DGRC1+Biostimulants are used in T12 over T6-18-46-0 (50 kg P_2O_5/ha).

Different fractions of P were analyzed. Before sowing, average total-P pool in soil is 3308 mg

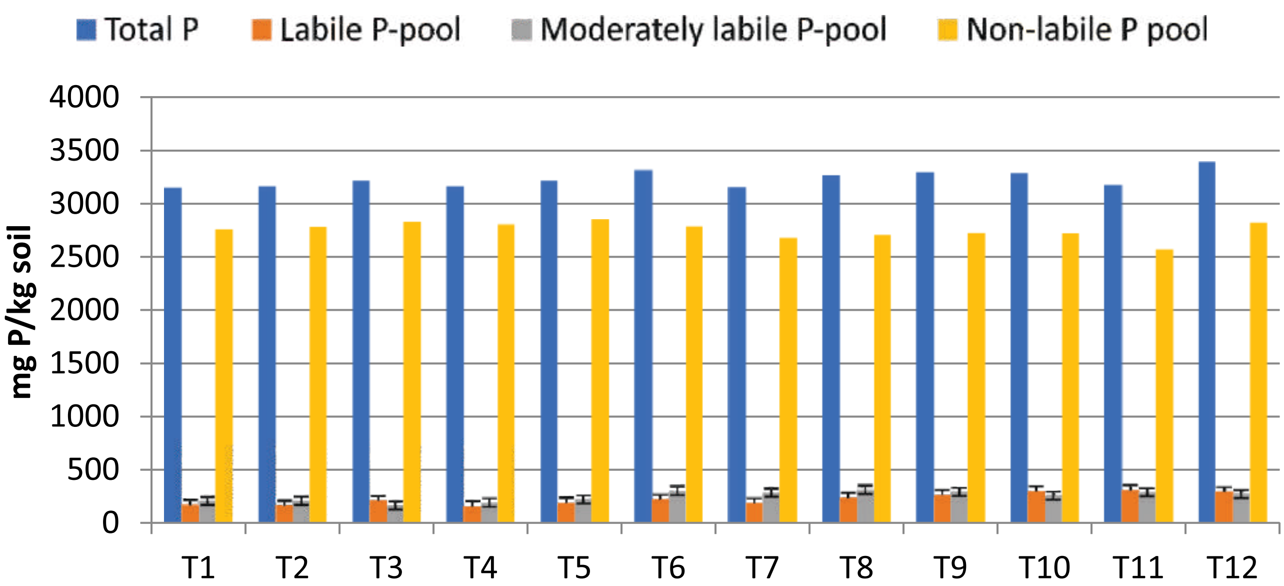


Fig 12.9: Effect of different treatments on P fractions in soil

(T1- 12-32-16 (25 kg P_2O_5/ha); T2-12-32-16 (37.5 kg P_2O_5/ha); T3-12-32-16 (50 kg P_2O_5/ha); T4- 18-46-0 (25 kg P_2O_5/ha); T5-18-46-0 (37.5 kg P_2O_5/ha); T6-18-46-0 (50 kg P_2O_5/ha); T7-12-32-16 (25 kg P_2O_5/ha) + DGRC + Biostimulant; T8-12-32-16 (37.5 kg P_2O_5/ha) + DGRC + Biostimulant; T9-12-32-16 (50 kg P_2O_5/ha)+ DGRC + Biostimulant; T10-18-46-0 (25 kg P_2O_5/ha) + DGRC + Biostimulant; T11-18-46-0 (37.5 kg P_2O_5/ha)+ DGRC + Biostimulant; T12-18-46-0 (50 kg P_2O_5/ha)+ DGRC +Biostimulant)

P_2O_5/kg, labile-P pool is 156 mg P_2O_5/kg soil, moderately labile P pool is 321 mg P_2O_5/kg soil and non-labile P-pool is 2831 mg P_2O_5/kg soil. At harvest, in different treatments total-P pool in soil ranged from 3150-3391 mg P_2O_5/kg, labile-P pool ranged from 163-312 mg P_2O_5/kg soil, moderately labile P pool ranged from 167-315 mg P_2O_5/kg soil and non-labile-P pool ranged from 2573-2854 mg P_2O_5/kg soil. A 61.6% increase in labile-P pool is noted when DGRC1+Biostimulants are used in T11 over T5-18-46-0 (37.5 kg P_2O_5/ha) **(Fig. 12.9)**

Effect of varying doses of P, S along with mulch and seed treatment (DGRC and bio-stimulant) on peanut yield and soil P pools

The experiment was conducted in *kharif* 2021, with 12 treatments (T1- 25 kg P_2O_5 + 20 kg S; T2-25 kg P_2O_5+ 40 Kg S; T3-25 kg P_2O_5+ 20 kg S + Mulch; T4-25 kg P_2O_5+ 40 Kg S + Mulch; T5-25 kg P_2O_5+ 20 kg S + Mulch + DGRC + Biostimulant; T6-25 kg P_2O_5+ 40 Kg S + Mulch + DGRC + Biostimulant; T7-50 kg P_2O_5 + 20 kg S; T8-50 kg P_2O_5 + 40 Kg S; T9-50 kg P_2O_5+ 20 kg S + Mulch; T10-50 kg P_2O_5+ 40 Kg S + Mulch; T11-50 kg P_2O_5+ 20 kg S + Mulch + DGRC + Biostimulant; T12-50 kg P_2O_5 + 40 Kg S + Mulch + DGRC + Biostimulant) and 3 replications in a RBD. Biostimulant used was Dhanzyme gold (Dhanuka) having sea weed extract and humic acids. Wheat straw mulch was used @ 10t/ha. DGRC is a consortium of phosphate solubilizing microbes. S is supplied with Bentonite S (90% S).Maximum pod yield (2198 kg/ha) was realized with T12-50 kg P_2O_5+40 Kg S+Mulch+DGRC+Biostimulant application and maximum haulm yield was observed in T8. No. of Nodules per plant ranged from 88-127/plant with highest in T6. Nodule weight per plant ranged from 157-228 mg/plant, with maximum in T5. Increasing S level from 20 to 40 kg S/ha increased pod yield by 21.5% (T8 vs T7). Application of mulch increased the pod yield by 10% (T4 vs T2)

P fractions were analyzed using Hedley-type fractionation scheme used by Li *et al.* (2015) and Negassa and Leinweber (2009). Before sowing average total-P pool in soil is 3251 mg P_2O_5/kg, labile-P pool is 137 mg P_2O_5/kg soil, moderately labile P pool is 336 mg P_2O_5/kg soil and non-labile P-pool is 2862 mg P_2O_5/kg soil. At harvest, in different treatments total-P pool in soil ranged from 3250-3351 mg P_2O_5/kg, labile-P pool ranged from 175-326 mg P_2O_5/kg soil, moderately labile P pool ranged from 228-379 mg P/kg soil and non-labile-P pool ranged from 2696-2797 mg P_2O_5/kg soil. Labile P-pool has increased by 137% at harvest in T12 compared to sowing. There was a decrease of moderate labile-P pool by 5.8%, with increase in S dose from 20 to 40 kg S/ha (T2 vs T1). There was an increase of labile P-pool by 11% when mulch is applied (T10 vs T8) **(Fig 12.10)**

Phosphorus and silicic acid varying doses along with seed treatment (DGRC+Biostimulant) affecting peanut yield and soil P pools

The experiment was conducted in *kharif* 2021, with 8 treatments (T1- 25 kg P_2O_5; T2-50 kg P_2O_5; T3-25 kg P_2O_5 + 5 g silicid acid per row of 4 m; T4-50 kg P_2O_5 + 10 g silicid acid per row of 4 m; T5-25kg P_2O_5+DGRC +Biostimulant; T6-50kg

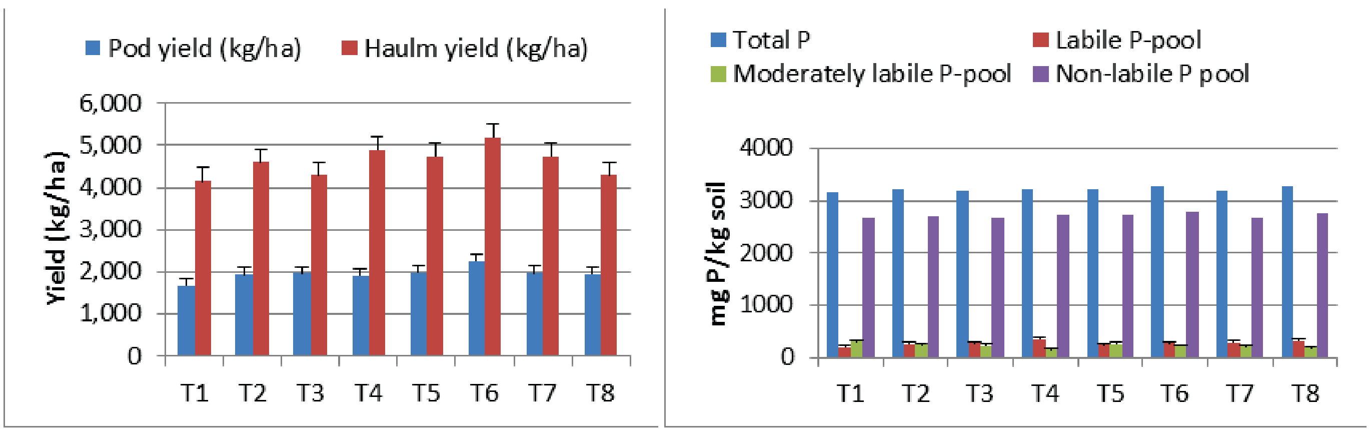


Fig. 12.10: Effect of different treatments on peanut yield and soil P pools

(T1- 25 kg P_2O_5; T2-50 kg P_2O_5; T3-25 kg P_2O_5 + 5 g silicid acid per row of 4 m; T4-50 kg P_2O_5 + 10 g silicid acid per row of 4 m; T5-25kg P_2O_5+DGRC +Biostimulant; T6-50kg P_2O_5+DGRC+Biostimulant; T7-25 kg P_2O_5+DGRC + Biostimulant + 5 g silicid acid per row of 4m; T8-50 kg P_2O_5 + DGRC + Biostimulant + 10 g silicid acid per row of 4 m)

P_2O_5+DGRC+Biostimulant; T7-25 kg P_2O_5+DGRC + Biostimulant + 5 g silicid acid per row of 4m; T8-50 kg P_2O_5 + DGRC + Biostimulant + 10 g silicic acid per row of 4 m) and 3 replications in a RBD. Biostimulant used was Dhanzyme gold (Dhanuka) having sea weed extract and humic acids. Highest pod yield (2259 kg/ha) was realized with T6-50 kg P_2O_5+ DGRC + Biostimulant application. No. of Nodules per plant ranged from 56-142/plant with highest in T8. Nodule weight per plant ranged from 107-197mg/plant, with maximum in T7. Silicic acid application was found to be effective in increasing the pod yield in low P application levels, its application increased pod yield by 17% (T3 vs T1). Increase in silicic acid level from 5g to 10 g/ row did not have significant effect on pod yield.

Different fractions were analyzed. Before sowing, average total-P pool in soil is 3274 mg P_2O_5/kg, labile-P pool is 148 mg P_2O_5/kg soil, moderately labile P pool is 315 mg P/kg soil and non-labile-P pool is 2768 mg P_2O_5/kg soil. At harvest, in different treatments total-P pool in soil ranged from 3168-3274 mg P_2O_5/kg, labile-P pool ranged from 191-354 mg P_2O_5/kg soil, moderately labile P pool ranged from 146-309 mg P_2O_5/kg soil and non-labile-P pool ranged from 2668-2774 mg P_2O_5/kg soil. A negative correlation was observed between labile P-pool and moderately labile P- pool (r=-0.74). There is a 39% increase in labile P-Pool with application of silicic acid (T4 vs T2)

Re-optimization of nitrogen doses for *kharif* groundnut (Bikaner)

An experiment was conducted during *kharif* 2021 in randomized complete block design (RCBD) having seven treatments viz. T1-control, T2-20 kg N/ha, T3-30 kg N/ha, T4- 40 kg N/ha (20 kg as basal +20 kg at 30 DAS), T5-50 kg N/ha (25 kg as basal + 25 kg at 30 DAS), T6-60 kg N/ha (30 kg as basal +30 kg at 30 DAS), and T7-70 kg N/ha (35 kg as basal + 35 kg at 30 DAS) and three replications to know the effect of different levels of nitrogen doses on groundnut yield. Girnar-2 variety was sown on 30th June, 2021 at 45x10 cm spacing. Pod yield increased with increasing level of N doses and highest significant pod yield was found at 50 kg N/ha (3541 kg/ha) being at par with 40 kg N/ha. However, significantly higher haulm yield was recorded at 70 kg N/ha. Number of mature pods per plant was significantly higher with 50 kg N/ha compared to other levels of nitrogen doses.

Project 13: Quality enhancement in groundnut and its product

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Evaluation of shelf-life of raw and roasted groundnut under storage condition

Packing and Storage

The raw and roasted groundnuts (GG 20 and Girnar 2) were packed in plastic bags and transparent front/silver Back (aluminium) food-grade bags. Each pouch was filled with 50 gm groundnuts and sealed. Plastic pouches were packed without vacuum, while aluminium bags were vacuum packed. The bags were stored for two months at room temperature. Stored kernels were analysed for peroxide value, free fatty acid content and tocopherol content at 0, 7, 15, 30 and 60-days after storage to evaluate the effect of roasting and storage on groundnut quality.

Flow Chart for the Processing of roasting and storage

↓

Groundnut seed

(GG 20 and Girnar 2)

↓

Roasting (160 ºC for 10 min.)

Cool at room temperature

↓

Packaging (Vacuum and normal)

Storage (at room temperature on different days, S1 to S5)

S1: 0 day, S2: 7-days, S3: 15- days, S4: 30-days and S5: 60-days

Peroxide value

The roasting of kernels significantly increased the peroxide value (**Fig. 13.1**). The maximum peroxide value (PV) in roasted treatment was observed in

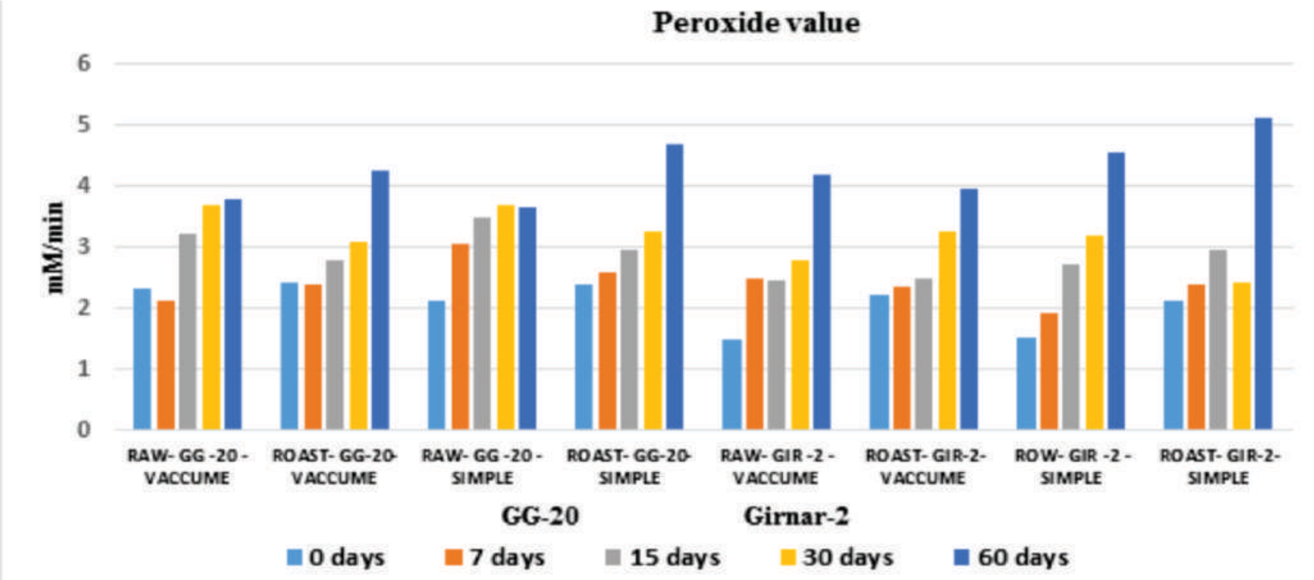

Fig.13.1: Effect of packaging and storage period on peroxide value (µM/1000 g) of raw and roasted groundnut kernel

simple plastic packing at 60 days (4.68%). Vacuum packaging had a significantly reduced peroxide value than that of standard plastic packaging of roasted kernels. At 60 days after storage, Girnar 2 had appreciably higher PV (5.11) than that of GG 20 (4.24). Observed differences may be due to higher oleic acid present in GG 20 than Girnar 2. Higher oleic acid is an indicator of the stability of the oil. Peroxide value increased to a lesser extent in vacuum-packed roasted kernels compared to standard plastic packing. This may be due to the absorption of atmospheric moisture in standard plastic packing during storage. Roasted kernels of GG 20 in plastic packing showed the same trend as observed in raw treatment. The maximum peroxide value was observed 60 days after storage in plastic packaging. The roasting of kernels significantly increases the peroxide value content. Peroxide value increased in both packaging materials during all storage time. However, it was increased to a lesser extent in roasted kernels in vacuumed packing than standard plastic packing. Significant effects of packaging, temperature and storage time were observed on the peroxide value of groundnut kernels. Vacuum packaging may reduce lipid peroxidation in groundnut kernels during long term storage, thus less affecting the quality **(Fig 13.1).**

The free fatty acid content

After roasting in both varieties, free fatty acid content was slightly increased (**Fig. 13.2**). The maximum free fatty acid content (7.77 %) was

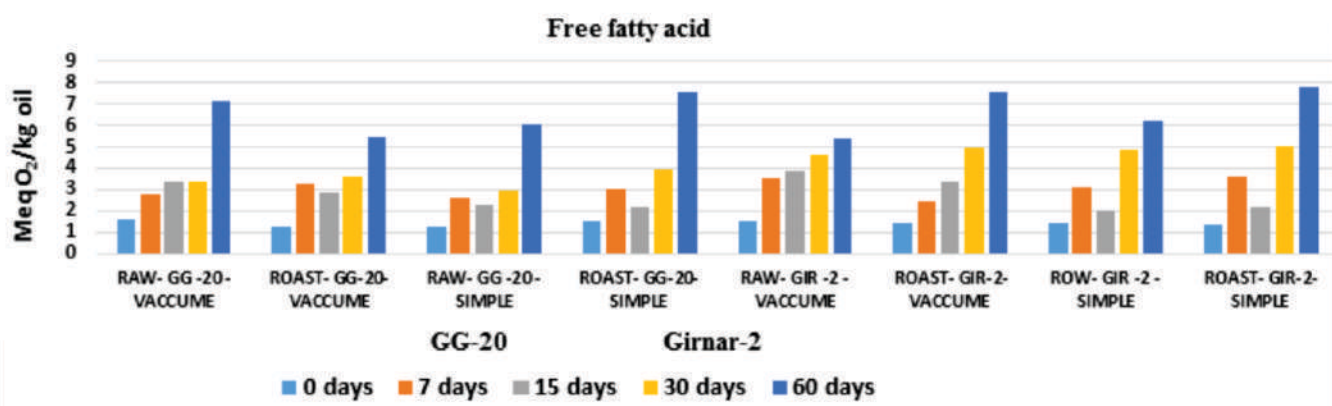

Fig. 13.2: Effect of packaging and storage period on free fatty acid content (Meq O_2/kg oil) of raw and roasted groundnut kernel

observed at 60 days after storage in roasted Girnar 2 under standard plastic packaging, and minimum free fatty acid content (1.60 %) was marked at 0-day storage in raw GG 20. Overall free fatty acid content increased at different stages of storage. The free fatty acid content of both the varieties was less increased under vacuum packaging in roasted and raw kernels up to 30 days of storage than standard packaging. After 60 days of storage, differences in free fatty acid content were less in a vacuum and simple packaging. However, Girnar 2 had higher free fatty acid content at initial (0 day) and 60 days after storage. Free fatty acids indicate the degree of triacylglycerol determination that occurs in hydrolysis,

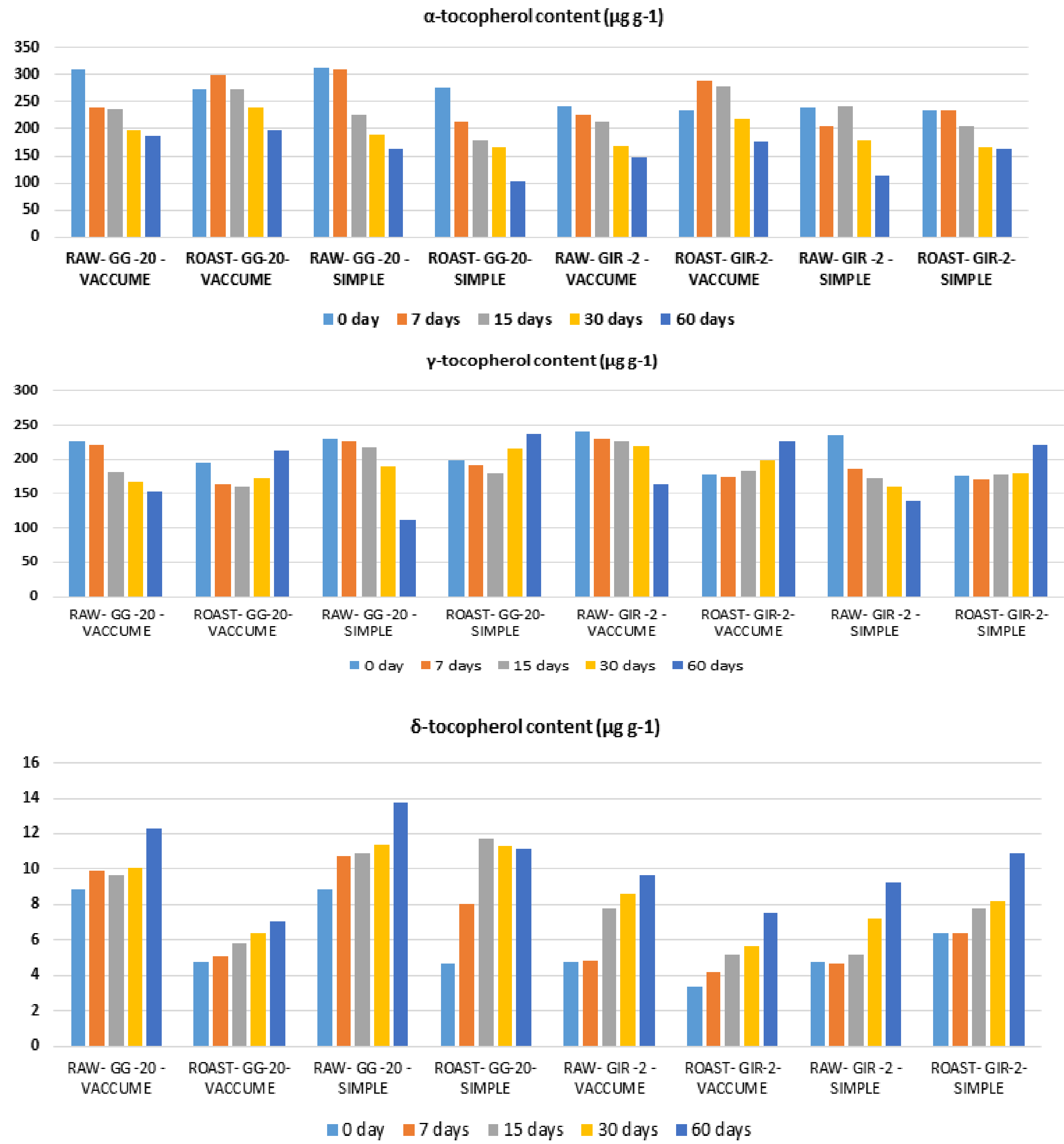

Fig 13.3: Effect of packaging and storage period on α- γ and δ tocopherol content (µg g-1) of raw and roasted groundnut kernel

fermentation and oxidation promoted by temperature and presence of water—the increase of free fatty acid content with storage time. Peroxide value and free fatty acids indicate rancidity, which altered due to roasting and storage of groundnut kernels. PV and FFA are evidence of autoxidation (free radical reaction) and hydrolytic rancidity, respectively.

Vitamin E (Tocopherols):

Vitamin E (α-, β- & γ- and δ-tocopherol) content was estimated from the oil of groundnut. Both β- & γ-tocopherol was separated at same retention time. Thus value represented by γ- tocopherol is the combined value of β- & γ- tocopherol. All tocopherols were decreased after roasting in groundnut kernels. After roasting, loss of α-tocopherol content was higher in GG-20 (12.21 %) than that of Girnar-2 (3.71 %) from their respective raw kernels. During storage, α-tocopherol was gradually reduced in both the varieties under simple and vacuum packaging. But in roasted kernels, it was increased to the tune of 9.9 % in GG-20 and 23.6 % in Girnar-2 at seven days after storage in vacuum packaging compared to their initial values (0 day).

After 60 days of storage, α-tocopherol was reduced 40.19 % in raw kernels of GG-20 under vacuum condition while under simple packaging, it was reduced 48.07 %. Roasted kernels under vacuum condition lost 27.47 % α-tocopherol while under simple packaging it was reduced 62.18 % compared to 0 day.

Gamma-tocopherol (representing both γ and β in our study) decreased after roasting in both varieties. After roasting, it was reduced by 13.65 % in GG 20 and 34.16 % in Girnar 2. It gradually decreased up to 30 days of storage after that slightly increased (212 $\mu g\ g^{-1}$) at 60 days of storage under vacuum condition compared to 0- day (196 $\mu g\ g^{-1}$). A similar trend was followed for roasted Girnar 2 (27.52 %) under vacuum storage, but the per cent increase was higher than GG-20 (8.16 %). After storage of 60 days in standard packaging, it was reduced 51.30 % in GG 20 and 40.42 % in Girnar 2 compared to initial storage (0 day).

Among the different tocopherols, content of δ-tocopherol was the least. It was also decreased after roasting. In contrast to other tocopherols, it was increased after storage in all treatments. Maximum δ-tocopherol was observed in raw kernels of GG 20 (13.72 $\mu g\ g^{-1}$) under simple packaging followed by raw kernels of GG 20 under vacuum packaging (12.25 $\mu g\ g^{-1}$) **(Fig 13.3).**

Preparation of salted groundnut by fortification with Zn

Zinc fortified salted groundnuts (TG 51 and Girnar 2) were prepared using 2 % salt (NaCl) and 500 mg and 1000 mg zinc sulfate per kg kernels. Groundnut kernels were soaked for 1, 2 and 4 hrs in salt and zinc sulfate solution and dried in a hot-air oven at 50 ºC. Zinc fortified salted groundnut kernels were analysed for zinc content. Zinc content was significantly increased in fortified groundnut kernels with soaking time. It was also enhanced with the increment of zinc sulfate concentration. The zinc content of TG 51 was increased 3.8-times after 1 hr seed soaking in 500 mg $ZnSO_4$/ kg seeds compared to control (water soaking: 27.9 mg/100 g seeds), while it was reduced by about 10 % in salt soaking (25.7 mg/100 g seeds). Zinc content was further increased (4.9 times) with 1000 mg $ZnSO_4$/ kg seeds. In Girnar 2, zinc content was increased about 2-times after 1 hr seed soaking in 1000 mg $ZnSO_4$/ kg seeds and 3.5-times with 2 hr soaking in 1000 mg $ZnSO_4$/ kg seeds compared to control (53.6 mg/100 g seeds). However, zinc content was reduced with increased soaking time in control (water) and salt solution. Thus, fortification of 1000 mg $ZnSO_4$/ kg seeds may improve zinc content (10 mg/100 g seed), fulfilling to RDA of Zn.

Preparation of salted groundnut by fortification with Zn and Ascorbic acid

Ascorbic acid and zinc sulfate was fortified with the kernels of Girnar 2 with a 2 % salt treatment. Ascorbic acid content was reduced in water (8 mg/100g kernels) and salt-soaked (9 mg/100g kernels) groundnut kernels compared to raw kernels (13 mg/100g kernels). Ascorbic acid content was slightly increased in Zn (500 and 1000 mg) fortified salted kernels (13.9 and 15.9 mg ascorbic acid, respectively). Ascorbic acid content was significantly improved in ascorbic acid fortified (500 mg and 1000 mg ascorbic acid/ kg seeds) groundnut kernels. Ascorbic acid content was improved with the soaking time and concentration. Ascorbic acid content was increased from 13 mg to 19.9 mg and 25.81 mg/100 g seeds by seed-soaking with 500 mg ascorbic acid/ kg seeds for 1 and 2 hrs respectively, it was further increased (29.8 and 31.8 mg/ 100 g seeds) by seed- soaking with 1000 mg ascorbic acid/ kg seeds for 1 and 2 hrs respectively. Seed-soaking with 2% NaCl, 500 or 1000 of $ZnSO_4$ and 500 mg of ascorbic acid maintained the range (19 to 29) of ascorbic acid in groundnut kernels. However, it was enhanced to 39 mg/ 100 g seeds with 2% NaCl, 500 or 1000 of $ZnSO_4$ and 1000 mg of ascorbic acid.

Laboratory analysis

Oil, protein and moisture content of about 5200 groundnut samples from the different sections of DGR and AICRP-G centres were measured by NIR spectroscopy at DGR Junagadh.

Summer 2021

a) Identification and advancement of F_1s from eight crosses effected during *kharif*, 2020 for quality traits improvement

Total 1542 crossed pods were harvested from eight crosses during *Kharif*, 2020 were sowed in summer, 2021. Total 168 probable F_1s were identified from eight crosses based on male parent characters **(Table 13.1.)**

Table 13.1. Identified individual hybrid plants in F_1 generation during summer 2021

S. No.	Cross	Characters	No. F_1 pods	No. of F_1 seeds	Probable F_1s
1	J 95 x PBS 29079 B	Large seed size	154	160	4
2	K 1812 x K 7 bold	Large seed size	303	460	33
3	K 1812 x GJG HPS 2	Large seed size	132	220	16
4	KDG 128 x K 7 bold	Large seed size	343	516	46
5	K 1812 x PBS 29146	Large seed, high protein and low oil	90	136	19
6	K 1812 x PBS 29213	Large seed, high protein and low oil	246	410	26
7	K 7 bold x PBS 29146	Large seed, high protein and low oil	99	136	10
8	J 95 x PBS 29146	Large seed, high protein and low oil	175	210	7

b) Evaluation of advanced breeding lines for quality and yield related traits

Based on the habit group two experiments were conducted as preliminary yield trial for evaluation of advanced breeding lines of groundnut. Total 31 advanced breeding lines were used in the study (14 lines Spanish and 17 lines Virginia).

In Spanish trial, 14 ABLs were evaluated with two checks (TPG41 and TKG 19A) in thrice replicated RBD during summer, 2021. All the traits *viz*., hundred kernel weight (HKW), hundred pod weight (HPW), shelling percentage (SP), kernel length (KL), pod yield per plant showed significant variation when compared to checks. Oil content and protein content were similar in all the treatments including checks. Genotype, PBS 19042 recorded the highest SP as 65.59 % followed by PBS 19050 (64.16%) and PBS 19052 (63.03%). Genotype, PBS19050 and PBS 19052 recorded 62.69 g and 60 g of hundred kernel weight, respectively; and were superior to the best check TKG 19A (40.25 g). The kernel length was varied from 1.41 cm (PBS 19044) – 1.71 cm (PBS 19037). Total 10 genotypes recorded >30 % of protein of which PBS 19038 and PBS 19040 genotypes recorded highest protein content (31.82 %). PBS 19050, PBS 19052, PBS 19040 and PBS 19041 lines were superior over the best check, TKG 19A (8.37g) in terms of pod yield/plant recording >10 g/plant. Two lines (PBS 19050 and PBS 19052) have good combination of confectionery traits with yield which need further evaluation under AICRPG.

In Virginia trial, 17 ABLs along with five checks Mallika, Girnar 2, Raj Mungphali 3, GJG HPS2 and BAU13 were evaluated under RBD with three replications. All the traits *viz*., hundred kernel weight (HKW), hundred pod weight (HPW), shelling percentage (SP), kernel length (KL), pod yield per plant showed significant variation when compared to checks. Kernel width, oil content and protein content found non-significant. Genotype, PBS 29236 recorded the highest SP (65.96 %) followed by PBS 29243 (64.60 %). The kernel length was varied from

1.37 cm (PBS 29245 and 29246) – 1.74 cm (PBS 29239). Total 7 genotypes recorded >30 % of protein of which PBS 29247 genotype recorded the highest protein content (32.82 %). PBS 29239, PBS 29243, PBS 29247 and PBS 29248 lines were superior over best check GJG HPS 2 (10.5g) in terms of pod yield/plant recording >13 g/plant.

c) Seed multiplication of new advanced breeding lines of groundnut

Seventeen new advanced breeding lines were multiplied for making sufficient seeds to conduct their evaluation trial.

d) Evaluation of released groundnut cultivars for sucrose and blanching traits

Seeds of total 185 (102 -SB, 44 -VB, 34 -VR and 5 - Valencia) released groundnut varieties obtained during *kharif* 2020 were utilised for the estimation of sucrose content. Genotypes which are showing >6% total soluble sugars using Anthrone reagent method were utilised for estimation of sucrose content using ion chromatography. The results are depicted in the **Table 13.2.**

Total 102 released Spanish bunch varieties of groundnut were raised during *summer* 2021 under alpha lattice design. The total soluble sugars were estimated using Anthrone reagent method in all the varieties. Total 41 varieties recorded > 6.5% of total soluble sugars. These 41 varieties were used for estimation of sucrose % using Ion chromatography. Among the 41 varieties R 2001-2 recorded highest sucrose content (7.69g/100g) followed by GG 2 (7.25g/100g) and VRI 4 (7.15g/100g). The sucrose content was the highest in summer season than in *kharif* season for the same varieties tested. During *kharif* 2020 and summer 2021 VRI 4 was found stable for sucrose content in Spanish bunch.

Total 185 (102 -SB, 44 -VB, 34 -VR and 5 -Valencia) released groundnut varieties seed material obtained in *Kharif* 2020 trial harvest were utilised for the estimation of blanchability. Varieties *viz.*, VRI 2, Tirupathi 3, Kadiri 6, TG 26, ICGS 1, GJG 31 of Spanish bunch; Somnath (TGS 1), Utkarsh, GG16 and GJG17 of Virginia runner; TMV 10, GG20, ICGS 5, ICGV 86325, Manjra (LGN2), TG 39, ICGV 00348, Kadiri 7, Kadiri 8, CO6, GJG 22, RG 578, Birsa groundnut 4, Raj Mungfali 3, KDG 128 and KDG 123 of Virginia bunch recorded >90% of blanchability. Similarly, blanchability was estimated in 102 Spanish bunch varieties of summer 2021 trial with standard procedure using hot air oven. Ten genotypes *viz.*, Tirupati 3, Kadiri 6, Prasuna, TAG 24, GG 2, ALG 06-320, R 9251, Girnar 1, GG5, Kadiri 5, Co3, GJG 31 and Co Gn 4 recorded >90% blanching.

Table 13.2. Genotypes with highest sucrose content in various habit groups studied

S.No.	Habit group	Genotypes with high sucrose content (g/100g seed)
1.	Spanish bunch	VRI 4 (5.79), TG 22 (5.78), SG 84 (5.46)
2.	Virginia Bunch	RS 138 (6.43), Raj Durga (RG 425) (5.87), T 64 (5.86)
3.	Virginia Runner	Punjab 1 (5.30), UF 70-103 (5.27), RG 382 (Durga) (5.0)
4.	Valencia	MH 2 (5.85), MH 4 (5.12)

5 AICRP on Groundnut

I. CROP IMPROVEMENT

1. Maintenance of groundnut germplasm

A total of four thousand two hundred and thirty (4230) germplasm accessions are being maintained at ten centres. This included 12 wild accessions /derivatives; 2813 Spanish bunch accessions; 35 Valencia accessions; 955 Virginia Bunch accessions; 88 Virginia Runner accessions; and 327 other wild derivatives.

2. Hybridization Program

For developing high-yielding groundnut cultivars possessing resistance to various abiotic and biotic stresses, which limit yield, a hybridization programme comprising of 222 single-crosses was undertaken at 17 AICRP-G centres during *kharif* season and total 176 single crosses were made at 10 centres during rabi-summer 2019-20.

3. Advancement of generations and selections made in inter and intra varietal crosses

Segregating generations of objective specific inter and intra varietal crosses effected at ten AICRP-G centers earlier were advanced to their respective next higher filial generations during rabi-summer 2019-20.

During rabi-summer 2019-20, progenies of 535 crosses were advanced to their respective next filial generation from which a very large number (7287) of selections were made at ten AICRP-G centres. The selections comprised mostly of single plants (6217) while the rest were progeny bulks (1070). Of the total crosses, which were advanced to different filial generations, most (373 crosses) crosses were in early generations (F_1- F_4), while only few (162) crosses were in advanced generations (F_4 onwards). Among selections made in early generation, most (5591) of them were of single plants and few (462) are of line bulks. Whereas in the advanced generations, 608 selections were of line bulks and 626 were of single plants

Different segregating generations of objective specific inter varietal and intra varietal crosses effected at 16 AICRP-G centres, were advanced to their respective next filial generations during *kharif* 2020.

During *kharif* season, progenies of 1080 crosses were advanced to their respective next filial generation from which very large numbers of (24051) selections were made. The selections comprised of large number (21932) of single plants and 2119 progeny bulks. Of the total crosses, which were advanced to different filial generations 682 crosses were in early generations (F_1- F_4) and 398 crosses in advanced generations (F_5 onwards). A vast majority (94%) of single plant selections made during the last season were in early generations (20664) and the rest (1268) in advanced generations.

4. Varietal evaluation at multilocations

A three tier system of evaluation of groundnut entries under the nomenclature of Initial Varietal Trial-Stage I (IVT-I); Initial Varietal Trial-Stage II (IVT-II) and Advanced Varietal Trial (AVT) is being adopted and the trials were allotted to the following 25 locations for Spanish Bunch trial; and 20 locations for Virginia trial distributed over five ecological zones in *kharif* 2020 and 20 centres of five eco-geographical zones in *rabi*-summer.

During *kharif* 2020, 17 entries of Spanish at 24 centres comprising of five zones and 12 entries of Virginia at 20 centres comprising of four zones (Except for zone III) were tested in IVT I. The trial would be repeated as such in all the centres in *kharif* 2021, by using the harvest of IVT-I at each centre as the source of seed for IVT II.

Under IVT II Spanish trial, 9 genotypes were evaluated at 24 centres across five zones during *kharif* 2020. None of the test genotypes promoted to AVT.

Under IVT II Virginia trial, 10 test genotypes were evaluated at 20 centres located across four zones (excluding zone III where Virginia genotypes are not grown) during *kharif* 2020. In Zone I across the four locations and over two years, RG 638 significantly surpassed the yield levels of the best check, Raj Mungfali-1 (ZC) and promoted to AVT.

In *rabi*-summer, 2019-20, 15 entries were tested under Initial Varietal Trial-Stage I (IVT-I) at 20 centres across five zones, and this trial will be repeated as such at all the centres in rabi-summer, 2020-21.

In *rabi*-summer, 2019-20, 15 entries were tested under Initial Varietal Trial (IVT): Stage I and II (IVT-I & II- Pooled) at 20 centres across five zones. In Zone I across the two locations over two years the test entry, J 100 had 10% higher kernel yield than the best check, TAG 24 (NC), while its pod yield remained at par with best check, SG 99. Hence, J 100 is promoted to AVT. In Zone IIIa, the test genotypes, TG 84, GKVK 27, and J 100 had 10% higher kernel yield over the best check, K. Harithandhra. Hence, TG 84, GKVK 27, J 100 are promoted to AVT.

In AVT during *rabi*-summer 2019-20, two entries, TG 81 and J 95 in Zone I, one entry, AG-2012-06 at Zone II and Zone IIIa, two test entries, J 94 and KGL1332 at Zone IIIb were tested where none of the test entry is recommended for identification as their pod and kernel yield found at par or less than the best check.

Under Large Seeded Varietal Trial (LSVT) I trial, four entries were tested with three checks at five centres during *kharif* 2020. The trial will be repeated as such in all the centres in kharif 2021 by using the harvest of LSVT I at each centre as the source of seed for LSVT II.

5. Salinity Tolerant Varietal Trial (STVT):

Under Salinity Tolerant Varietal Trial (STVT) Stage I, 13 entries were tested with four checks at three centres, Mandvi, Kothara, Mahuva in Gujarat during *kharif,* 2020 and the trial will be repeated as such in all the centres in kharif 2021 by using the harvest of STVT I at each centre as the source of seed for STVT II.

6. High Oleic Varietal Trial (HOVT):

Under High Oleic Varietal Trial (HOVT) I five test genotypes with four check varieties (TG 37A, GJG 32, JL 1085 and DH 256) in Spanish habit group; four test genotypes with four check varieties (Girnar 4, Girnar 5, KDG 123 and KDG 128) in Virginia habit group were evaluated at six centres *viz*., Junagadh, Durgapura, Tindivanam, Dharward, Palem and Tirupati. The trials will be repeated as such in all the centres in *kharif* 2021, by using the harvest of HOVT I at each centre as the source of seed for HOVT II.

During *kharif* 2020 under High Oleic Varietal Trial Stage I and II Pooled, five genotypes with four check varieties in Spanish Habit group, five genotypes with five check varieties in Virginia habit group were evaluated at six centres *viz*., Junagadh, Durgapura, Tindivanam, Dharward, Palem and Tirupati. None was recommended for identification.

In Advanced High Oleic Varietal Trial (AHOVT) Spanish Bunch (SB) Habit Group, one high oleic entry, ICGV 16697 was tested in six centres *viz*., Junagadh, Durgapura, Tindivanam, Dharwad, Palem and Tirupati in *kharif* 2020. None was recommended for identification.

7. Early Maturity Varietal Trial:

In Early Maturity Varietal Trial (EMVT): Stage I and Stage II Pooled, nine test genotypes allotted to five centres for evaluation during *kharif*, 2020. None deserves promotion to advance varietal trial as they cannot surpass the best check(s) in terms of pod and kernel yield.

8. Breeder Seed Production 2020-21

During kharif 2020, DAC indents to the tune of 13299.55q of breeder seeds were received for 60 groundnut varieties. Based on the availability of nucleus/breeder seed stage I, a production target of 9213.60q was assigned for 52 groundnut varieties to 21 centres. During *kharif* 2020, a total quantity of 1829.76q breeder seed could be produced. To mitigate the short fall, a compensatory programme was undertaken during *rabi*-summer 2020-21 and the anticipated production is about 10441.80q. Thus, the total expected production of groundnut breeder seeds during 2020-21 would be 12271.56q with surplus of 3057.96 q .

II. CROP PRODUCTION

Kharif 2020

1. Identification of rainfed groundnut+millet intercropping system for red soils of Karnataka

The experiment was conducted for three years at Bhubaneswar. Sole groundnut recorded the highest pod yield among all the treatments. Among different intercropping systems, groundnut + finger millet (2:1) incurred the highest groundnut equivalent yield (GEY) of 1606 kg/ha.

2. Response of kharif groundnut to plant geometry and fertility levels in light soils

The trial was conducted at Jodhpur for three years. The pooled data revealed that plant geometry treatment did not affect the groundnut crop significantly. A numerically higher value of pod yield was found in 25 x 10 cm plant spacing. Among fertility levels, RDF @ 125%recorded the maximum pod yield and was at par with RDF @ 100%.

3. Identification of remunerative groundnut based cropping systems

The experiment was conducted at Dharwad, Jalgaon, Junagadh and Vridhachalam for three years covering two seasons. At Dharwad, mean of three years indicated that significantly higher groundnut crop pod equivalent yield was obtained with Groundnut-Chickpea cropping system (3365 kg ha^{-1}) which was at par with groundnut and cotton intercropping system in 4 : 2 row ratio and groundnut and foxtail millet intercropping system in 4 : 2 row ratio followed by chickpea. At Jalgaon, intercropping of groundnut +pigeonpea (4:2) and cropping system of groundnut-chickpea produced favourable effect on growth, yield and monetary returns. At Junagadh, significantly higher pod equivalent yield (4561 kg/ha) was recorded by groundnut – coriander cropping system. At Vriddhachalam, groundnut intercropped with maize at 4:1 ratio was recorded with higher groundnut equivalent yield of 2205 kg/ha followed by groundnut + cotton (4:2) and groundnut + brinjal (4:2) recording groundnut equivalent yield of 2114 & 2058 kg/ha, respectively.

4. Application of bio-formulations in *kharif* groundnut production

The experiment was conducted for three years at Mohanpur. Pod yield of groundnut was greatly influenced by fertilizer doses and was found maximum under the treatment 100 % of RDF: 20 kg N, 60 kg P_2O_5 and 40 kg K_2O ha^{-1}. Among the bio-formulations, the treatment NPK liquid fertilizer along + zinc solubilizer was found with maximum pod yield followed by Biogrow but these two treatments were significantly superior to Control.

5. Integrated water management in rainfed groundnut

The experiment was conducted for three years at Bhubaneswar, Gwalior, Jalgaon, Kadiri, and Palem and for one year at Durgapura. At Bhubaneswar and Gwalior an application of hydrogel @ 2.5 kg/ha along with mulching of agrowaste/weed biomass @ 5 t/ha recorded significantly higher pod yield. At Jalgaon, Palem and Durgapura an application of hydrogel 2.5kg/ha + mulching 5 t/ha + use of endophytic bacteria recorded higher dry pod yield. But at Kadiri, use of mulching with agrowaste/weed biomass@5 t/ha gave higher pod yield

6. Identifying suitable crop geometries for mechanical interculturing in Spanish bunch type groundnut

The trial was conducted at Jalgaon, Junagadh and Bikaner. At Jalgaon and Junagadh, intercropping of groundnut + pigeon pea (3:1 row proportion) (60/30/30 cm) recorded significantly higher groundnut pod equivalent yield which was at par with intercropping of groundnut pigeon pea (2:1 row proportion) (60/30 cm). At Bikaner different crop geometries did not have any significant effect on groundnut pod yield.

7. Developing Conservation Agriculture practices in groundnut-wheat cropping system

The trial was conducted for two years at Durgapura and Jalagaon. At Durgapura, results indicated that groundnut sown on permanent beds with and without residues produced significantly higher pod yield and at Jalgaon, after harvesting of wheat, the groundnut crop sown on reduced tillage (one blade harrowing just after harvesting of wheat) followed by residues incorporation which recorded higher dry pod yield.

8. Improving phosphorus use efficiency in kharif groundnut with microbial cultures

The trial was conducted for three years at Bikaner, Hiriyur, Junagadh, Jhargram, Puducherry, Tindivanam and Vridhachalam. At Bikaner, Hiriyur, Jhargram, Tindivanam and Vriddchalam. Significantly economized treatment was application of 40 kg P_2O_5 with DGRC culture. Application of 20 kg P_2O_5 + DGRC at Junagadh and application of 60 kg P_2O_5 + DGRC at Puducherry were most economized treatments. At Ludhiana, experiment was conducted for one year and application of FYM @ 2.5 t/ha + DGRC culture recorded significantly higher pod yield.

9. Integrated weed management in *kharif* groundnut

The experiment was conducted at Dharwad, Durgapura, Gwalior, Hiriyur, Jodhpur, Puducherry, Tindivanam, Tirupati and Vridhachalam for three years and for two years at Palem. At all the centers treatment consisting of Pendimethalin 30EC + Imazethapyr 2 EC @ 1.0 kg/ha PE (ready mix) + manual weeding at 25-30 DAS or quizafop – p- ethyl @ 50 g/ha at 15-20 DAS were economical with respect to weed management in kharif groundnut. At Ludhiana, experiment was conducted for one year and there application of Pendimethalin 30EC + Imazethapyr 2 EC @ 1.0 kg/ha PE (ready mix) + manual weeding at 25-30 DAS recorded significantly higher pod yield.

10.Optimization of seed rate for groundnut cultivars having differential seed sizes

The experiment was conducted at Bikaner, Bhubaneswar, Jalgaon and Junagadh for three years and at Durgapura for two years. At Bikaner, significantly higher pod yield was obtained with HNG-10 @ 210 kg ha^{-1} and Mallika @ 240 kg ha^{-1} . At Bhubaneswar, Dharani and Devi groundnut varieties with seed rate as calculated by considering HKW was taken up for recommending plant population. At Jalgaon, significantly higher pod yield was recorded by Phule Morana and Phule warna with seed rate as calculated by considering HKW and recommended plant population. At Junagadh, significantly higher pod yield was recorded by bunch groundnut variety GJG 32 and semi-spreading variety GJG 22 with seed rate as calculated by considering HKW for recommended plant population. At Durgapura, variety RG 510 (HKW 50 g) with seed rate considering HKW and RPP recorded maximum pod yield.

11. Identifying optimum row ratio for rainfed groundnut + maize/pearlmillet intercropping system

This experiment was conducted for two years at Dharwad and Bikaner with maize and pearl millet, respectively. At Dharwad, among the intercropping treatments, groundnut + maize (5:1), groundnut + maize (4:1) and groundnut + maize (3:1) recorded significantly higher groundnut pod equivalent yield than groundnut + maize (2:1) and sole maize and were at par with sole groundnut. While at Bikaner, highest groundnut equivalent yield was obtained at sole groundnut followed by 5:1 and 4:1 (Groundnut: Bajra) ratios.

12. Identifying suitable crop geometry and nutrient dose for Spanish bunch groundnut during *kharif*

This trial was conducted for two years at Junagadh. Significantly higher pod yield was recorded by 30cm x 10cm (3.33 lakh/ha pp) with100% RDF + Biofertilizer (*Rhizobium*, PSB, and KSB @ 3 L/ha). At Mohanpur, one year data indicated that highest pod yield was observed in closer spacing of 22.5 am x 10 cm with 125 % of RDF.

13. Effect of paclubutrazole on productivity of groundnut

Vijayanagram centre conducted this trial for two years. Results showed that paclobutrazol has significantly reduced plant height with increasing concentrations and shortest plant height was recorded at 200 ppm.However, yield attributes, pod yield and haulm yield were significantly higher with 50 ppm concentration and pod yield decreased with increasing paclobutrazol concentration. Among different time of sprayings, double spraying at 30 and 50 DAE recorded shortest plant height but pod and haulm yields got reduced in double spraying when compared to single spraying at 30 DAE or 50 DAE.

14a. Identification of groundnut + millet intercropping system for southern zone of Andhra Pradesh

This experiment was conducted at Titupati and Kadiri during kharif 2020. At Tirupati, among different intercropping treatments, groundnut + fox tail millet in 5:4 ratio (1458 kg ha^{-1}) and 5:3 ratio (1432 kg ha^{-1}) recorded significantly higher groundnut pod equivalent yields than the groundnut with other small millets (little millet and brown top millet) in 5:4 and 5:3 row proportions and sole crop cultivation of fox tail millet, little millet and brown top millet. At Kadiri, among the intercropping treatments, Groundnut + foxtail millet (5:3) recorded significantly higher groundnut pod equivalent yield (1467 kg/ha) than the sole crop cultivation of foxtail millet, little millet and brown top millet and intercropping treatments.

14b. Identification of groundnut + millet intercropping system for grid region of Madhya Pradesh

This experiment was conducted at Gwalior during kharif 2020. Among various treatments, groundnut + barnyard millet (6:1) recorded significantly higher groundnut pod yield (2510 kg/ha) followed by groundnut + fox tail millet (6:1) (2413 kg/ha) and sole groundnut (2326).

14c. Identification of groundnut + millet intercropping system for lateritic soils of Konkan region of Maharashtra

This experiment was conducted at Shirgaon during *kharif* 2020. The maximum pod equivalent yield was recorded under groundnut + finger millet at 4:2 followed by 6:3 and 2:1 proportion respectively and groundnut + prosomillet 6:3 followed by 4:2 and 2:1 proportion respectively recorded higher groundnut pod equivalent yield than sole groundnut.

15. Effects of potash solubilising bacteria and levels of potash on growth, yield and quality of groundnut

This experiment was conducted for one year at Durgapura and Tirupati. At Durgapura, application of 75% RDK (22.5 kg K_2O/ha) gave significantly higher pod (4556 kg ha-1) over 25% RDK and 50% RDK but at par with 100% RDK and application of KSB gave significantly higher pod (4308 kg ha^{-1}) over no KSB. At Tirupati, 100% RDK recorded significantly more pod yield per hectare (2578 kg) and was comparable with 75% RDK and seed inoculation with potash solubilizing bacteria.

16. Intensification of rainfed groundnut production

This experiment was conducted at Dharwad, Hiriyur, Kadiri, Vriddhachalam and Tindivanam during *kharif* 2020. At Dharwad, effect of intensification of rainfed groundnut production on groundnut pod equivalent was significant. Skipping of one row after every two rows of groundnut sown at 30 x 10 cm spacing and planting coriander for leafy vegetable purpose in that skipped row and harvesting at 30 days after sowing resulted in significantly higher groundnut pod equivalent yield (4161 kg ha^{-1}). The next best treatment was skipping of one row after every three rows of groundnut sown at 30 x 10 cm spacing and planting coriander for leafy vegetable purpose in that skipped row and harvesting at 30 days after sowing (3837 kg ha^{-1}). The cash flow during cropping period was maximum in skipping of one row after every two rows of groundnut sown at 30 x 10 cm spacing and planting coriander for leafy vegetable purpose (Rs. 110930 ha^{-1}) followed by skipping of one row after every three rows of groundnut sown at 30 x 10 cm spacing and planting coriander for leafy vegetable purpose (Rs.82634 ha^{-1}). The same treatments with harvesting of coriander for spice/grain purpose at 90 days after sowing recoded cash flow of Rs. 19790 ha^{-1} and Rs. 16666 ha^{-1}, respectively). The gross returns (Rs.210026 ha^{-1}), net returns (Rs.147775 ha^{-1}) and B:C (3.37) ratio were also highest with skipping of one row after every two rows of groundnut sown at 30 x 10 cm spacing and planting coriander for leafy vegetable purpose in that skipped row and harvesting at 30 days after sowing. At Hiriyur, the results revealed that treatments having Groundnut sowing at 30 X 10 cm spacing with RPP had significantly higher groundnut yield (2897 kg/ha) than other treatments. Similarly, among skipping one row of groundnut after every three of groundnut sown at 30 X 10 cm spacing in conjunction with RPP was the next best treatment in obtaining the higher yield (2638 kg/ha). Further, The data pertaining to economics namely, gross returns (Rs 2,05,361/ha), net returns (Rs1,47,781/ha) and B:C (3.6) ratio were higher in plots receiving T2 + Planting coriander for vegetable purpose in skipped row and harvesting at 30 DAS + Open dead furrow thereafter for in-situ moisture conservation as compared to the rest of the treatments. At Kadiri, this trial was vitiated because of poor emergence of coriander seeds due to continuous rains and high moisture content in the seed zone.

At Vriddhachalam, groundnut variety VRI 8 was being used as main crop and successfully harvested. Whereas, the intercrop coriander did not get germinated at this centre under red sandy soil condition in-spite of repeated sowing. At Tindivanam, the groundnut crop established very well and harvested whereas the intercrop of coriander was not germinated even through the re-sowing of coriander done for three to four times.

17. Alleviation of salinity stress in groundnut by application of endophytic microorganisms

This expriment was conducted by Kothara and Mandvi. Since there is lot of variation between recorded and recommanded plant population at both the locations. This experiment will be repeated during next season.

18.1. Agronomic management practices for AVT entry (ICGV 16690)

Dharwad: The optimum plant spacing for AVT entry ICGV 16690 was 30 x 10 cm with 100% RDF i.e., FYM @ 7.5 t ha^{-1} , N: P_2O_5:K_2O @ 18: 46: 25 kg ha^{-1} and $FeSO_4$ and $ZnSO_4$ @ 25 kg ha^{-1}.

18.2. Agronomic management practices for AVT entry (ICGV 16697)

Dharwad: The optimum plant spacing for AVT entry ICGV 16697 was 30 x 10 cm with 100% RDF i.e., FYM @ 7.5 t ha^{-1} , N: P_2O_5:K_2O @ 18: 46: 25 kg ha^{-1} and $FeSO_4$ and $ZnSO_4$ @ 25 kg ha^{-1} .

18.3. Agronomic management practices for AVT entry (ICGV 16690 and ICGV 16697) at Tirupati: The optimum plant spacing for AVT entry ICGV 16690 and ICGV 16697 was 30 x 10 cm with 120% RDF.

Recommendations (*Kharif* 2020)

1. Identification of rainfed groundnut + millet intercropping system for red soils

Intercropping of groundnut + finger millet in 2: 1 row ratio is recommended at Bhubaneswar.

2. Identification of remunerative groundnut based cropping systems

In zone 8 of Karnataka, intercropping of groundnut and cotton in 4: 2 row ratio followed by groundnut-safflower, groundnut-chickpea and groundnut-sorghum cropping systems are profitable at Dharwad

Groundnut + Pigeonpea (4:2) intercropping system and Groundnut-Chickpea cropping systems are profitable for assured rainfall zone of north Maharashtra region (Jalagaon).

Kharif semi-spreading groundnut followed by coriander during *rabi* season and intercropping (relay) of semi-spreading groundnut + pigeonpea (2:1) are profitable for South Saurashtra Agroclimatic Zone (Jungadh).

Groundnut + maize (4:1) followed by Groundnut + Cotton (4:2) system are profitable at Vridhachalam.

3. Application of bio-formulations in kharif groundnut production

Seed inoculation with bio-formulation is beneficial for enhancing the pod yield and economic return of groundnut at Mohanpur.

4. Integrated water management in rainfed groundnut

Use of hydrogel @ 2.5 kg/ha along with mulching of agrowaste & weed biomass @ 5 t/ha and endophytic bacteria was useful for alleviating moisture stress in groundnut (Bhubaneswar, Gwalior, Jalgaon and Palem).

5. Identifying suitable crop geometries for mechanical interculturing in Spanish bunch type groundnut

Crop geometry did not influence pod yield (Bikaner).

Three rows of groundnut at 30x10cm spacing alternated with one row of pigeonpea (at 120x20cm) for mechanical interculturing through mini-tractor is useful in assured rainfall zone of north Maharashtra and South Saurashtra Agro-climatic Zone at Jalagaon, Junagadh.

6. Improving phosphorus use efficiency in kharif groundnut with microbial cultures

Application of 40 kg P_2O_5 + DGRC at the centres *viz*, Bikaner, Hiriyur, Jhargram, Tindivanam, and Vridhaochalam is useful. Simultaneously application of 20 kg P_2O_5 + DGRC at Junagadh and 60 kg P_2O_5 + DGRC at Puducherry are recommended.

7. Integrated weed management in groundnut

Pre-emergence application of Pendimethalin 30 EC + Imazethapyr 2 EC (ready mix) @ 1.0 kg a.i. ha-1 as pre-emergence application followed by manual weeding at 25-30 DAS/ Quizalofop – p- ethyl @ 50 g. ha^{-1} at 15-20 DAS at centres *viz*, Dharwad, Durgapura, Gwalior, Hiriyur, Jodhpur, Puducherry, Tindivanam, Tirupati, Vridhachalam were useful.

8. Optimization of seed rate for groundnut cultivars having differential seed sizes during kharif season

Seed rate for groundnut variety HNG-10 is 180 kg ha^{-1} and for Mallika 240 kg ha^{-1} at Bikaner.

Dharani and Devi groundnut varieties with seed rate as calculated by considering HKW for recommended plant population at Bhubaneswar are useful.

Phule Morana and Phule Warna groundnut varieties with seed rate as calculated by considering HKW for recommended plant population is useful at Jalgaon.

Bunch groundnut variety GJG 32 and semi-spreading variety GJG 22 with seed rate as calculated by considering HKW for recommended plant population is useful at Junagadh.

Rabi-summer 2019-20

1. Standardization of potash levels and apportioning time in summer groundnut under drip irrigation.

This experiment was conducted by Junagadh. Application of potash @50 kg/ha recorded significantly the highest pod yield and remained at par with application of potash @ 40 kg/ha. Application of fertigation of potash uniformly in equal splits at 8 days interval up to 75 DAS (8 splits) recorded higher pod yield.

2. Application of bio-formulations in *rabi*-summer groundnut production

This experiment was conducted by Dharwad, Jalgaon, Jungadh, Kadiri, Mohanpur, Rahuri and Tirupati. At Dharwad, application of 100% recommended dose of fertilizer (2699 kg ha^{-1}) recorded significantly higher dry pod yield and was on par with 75% RDF. Among bio-formulation treatments, seed treatment with NPK liquid formulation + Zn solubilizing bacteria recorded significantly higher dry pod yield over no bio-formulation and was on par with bio-grow seed treatment (2386 kg ha^{-1}). At Jalgaon, application of 100% RDF produced significantly the higher groundnut dry pod yield; and application of Bio-grow formulation as seed treatment @ 50 ml/10 kg seed along with 200 ml water recorded significantly the highest dry pod yield. At Junagadh, application of 75% RDF and 100% RDF had significantly higher pod yield. Seed treatment of bio-formulation of Bio-grow (50ml/acre) and NPK liquid formulation (100ml/acre) + Zn solubilising bacteria (50ml/acre) resulted in significantly higher pod yield. At Kadiri, maximum pod yield recorded with the application of 100% RDF (at par with 75% RDF). Regarding the effect of bio formulations, both the bio formulations exerted significant influence on yield of irrigated groundnut. At Mohanpur, pod yield of groundnut was greatly influenced by fertilizer doses and was found maximum at 100 % of RDF. Among the bio-formulations, NPK + Zn Solubilizing bacteria followed by Biogrow significantly superior to Control. At Rahuri, application of 100 % RDF produced significantly dry pod yield. The application of Bioformulation Bio-grow recorded significantly higher dry pod yield. At Tirupati, 100% Recommended dose of fertilizers had significantly more per hectare pod yield; and seed inoculations with bio formulations has shown non significant differences on yield.

3. Effect of foliar application of water soluble fertilizer on growth, yield and nutrient uptake of summer groundnut

This experiment was conducted by Akola, Jalgaon, Junagadh, Puducherry, Rahuri, Tindivanam and Vriddachalam. At Jalagaon, application of 75 %RDF +2.0 % WSF at 45 ,60 and 75 DAS(T11) to groundnut produced significantly higher groundnut dry pod yield and at par with 75%RDF +2.0 % WSF at 45 and 60 DAS. At Pudducherry and Vriddachalam, foliar application of water soluble fertilizer (WSF) with 75% RDF + 2.0% WSF at 45, 60 and 75 DAS gave maximum return. At Junagadh, Rahuri and Akola, significantly highest dry pod yield was obtained by application of 75 % RDF + 1.5 % WSF at 45, 60 and 75 DAS and was at par with application of 75 % RDF + 2.00 % WSF at 45, 60 and 75 DAS. At Tindivanam, pod yield was higher with an application of 75% RDF + 2.0% WSF at 45 and 60 DAS.

4. Improving phosphorus use efficiency in rabi-summer groundnut with microbial cultures

This experiment was conducted by Bhubanewar, Junagadh, Jhargram, Puducherry, Tinivanam, Tirupati, and Vriddhachalam. At Bhubaneswar, Jhargram and Puducherry 60 kg/ha of P to Groundnut with DGRC1 strain treatment had higher yield. At Junagadh, Tindivanam, and Vriddhachalam, significantly higher pod yield recorded by application 40kg/ha of P + PSB culture @ 15 g/kg seed. At TIRUPATI ,microbial cultures and phosphorus effect on groundnut had non-significant effect on pod yield.

5. Integrated weed management in *rabi*-summer

This experiment was conducted by Akola and Kadiri. At Akola, Bhubaneswar and Kadiri, application of Pendimethalin 30EC + Imazethapyr 2 EC @ 1.0 kg/ha PE (ready mix) + manual weeding at 25-30 DAS was found superior.

6. Identification of optimum sowing window and irrigation scheduling in *rabi* groundnut

At Palem, highest pod yield was obtained ha^{-1} with irrigation scheduling at1.0 IW/CPE and sowing on October 15th.

7. Optimization of seed rate in *rabi* groundnut

At Palem, significantly higher pod yield was obtained with line sowing and seed rate @ 200 kg ha-1) has recorded significantly higher pod yield.

8. Optimization of sowing window and irrigation scheduling in summer groundnut

At Palem, highest pod yield ha^{-1} obtained with irrigation scheduling at 1.0 IW/CPE and sowing on January 15th.

9. Evaluation of groundnut cultivars for dates of sowing in summer

At Rahuri, sowing of summer groundnut on 15th February produced significantly higher dry pod yield with variety Phule Unnati. At Kadiri, Kadiri Chitravathi recorded higher pod yield sown on 5th May.

10. Effect of green manure incorporation on yield of groundnut crop

At Tindivanam, higher pod yield recorded from the treatment Sunnhemp incorporation along with 75% RDF application.

11. Effect of Zero Budget Natural Farming Practices on Groundnut

At Jalgaon, application of Zero Budget Natural Farming to groundnut produced significantly higher groundnut dry pod yield, gross and net monetary returns and B:C ratio.

12. A. Agronomic management of AVT

At Dharwad, optimum plant spacing for AVT entry AG-2012-06 was 30 x 10 cm with 100% RDF i.e., FYM @ 7.5 t ha^{-1} , N: P_2O_5:K_2O @ 18: 71: 25 kg ha-1 and $FeSO_4$ and $ZnSO_4$ @ 25 kg ha^{-1}. At Junagadh, optimum fertilizer dose for AVT entry AG-2012-06 is existing 100% RDF.

B. AVT entries SGL 132 and J 94 under different agronomic management practices.

At Vridhachalam, optimum plant spacing for SGL 132 and J 94 were 30 x 10 cm with 100% RDF.

Recommendations (*Rabi*-summer 2019-20)

1. Standardization of potash levels and apportioning time in summer groundnut under drip irrigation

The farmers of South Saurashtra agro-climatic zone growing groundnut during summer season are advised to apply potash @ 40 kg/ha with fertigation of potash uniformly in equal splits at 8 days interval up to 60 DAS (6 splits) along with recommended dose of N and P fertilizers (25-50 NP kg/ha) for obtaining higher yield and net return at Junagadh.

2. Application of bio-formulations in *rabi*-summer groundnut production

Seed treatment with NPK liquid formulation 250 ml/ha + Zn solubilizing bacteria 125ml/ha could reduce 25% RDF without any reduction in yield at Dharwad and Kadiri.

Application of 100% RDF to soil and Bio-grow formulation (125 ml/ha) as seed treatment @ 50 ml/10 kg at the time of sowing is recommended for platue and assured rainfall zone of Maharashtra at Jalagaon.

The farmers of South Saurashtra Agro-climatic Zone growing groundnut during summer season are advised to apply 75% RDF (18.75-37.5-37.5 kg NPK/ha) with NPK liquid fertilizer (250 ml/ha) + Zn solubilising bacteria (125ml/ha) or 50% RDF(12.5-25.0-25.0 kg NPK/ha) with bio-grow(125 ml/ha) for obtaining higher yield and net return at Junagadh.

Seed treatment with Bio grow or NPK liquid formulation + Zn solubilizing bacteria found beneficial in groundnut at Mohanpur.

Application of 100 % RDF to summer groundnut along with bio-formulation bio-grow seed treatment @50 ml dissolved in 200 ml water/10 kg seed is recommended for western Maharashtra at Rahuri.

Existing nutrient management i.e., Application of 100 % RDF to summer groundnut found to be best with or without Bio-formulations at Tirupati.

3. Effect of foliar application of water soluble fertilizer on growth, yield and nutrient uptake of summer groundnut

Application of fertilizer 75% RDF at the time of sowing + 2.0 % WSF at 45 and 60 DAS is recommended for platue and assured rainfall zone of Jalagaon im Maharashtra.

The farmers of South Saurashtra Agro-climatic Zone growing groundnut during summer season are advised to apply 75% RDF and 1.5% WSF (19-19-19 NPK) at 45, 60 and 75 DAS for obtaining higher yield and net return at Junagadh and Rahuri.

The foliar application of 75% RDF + 2.0% WSF at 45, 60 and 75DAS was remunerative at Puducerry.

III. CROP PROTECTION

PATHOLOGY

Kharif 2020

Intensity of foliar diseases (ELS, LLS and rust) was reached to peak from 40th standard meteorological week (SMW) (08th -14th October 2020) to 45th SMW (05th to 11th November, 2020) across different centers.

In screening trial (IVT and AVT) thirty one genotypes (ISK-I-2020-1, ISK-I-2020-2, ISK-I-2020-5, ISK-I-2020-10, ISK-I-2020-11, ISK-I-2020-22, ISK-I-2020-27, IVK-I-2020-1, IVK-I-2020-3, IVK-I-2020-4, IVK-I-2020-11, IVK-I-2020-14, IVK-I-2020-15, IVK-I-2020-16, IVK-I-2020-18, IVK-I-2020-19, IVK-I-2020-23, LSVT-I-2020-1, LSVT-I-2020-3, LSVT-I-2020-4, LSVT-I-2020-7, HOVTSB-I-2020-3, HOVTSB-I-2020-4, HOVTVG-I-2020-1, HOVTVG-I-2020-2, HOVTVG-I-2020-4, HOVTVG-I-2020-7, AHOVTSB-2020-2, STVT-I-2020-2, ISK-I-2019-3 and ISK-I-2019-32) recorded multiple disease resistance against ELS, LLS, rust, collar rot and stem rot diseases at different centers.

Eight genotypes (GPBD4, KDG-123, DH-256, VG024, VG19541, VG19545, VG19721 (K), and VG19726) recorded multiple disease resistance against ELS, LLS, Rust, stem rot, collar rot and dry root rot.

Per cent yield loss estimation with and without management practices against major diseases was carried out at hot spot locations. At Aliyarnagar, per cent pod yield loss of 26.69 % and haulm yield loss of 32.83 % were recorded due to foliar diseases (ELS, LLS and rust). At Bikaner, 17.57 % of pod yield loss and 19.81 per cent of haulm yield loss were recorded due to collar rot disease. At Dharwad, 42.1% loss of pod yield and 19.9 % loss of haulm yield were recorded due to foliar diseases (ELS, LLS and rust) ad stem rot disease. At Jalgaon, 22.0 % loss of pod yield and 21.55 % loss of haulm yield were recorded due to late leaf spot. At Junagadh, 45.9 % loss of pod yield and 32.4 % loss of haulm yield were recorded due to foliar diseases (ELS, LLS and rust) ad stem rot disease. At Kadiri, 27.7 % loss of pod yield and 19.9 % loss of haulm yield were recorded due to ELS, LLS, rust and stem rot. At Raichur, 31.6 % loss of pod yield and 32.1 % loss of haulm yield were recorded due to stem rot disease. At Vriddhachalam, 18.5 % loss of pod yield and 16.42 % loss of haulm yield were recorded due to dry root rot.

Rabi-summer 2019-20

In screening trial (IVT and AVT), there are total 6 genotypes (INS-I-2019-12, INS-I-2019-15, INS-I-2019-19, AIS-2019-2, INS-I-2018-14 and AIS-2018-11) recording multiple disease resistance across the centers.

Predominant thrips species existed were *Scirtothrips dorsalis* Hood and *Thrips palmi* Karny in all the hotspot locations. PBND incidence ranged from 4.0 % to 34.0 % at different centres and maximum recorded at Raichur. Weed density ranged from 12 to 170 at different phenological stages having predominant weeds *viz*., *Parthenium hysterophorus, Acanthospermum hispidum, Tridax procumbens* and *Euphorbia hirta*.

Recommendations (Pathology)

Development of technologies for management of collar rot (*Aspergillus niger*)

Bikaner, Rajasthan: As per the pooled data from

2018 to 2020, deep summer ploughing with mould board plough + Soil application of *Trichoderma* @ 4 kg/ ha enriched in 250 kg FYM/ha + Seed treatment with Tebuconazole 2DS @ 1.5 g/ kg of seed followed by seed treatment with PGPR @625g/ ha of required seed + soil application of *Trichoderma* @ 4 kg/ ha enriched in 250 kg FYM/ha at 35 and 80 DAS reduced collar rot incidence up to 56.6 % with increased realization of pod (43.6 %) and haulm yield (25.5 %) over the control (with an ICBR of 1:26.28).

Ludhiana (Punjab): Sowing at a depth of 2.5 cm + seed treatment with Carboxin + Mancozeb @ 2 g/kg seed + Tebuconazole 25.9EC @ 1.5 ml/l @ 10 DAG reduced collar rot incidence (70.3 %) over the control with an ICBR of 1:18.7.

Validation of management modules for soil borne diseases

Recommendations were made as per the pooled data from 2017-2020, deep summer ploughing with mould board plough + soil application of *Trichoderma* @ 4 kg/ ha enriched in 250 kg FYM/ha + seed treatment with Tebuconazole 2DS @ 1.5 g/ kg of seeds followed by seed treatment with PGPR @ 625 g/ ha of required seed + soil application of *Trichoderma* @ 4 kg/ha enriched in 250 kg FYM/ha at 35 and 70 DAS was effective with reduction of stem rot to the extent of 68.4 % with ICBR of 1:6.92 at Aliyarnagar; 59.5% reduction of collar rot with ICBR of 1:16.5 at Bikaner; 56.4% reduction in collar rot and that of 52.6% in stem rot with ICBR of 1:2.8 at Jalgaon; 77.1% reduction in collar rot, 84.8% stem rot with ICBR of 1:8.98 at Junagadh; 61.4% reduction of dry root rot, 61.7% stem rot with ICBR of 1:3.9 at Kadiri; 58.1% reduction of collar rot, 63.8% dry root rot, 60.7% stem rot with ICBR of 1:4.9 at Vriddhachalam,

A popular variety + deep summer ploughing with mould board plough + soil application of *Trichoderma* @ 4 kg/ ha enriched in FYM +seed treatment with *Tebuconazole* @ 1.5 g/ kg of seed + soil application of *Trichoderma* @ 4 kg/ ha enriched in FYM at both 35 and 70-80 days after sowing (DAS) was effective in reducing collar rot (65.24 %) and stem rot (60.63 %), with ICBR of 1:10.12 at Dharwad. Similar reduction of collar rot (80.1 %), stem rot (83.8 %), and dry root rot (75.0 %), with the highest ICBR of 1:6.14 were recorded at Raichur.

Among different types of bags used for storage of groundnut produce, Purdue improved crop storage bags (PICS) did not support bruchid beetle and damaged pods (with or without bruchid beetle release at all the centres).

Planting of groundnut during 2nd fortnight of June with 10% additional plant stand (seed rate @ 165 kg/ha, spacing 30 x 9 cm^2) was effective in reducing the incidence of PBND 8.43% in Raichur & 6% in Pavagada) and PSND 10.9% in Kadiri). Early sowing escapes the PBND and PSND also.

Soil application of *Trichoderma harzianum* at 100 g per 100 m^2 at sowing and at 30 DAS recorded less incidence of leaf blight and wilt disease (6.7%), with higher pod (3750 kg/ha) and haulm yield (4800 kg/ha) and highest ICBR of 1:25.43. However, similar effect was observed (at par) with foliar spray with carbendazim 12% + Mancozeb 63% WP (SAAF 75% WP) i.e. 10 g SAAF in 5L water for 100 sq. m area) at 40 and 55 DAS.

ENTOMOLOGY

Kharif 2020

Highest incidence of thrips and leafhoppers (19 per terminal bud and 23 per top three leaves, respectively) was recorded at Pavagada. Similarly in Raichur highest *Spodoptera* and leaf miner foliage damage of 35 and 25 per cent was recorded. Six per cent damage by hairy caterpillars was observed at Dharwad, whereas, Ludhiana reported 15 per cent damage by termites.

Dharwad recorded maximum trap catch of *Spodoptera* and *Helicoverpa* @ 222.6 and 25.4 moths per trap on 31st and 32nd standard week, respectively. On 36th standard week, Lathur recorded highest trap catch of 11 and 9 moths per trap of *Spodoptera* and *Helicoverpa*, respectively. At Raichur maximum adults of *Spodoptera* (79 moths per trap), *Helicoverpa* (35.2 moths per trap), leafhopper (7.8 adults per trap) and thrips (8 adults per trap) were recorded on 43, 39, 40 and 41st standard week, respectively.

Among the screened germplasm ISK-I-2020-27, 28, 32; LSVT –I-2020-1, 2 and 6, HOVT-SB-I-2020-9, HOVTVG-1-2020-1, 2, 3, 4, 5, 6, 7, 9 (in 2020 series); ISK-I-2019-32,33;HOVT-VG-I-2019-4; ALSVT-2019-3, 4, 5 (in 2019 series) were found promising for *Spodoptera* where the check, JL-24 recorded Grade 7- 8 (50-75% leaf damage) score at Dharwad.

Among the screened germplasm IVK-I-5,16, HOVTSB-I-2020-2,4,8, HOVTVG-I-1 were found promising for *Spodoptera* where the check, TMV 2 recorded 7 Score at Raichur.

At Lathur, HOVTSB-I-2019-1,3,5,7, IES-I-2019-10, HOVTSB-I-2020-8, HOVTVB-I-2020-4, STVT-I-220-6,8,9,11,13,16 were found promising for *Spodoptera* where the check, JL 24 recorded 7 score.

Chlorantraniliprole 18.5 SC @ 0.3 ml/l recorded the lowest population of both the defoliators, *Spodoptera* and *Thysanoplusia at* Dharwad, *Helicoverpa* at Junagadh, *Spodoptera* at Lathur, both *Spodoptera* and leaf miner at Raichur and Vridhachalam with the highest pod yield of 1845 kg/ha at Raichur and followed by 1843 kg/ha at Dharwad with ICBR of 1:23.

Rabi-summer 2019-20

Highest incidence of thrips and leafhoppers (49 per terminal bud and 19 per top three leaves respectively) was recorded at Pavagada. Similarly in Raichur highest *Spodoptera* and leaf miner with foliar damage of 34 and 22 per cent was recorded. Hairy caterpillar incidence was observed only at Dharwad.

Maximum trap catch of 77.4 Spodoptera moths per trap was recorded at Raichur at 5^{th} standard week followed by 26 at Dharwad on 9^{th} standard week and 12.8 at Vridhachalam on 6^{th} standard week. Raichur also recorded maximum incidence of Helicoverpa (29 moths per trap), leafhopper (8.2 adults per trap) and thrips (10.8 adults per trap) on 5^{th}, 4^{th} and 2^{nd}standard week, respectively.

Among the screened germplasm INS-I-2019-9, INS-I-2019-22 were found promising for Spodoptera where the check (TMV 2) recorded 7 (75% foliar damage) scale.

Prediction models were worked out for major insect pests of groundnut by analysing historical data from 2014 to 2019. Analysed results for *Helicoverpa* and leaf miner population showed significant interaction with weather parameters with R square values of 0.97 and 0.90 respectively followed by leafhopper, thrips and *Spodoptera* at Raichur. Maximum temperature, rainfall and morning humidity have highly influenced on population of *Helicoverpa* with P- values of 0.06, 0.08 and 0.08, respectively.

AICRP-G FLDs

Kharif 2020

During *kharif* 2020 FLDs were allotted in 9 states (Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Madhya Pradesh, Rajasthan, Manipur, Tamil Nadu and West Bengal) having 17 groundnut research FLD centres. The FLDs were allotted on Whole Package basis (WP). The FLDs allotted were 360 FLDs for 17 centers and the results were received for 372 FLDs (103 per cent of implementation).

There were 18 new varieties' (less than 10-year-old) of which production potential and profitability were compared with 15 old and ruling varieties which are cultivated with farmers' traditional (cultivation) practices.

The average pod yield achieved was 2206 kg/ha under improved whole package of practices, in which mainly, new varieties were demonstrated. The old varieties performance observed was 1829 kg/ha with farmer's traditional practices. The yield increase observed was 21 per cent (with a range of 4-48%).

The average cost of cultivation (CC) with improved practice was Rs. 52745/ha in comparison to Rs.48866/ha with farmer's practice. The maximum CC observed was Rs. 88367/ha in improved practice and Rs. 82733/ha with farmer's traditional practice.

The average Gross Marginal Returns with improved practice was Rs.120490/ha and Rs.100684/ha with respect to traditional practices. Net returns observed was Rs.67745/ha and Rs.51818/ha for improved practice and farmer's practices respectively. The average B:C ratio was 2.38 and 2.16 for improved practice and farmer's practices respectively.

Rabi-summer 2019-20

The *rabi*-summer 2019-20 FLDs were allotted in 6 states having 7 groundnut research FLD centers. The states in which FLDs conducted were Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Telangana and Odisha. The FLDs were allotted on Whole Package (WP). The FLDs allotted were 117 FLDs and the results were received for 117 FLDs, from 7 centers which indicated 100 per cent of implementation.

There were 4 new varieties' (less than 10-year-old) production potential and profitability were compared with 8 old ruling varieties which are cultivated with farmers' traditional cultivation practices.

The average pod yield achieved was 2327 kg/ha under improved whole package of practices, in which mainly, new varieties were demonstrated. The old varieties performance observed was 1970 kg/ha with farmer's traditional practices. The yield increase observed was 20 per cent. The minimum yield difference observed was 11 percent and the maximum was 38 per cent.

The average cost of cultivation with improved practice was Rs.48573/ha in comparison with Rs. 45504/ha with farmer's practice. The maximum observed was Rs. 65607/ha in improved practice and Rs. 59553/ha with farmer's traditional practice.

The average Gross Marginal Returns with improved practice was Rs.121333/ha and Rs.103287/ha with respect to traditional practices. Net returns observed was Rs.72760/ha and Rs.57882/ha for improved practice and farmer's practices respectively. The average B:C ratio was 2.54 and 2.27 for improved practice and farmer's practices, respectively.

6 Externally funded projects

1. ICAR Seed Project on Seed Production in Agricultural Crops

Nodal Officer & PI: *SK Bera*

Funding Agency: ICAR- Indian Institute of Seed Science, Mau-275103, Uttar Pradesh

Duration: 2020-2025

Fund outlay: Rs. 12.25 lakh (2021-22)

Summary

Seed production of groundnut varieties released by ICAR-DGR was done under Mega seed project during *kharif* 2021. Nucleus seed of 3.5 q, 2.0 q, 65.12 q and 13.75 q was produced for Girnar 2, Girnar 3, Girnar 4 and Girnar 5, respectively. Besides, 8.2 q breeder seed of Girnar 3 and 35.8 q quality seed of Girnar 2 were also produced during *kharif* 2021. A total grant of Rs.12.25 lakh was received under this project during the FY 2021-22, while Rs.46.80 lakh was accrued as profit.

2. National Innovations in Climate Resilient Agriculture (NICRA)

Center PI: *Harish G*

Centre Co-PI: *Ananth Kurella*

Fund: Rs. 18 Lakhs

Duration: April 2017- March 2021

Objectives: Pest and disease dynamics, changes in crop-pest/pathogen relationships, changed profile of insect pests and emergence of new biotypes due to climate change, and development of forewarning system

Summary

Diseases *viz.*, collar rot, stem rot, early and late leaf spots, Alternaria leaf spot and rust were recorded in groundnut during the season.

The maximum incidence of collar rot (20%) was recorded in 15-30 days (severe) and that of stem rot (2%) in 60-100 days old crop in few fixed plots. The severity of the foliar diseases *viz.,* ELS, LLS, Alternaria Leaf Spot (ALS) and rust were high (ELS was 65.19%, LLS 66.67%, ALS 34.07%, and rust up to 65.19%). The rust severity was apparent at the stage of harvest.

Insect pests *viz.,* aphids, thrips, leafhoppers, *Spodoptera*, and *Helicoverpa* were observed in the fields. Infestation due to aphids (20%), thrips (22%), leafhoppers (26%), *Spodoptera* (26%) and *Helicoverpa* (20% to 25%) was thus observed.

3. All India Network Project on Soil Biodiversity-Biofertilizers

PI: *KK Pal*

Co-PI: *R Dey*

Funding Agency: ICAR

Fund: 13.50 lakh

Duration: April 2017- March 2022

Objectives:

- Identification of drought- and salinity- tolerant rhizobia for enhancing BNF and yield of groundnut
- Microbial diversity in groundnut based cropping systems
- Development of formulation of bioinoculants

Summary

Evaluation of moisture-deficit stress tolerant rhizobia

In summer 2021, four groundnut rhizobia viz. K508, K515, K521, K557 along with standard isolate NC92 were evaluated with application of irrigation at 15 days interval after emergence (total five irrigations after emergence). These rhizobia were capable of tolerating matric potential of -2.5 to -3.5 MPa. Application of K515, K557, and K521 significantly enhanced the pod yield (22%, 17% and

13%, respectively), haulm yield, and shelling out-turn of groundnut (cv TG37A).

Evaluation of salinity tolerant rhizobia for BNF and yield

During summer 2021, five newly identified groundnut rhizobia viz., K508, K515, K521, K557, and Rh29 along with standard isolated NC92 were evaluated under soil salinity (EC 3.06) at harvest. The tolerant strains could survive upto 7.5% of NaCl in growth media. Application of K515, K521, K557, and Rh29 enhanced the pod yield significantly, ranging from 21 to 29% (max. with K557). In general, these isolates also enhanced the haulm yield, nodulation, HKM, and shelling out-turn of groundnut (cv TG37A).

4. Exploring the Diversity of Extreme Halophiles by Functional and Comparative Genomics for Isolating Novel Genes and Alleles for Affording Salinity Tolerance to Crop Plants

PI: *KK Pal*

Co-PI: *R Dey*

Funding Agency: ICAR through AMAAS project

Fund: 53.36 lakh

Duration: April 2017- March 2022

Objectives:

- To understand the biochemical and molecular bases of osmo-adaptation and osmoregulatory mechanisms of selected extreme halophilic *bacilli*, archaea and fungi on evolutionary perspective
- To identify candidate gene(s) having relevance to salinity tolerance for future exploitation in development of crops tolerant to salinity

Summary

Validated the expression of genes linked to alternate route of carbon gain and osmotolerance in *Bacillus* sp. SB49 (NaCl tolerance upto 30%) and *Virgibacillus* sp. MSP4-1 (salinity tolerance 8-23.5%,) like phosphoserine aminotransferase, phosphoserine phosphatase, sodium-hydrogen antiporter, malate dehydrogenase, carbonic anhydrase, phosphoenolpyruvate carboxylase, malate synthase, isocitrate lyase and serine hydroxymethyl aminotransferase, expressed at different level of osmolarity (0, 10, 20, 30% NaCl for *Bacillus* sp. SB49; 8, 15 and 23.5% for *Virgibacillus* sp. MSP4-1). The same route of carbon gain was extended to *Bacillus* sp. NSP9.1 (0-15%; NCBI Acc. No. CP04823). It was found that level of expression of different genes involved in alternate route of carbon gain vis-à-vis osmotolerance is comparatively less as compared Bacillus sp. SB49 and *Virgibacillus* sp. MSP4-1. In case of *Bacillus* sp. NSP9.1, there was 1.41 to 3.47 fold increase in expression when grown at 15% NaCl as compared to when grown without NaCl in growth medium. However, gene for a key enzyme, phosphoenolpyruvate carboxylase (PEPC), has not been found in the genome of *Bacillus* sp. NSP9.1.

cDNAs were synthesized from the mRNA obtained from *Aspergillus sydowii* BF5 at 0, 10 and 30% of NaCl. So far, involvement of two enzymes viz. malate dehydrogenase and phospenolpyruvate carboxylase have been confirmed. Further studies are underway.

5. Effect of Poly4 (Polyhalite) on yield and quality of rainfed groundnut and on soil properties in semiarid Alfisols of Telangana and arid Alfisols of Andhra Pradesh

PI: *GA Rajanna,* Regional Research Station, ICAR-DGR, Anantapuramu – 515 001, Andhra Pradesh.

Project cost: Rs. 6,37,500/-

Funded by: Anglo American Wood smith Limited (AAWL) and Sirius Minerals India Private Limited

Activity: *Kharif* groundnut *var* K-6 was sown on 04-07-2021 and harvested on 16-10-2021. Crop was good, plant and soil samples were drawn for analysis and sent to Hyderabad for lab analysis.

Visit of Director, ICAR-CRIDA, Hyderabad to POLY 4 experiment

Dr. V.K. Singh, Director, ICAR-Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad and Dr.Ravindra Chary, Project Coordinator, All India Coordinated Research Project

on Dryland Agriculture (AICRPDA), Hyderabad visited experiments of ICAR-DGR, RRS, Ananthapur on 31-08-2021. The experiments were well maintained with weed free conditions and Director of CRIDA appreciated the experiments of DGR and suggested ways to generate more information under Poly 4 external project experiment.

7 Publications

Research Articles

1. Ajay BC, KT Ramya, AR Fiyaz, G Govindaraj, SK Bera, N Kumar, K Gangadhar, P Kona, GP Singh, T Radhakrishnan (2021). R-AMMI-LM: Linear-fit Robust-AMMI model to analyze genotype-by environment interactions. *Indian Journal of Genetics and Plant Breeding*, 87-92.

2. Ajay BC, SK Bera, AL Singh, N Kumar, MC Dagla, K Gangadhar, HN Meena, AD Makwana (2021). Identification of stable sources for low phosphorus conditions from groundnut (*Arachis hypogaea* L.) germplasm accessions using GGE biplot analysis. *Indian Journal of Genetics and Plant Breeding*, 81(2): 300-306.

3. AK Choudhary, DS Yadav, P Sood, S Rahi, K Arya, SK Thakur, R Lal, S Kumar, J Sharma, A Dass, S Babu, RS Bana, DS Rana, A Kumar, SK Rajpoot, G Gupta, A Kumar, MN Harish, AU Noorzai, GA Rajanna, MH Khan, VK Dua, R Singh (2022). Post-Emergence herbicides for effective weed management, enhanced wheat productivity, profitability and quality in North-Western Himalayas: A 'Participatory-Mode' Technology Development and Dissemination. *Sustainability*, 13(10): 5425.

4. AM Deka, IA Sheikh, D Pathak, CS Praharaj (2021). Effect of tillage practices and mulching on growth and yield of chickpea (*Cicer arietinum* L.) in rice-chickpea based cropping system under rainfed condition of Assam. *Journal of Crop and Weed*, 17(3): 9-16.

5. C Lal, Ajay BC, KV Rupapara (2021). AMMI and GGE models indicating seasonal variations as major source of variations for nodulation related characters in peanut. *Indian Journal of Genetics and Plant Breeding*, 81(2): 277-288.

6. CP Nath, KK Hazra, CS Praharaj, U Singh, SS Singh, N Kumar, R Nandan, NP Singh (2021). Long-term impact of legume based cropping with chemical and integrated fertilization on viable weed seed density, diversity, and community structure. *Weed Research*, 61(5): 360-374.

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10. DB Deshmukh, MT Variath, N Patne, P Kona, B Marathi, J Pasupuleti (2021). Inheritance of high oleic acid content and high throughput non-destructive phenotyping for nutritional traits in groundnut kernels. *Indian Journal of Genetics and Plant Breeding,* 81(4): 566-574.

11. CR Kantwa, A Sweta, Patel, PK Saras, R Sutaliya, KG Vyas, RR Choudhary, J Joshi, BJ Patel (2021). Yield Potential and Economic Feasibility of Wheat Varieties under Integrated Nutrient Management in Semi-Arid Region of India. Agricultural Mechanization in Asia.52 (02): 2959-2967.

12. DN Borase, M Sentilkumar, CP Nath, KK Hazra, SS Singh, N Kumar, U Singh, CS Praharaj (2021). Long-term impact of grain legumes and nutrient management practices on soil microbial activity and biochemical properties. *Archives of Agronomy and soil science*, 67(14): 2015-2032.

13. GK Mittal, B Singh, MK Mahatma, AK Gupta (2021). Morpho-physiological changes in maize

genotype under water stress condition at pre and post flowering stages. *Biological Forum – An International Journal*, 13(4): 326-331.

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17. KK Pal, R Dey, DN Sherathia, Devidayal, S Mangalassery, A Kumar, RB Rupapara, M Mandaliya, P Rawal, RA Bhadania, M Thomas, MB Patel, P Maida, BD Nawade, S Ahmad, P Dash, T Radhakrishnan (2021). Alleviation of salinity stress in peanut by application of endophytic bacteria. *Frontiers in Microbiology*, 12: 650771.

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Extension Folder

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Reports

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2. Policy paper on "Diversification of cropping system in Punjab and Haryana through intensification of cultivation of maize, pulses and oilseeds' edited by Sujay Rakshit, NP Singh, Nita Khandekar and PK Rai, 2021, pp 24. (CS Praharaj as a contributor for Pulses) 18.03.2021.

3. QRT (2011-15) Final Report submitted to Council following approval by Chairman and Members of QRT pertaining to activities and achievements of IIPR, and its Centers, AICRPs and its network under SAU and CAUs.

4. QRT (2016-20). Progress Report (ICAR-IIPR and AICRPS) submitted to Chairman and Members of QRT pertaining to activities and achievements of IIPR, and its centres, AICRPs and its network under SAU and CAUs, Vol I (207pp) and Vol II (143pp).

5. Regional Committee IV ATR and Report highlighting varieties and tech submitted on dated 17.6.2021 to Member secretary, ICAR-IISR, Lucknow, 16pp.

6. SFC/EFC Report (2021-26) by Pulses and Oilseeds Crop Improvement for 12 Institutes and AICRP on Pulses and Oilseeds submitted to Council (CS Praharaj Nodal scientist for the team). 12.03.2021 and further revised and sent in Sept 09, 2021 for approval.

8 Work Plan 2021

New Projects (From May 2021 onwards)

Programme 1: Crop Improvement

1. **Management of drought stress in groundnut at Anantapur and adjacent areas**
   Ajay BC, KK Pal, Rajanna GA, KK Reddy, Praveen Kona
2. **Management of groundnut genetic resources and trait discovery**
   Kirti Rani, MK Mahatma, Harish G, Ajay BC, Sushmita Singh, Ananth Kurella
3. **Breeding groundnut for earliness, fresh seed dormancy and confectionery types**
   Praveen Kona, Narendra Kumar, Chandramohan Sangh, Kirti Rani
4. **Development of groundnut pre-breeding materials for biotic and abiotic stresses and quality traits**
   SK Bera, Narendra Kumar, Ajay BC, Chandramohan Sangh, Ananth Kurella
5. **Genetic enhancement of groundnut through genome editing and molecular approaches**
   Chandramohan Sangh, SK Bera, Papa Rao V.

Programme 2: Crop Production

6. **Development of groundnut production technologies for arid region of Rajasthan**
   Narendra Kumar, Rajaram Choudhary, Kirti Rani, BDS Nathawat
7. **Climate resilient sustainable agriculture through low cost natural farming in groundnut based cropping system**
   Praharaj CS, Reddy KK, Pal KK, Sushmita

Programme 3: Crop Protection

8. **Management of White grubs, Bruchid beetle, Spodoptera and Helicoverpa in groundnut**
   Harish G., Rinku Dey, Nataraja MV
9. **Development of rapid detection techniques of Peanut Bud Necrosis and Tobacco Streak Viruses in groundnut**
   Nataraja MV, Ananth Kurella, Harish G and Papa Rao V.
10. **Microbial management of major foliar fungal diseases of groundnut and variability analysis in pathogens**
    Rinku Dey, Ananth Kurella, Chandramohan Sangh, Narendra Kumar, Rajaram Choudhary

Programme 4: Basic Science

11. **Drought, heat, and salinity stress in groundnut: basis of tolerance and management**
    KK Pal, Rinku Dey, Sushmita Singh, KK Reddy, Papa Rao V, Praveen Kona, MK Mahatma, Ajay BC, Rajanna GA, Rajaram Choudhary
12. **Optimization of mineral nutrition in groundnut for better human and soil health**
    Sushmita Singh, KK Pal, Rinku Dey, KK Reddy, MK Mahatma, Rajanna GA, Rajaram Choudhary

13. **Quality enhancement in groundnut and its product**

    MK Mahatma, Praveen Kona, Sushmita Singh, KK Reddy

Old Projects (till April 2021)

Programme 1: Genetic Improvement of Groundnut

- **Management of stem and collar rot diseases of groundnut**

  Narendra Kumar, SK Bera, MK Mahatma, Chandramohan S, Raja Ram Choudhary, Ananth Kurella, Kirti Rani

- **Breeding Groundnut for Paddy and Potato cropping systems**

  Kirti Rani, KK Pal, Nataraja MV, KK Reddy

- **Management of drought stress in groundnut at Anantapur and adjacent areas**

  Ajay BC, KK Pal, Praveen Kona, Sushmita Singh, Rajanna GA

- **Management of groundnut genetic resources, development of pre-breeding material and trait discovery**

  SK Bera, MK Mahatma, Ananth Kurella, Narendra Kumar, Ajay BC, Harish G, Kirti Rani

- **Genetic enhancement of nutritional traits in groundnut through genome editing and molecular approaches**

  Chandramohan S, SK Bera, Papa Rao V.

Programme 2: Groundnut pests and diseases- emerging problems and their management

- **Management of White grubs, Bruchid beetle, Spodoptera and Helicoverpa in groundnut**

  Harish G., Rinku Dey, Nataraja MV

- **Epidemiology of Peanut Bud Necrosis and Tobacco Streak Viruses in groundnut and development of their rapid detection**

  Nataraja MV, Ajay BC, Harish G, Ananth Kurella and Papa Rao V.

- **Microbial management of major foliar fungal diseases of groundnut and Variability analysis in pathogens**

  Rinku Dey, Ananth Kurella, Chandramohan Sangh, Narendra Kumar, Rajaram Choudhary

Programme 3: Basic studies in groundnut in relation to plant health, nutrition, quality and abiotic stresses

- **Management of salinity stress in groundnut**

  KK Pal, Sushmita Singh, KK Reddy, Papa Rao V, Praveen Kona

- **Optimization of mineral nutrition in groundnut for better human and soil health**

  Sushmita Singh, AL Singh, Rinku Dey, KK Reddy, Rajaram Choudhary

- **Quality enhancement in groundnut and its product**

  MK Mahatma, Praveen Kona

9 Training and Capacity building

S.No.	Scientist's name	Training programme attended	Date
1.	Dr. C.S. Praharaj	One day "Generic online training in cyber security" organized by Ministry of Electronics and Information Technology (MeitY0, Government of India).	March 25, 2021
2.	Dr. SK Bera	DST sponsored online MDP training on "Science administration and research management", at Administrative Staff college of India, Hyderabad	November 15-26, 2021
		DST sponsored online MDP training on "Natural resource and environment management" at Indian Institute of Forest Management, Bhopal	January 17-21, 2021
3.	Dr. MK Mahatma	Attended online training workshop on "Analysis of multi-location experiments" organized by ICAR-NAARM.	October 28 to November 1, 2021
4.	Dr. Sushmita Singh	Workshop on nitrogen-protein analyzer based on Kjeldahl Method	June 24th, 2021
5.	Dr. Chandramohan Sangh	Online training on "Prediction of non-coding RNA" conducted by IASRI	February 16-18, 2022
6.	Dr. Kiran Reddy	Attended 3-days online training on 'Vertebrate pest management-Wild Boar, Monkey and Birds' organized by National Institute of Plant Health Management, Hyderabad	June 16-18, 2021
7.	Dr. Praveen Kona	Attended online Training workshop on "Analysis of multi-location experiments" organized by ICAR-NAARM.	October 28 to November 1, 2021
8.	Dr. Kirti Rani	Attended an "On-line training programme on "Molecular breeding approaches and tools" held at ICAR-IIOR, Hyderabad.	September 29-October 1, 2021
9.	Papa Rao V	Attended "Drug discovery from lab to industry in biotechnology:" organized by NIT Andhra Pradesh	August 23-27, 2021

Webinar organized on "Comprehensive nutritional composition of oilseeds and fatty acid profile of edible oils available in the Indian market"

Under the aegis of "Azadi ka Amrut Mahotsav", celebrating 75 years of Independence of India, a webinar was organized by ICAR-DGR on the topic "Comprehensive nutritional composition of oilseeds and fatty acid profile of edible oils available in the Indian market" on 5th October, 2021. The lecture was delivered by Dr. Paras Sharma, Scientist 'C', ICMR-National Institute of Nutrition, Hyderabad. The Panelists for the webinar were Prof. Govind Singh, Hon'ble Vice Chancellor, Madhav University, Rajasthan; Dr. J.B. Misra, Technical Advisor, IOPEPC, Mumbai and Dr. Vineet Sharma, Principal Scientist, Biochemistry, ICAR- IISR, Indore. The webinar was organized by Dr. Rinku Dey, Dr. M.K. Mahatma, Dr. Sushmita Singh and Dr. Kirti Rani. The lecture was very informative and interactive and was attended by a large number of participants from the ICAR institutes all across the country and was a great success.

Participation and papers presentation in Conferences/ seminars/ symposia/ meetings/ Conferences/ seminars/ symposia/ meetings

Ananth Kurella

Harish G, Nataraja M V, Ananth Kurella and Savaliya S D (2021) Integrated community approach: For successful management of white grubs in peanut. International Web Conference on Innovative and Current Advances in Agriculture and Allied Sciences-2021, 20-21, July, 2021 Meerut, Uttar Pradesh

Ananth Kurella, Harish G, Padvi R.D. and Harshil Parmar (2021) Effect of Date of Sowing on the Development of Groundnut Rust, Puccinia arachidis. Global Research Initiatives for Sustainable Agriculture and Allied Sciences-2021, 13-15 December, 2021 SKRAU, Bikaner, Rajasthan.

Ananth Kurella, Nataraja M.V. and Harish G. (2021) Detection and Diagnosis of Bud Necrosis and Stem Necrosis Diseases of Groundnut: A Way Forward. Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2021), 19–21 July, 2021 Meerut (U.P.) India.

Chandra Sekhar Praharaj

Praharaj CS, Raghavendra Singh, Ummed Singh and Umakant Behera 2021. Pulses as candidate crops for NEH Region. International Conference on "Integrated agriculture, natural farming, biodiversity conservation and rural bio-entrepreneurship under changing climate scenario",COA, CAU, Kyrdemkulai, Meghalaya, India, December 7-9, 2021, 3pp (Lead Lecture).

Singh Ummed, C.S. Praharaj, Rajesh Kumar, Monaj Kumar, KK Hazra and Rajesh Kumar 2021. Customized fertilizers: Precurser for higher nutrient use efficiency and productivity of field crops. In: 5thInternational Agronomy Congress on Agri-innovations to combat food and nutrition challenges" by Indian Society of Agronomy, Nov. 23-27, 2021 at PJTSAU, Hyderabad, Telengana, India (Ext. Sum.) Vol 3, pp. 1334-35.

Singh Raghavendra, Subhash Babu, Avasthe RK, Kumar Amit, and CS Praharaj 2021. Pulses for improving livelihood security and environmental sustainability of maize-fallow land. In : 5thInternational Agronomy Congress on Agri-Inovations to combat food and nutrition challenges" by Indian Society of Agronomy, Nov. 23-27, 2021 at PJTSAU, Hyderabad, Telengana, India (Ext. Sum.) Vol 2, pp. 721-23.

Praharaj CS, Kumar N., Singh Ummed, Nath CP, Hazra KK, Singh Raghavendra, Dutta Asik, Kancheti M, Kumar Sandeep and Singh NP 2021. Achieving stability in production of pulses- Key to self-sufficiency in India. In: 5th International Agronomy Congress on Agri Inovations to combat food and nutrition challenges" by Indian Society of Agronomy, Nov. 23-27, 2021 at PJTSAU, Hyderabad, Telengana, India (Ext. Sum.) Vol 1, Pp.665 - 667.

Kumar Narendra, Nath CP, Dutta Asik, Das Krishnashis, Praharaj CS, Hazra KK and Singh NP 2021. Impact of long-term zero tillage, residue retention, and inclusion of pulses in cropping system on productivity, soil health and sustainability. In: 5thInternational Agronomy Congress on Agri Inovations to combat food and nutrition challenges" by Indian Society of Agronomy, Nov. 23-27, 2021 at PJTSAU, Hyderabad, Telengana, India (Ext. Sum.) Vol 1, Pp. 369-70.

Mrunalini Kancheti, KK Hazra, AK Parihar and CS Praharaj 2021. S6.47: Pre-harvest assisted mechanical harvesting in pulses -Opportunities and challenges (S6.47). In: National Web Conference on 'Sustaining Pulse Production for Self Sufficiency and Nutritional Security, ICAR-IIPR, Kanpur, February 9-11, 2021, p. 436.

Singh Ummed, Pushkar Dev, CS Praharaj, PR Raiger and Majoj Kumar 2021. Agronomic interventions for zinc bio-fortification of mungbean: an approach towards hidden hunger mitigation (S3.85). In:National Web Conference on 'Sustaining Pulse Production for Self Sufficiency and Nutritional Security, ICAR-IIPR, Kanpur, February 9-11, 2021, p. 251.

Deo Man Mohan, Prasoon Verma and CS Praharaj 2021. Status of farm mechanization for differentoperations in pulses (S3.80).In: National Web Conference on 'Sustaining Pulse Production for Self Sufficiency and Nutritional Security, ICAR-IIPR, Kanpur, February 9-11, 2021, p. 246.

Dutta A, KK Hazra, CP Nath, Narendra Kumar and CS Praharaj 2021.Impact of long-term pulse based crop rotations and nutrient management practices on soil potassium pools in Gangetic plain zone of India (S3.79). In: National Web Conference on 'Sustaining Pulse Production for Self Sufficiency and Nutritional Security, ICAR-IIPR, Kanpur, February 9-11, 2021, p. 245.

Nath CP, Narendra Kumar, CS Praharaj, KK Hazra, AK Parihar, B Mondal, Yogesh Kumar and AK Srivastava 2021. Post-emergence herbicide tolerance in pulses: research progress and path ahead (S3.68). In:National Web Conference on 'Sustaining Pulse Production for Self Sufficiency and Nutritional Security, ICAR-IIPR, Kanpur, February 9-11, 2021, p. 234.

Hazra KK, A Dutta, CP Nath, N Kumar and CS Praharaj 2021. Soil phosphorus mobilization capacity of winter pulses in moderately-alkaline soil of Gangetic plain (S3 67). In:National Web Conference on 'Sustaining Pulse Production for Self Sufficiency and Nutritional Security, ICAR-IIPR, Kanpur, February 9-11, 2021, p. 233.

Kumar Narendra, CP Nath, Asik Dutta, K Das, CS Praharaj, KK Hazra and RL Jat 2021. Climate resilient CA practices for enhancing productivity and sustainability of rice-wheat-mungbean system in IGP. (S3 65). In:National Web Conference on 'Sustaining Pulse Production for Self Sufficiency and Nutritional Security, ICAR-IIPR, Kanpur, February 9-11, 2021, p. 231.

Praharaj CS, N Kumar, CP Nath, KK Hazra, A Dutta, Prasoon Verma, Ummed Singh, R Singh, Ram Lal Jat, M. Kancheti, Sandeep Kumar and Rajesh Kumar 2021. Climate smart technologies could aid in sustainability of pulses production in India (S3 64). In: National Web Conference on 'Sustaining Pulse Production for Self Sufficiency and Nutritional Security, ICAR-IIPR, Kanpur, February 9-11, 2021, p. 230.

Kumar Rajesh, CP Nath, Chandra Mani Tripathi, Pradeep Kumar, Devraj and CS Praharaj 2021. Income augmentation through elimination of summer fallow with mungbean, maize and okra in farmingsystem of Uttar Pradesh (S3 23). In: National Web Conference on 'Sustaining Pulse Production for Self Sufficiency and Nutritional Security, ICAR-IIPR, Kanpur, February 9-11, 2021, p. 191.

Deka AM, IA Sheikhi, D Pathak and CS Praharaj 2021. Effect of conservation agriculture practices on growth, yield and economics of chickpea (Cicer arietinum L.) under rainfed condition of Assam (S3.49). In: National Web Conference on 'Sustaining Pulse Production for Self Sufficiency and Nutritional Security, ICAR-IIPR, Kanpur, February 9-11, 2021, p. 216.

Jat RL, CS Praharaj, N Kumar and NP Singh 2021. Impact of micronutrients with or without manure on soil health and productivity of soybean-chickpea system in vertisols S3.44: National Web Conference on 'Sustaining Pulse Production for Self Sufficiency and Nutritional Security, ICAR-IIPR, Kanpur, February 9-11, 2021, p. 211.

Lead Paper presentation in International Conference on "Integrated agriculture, natural farming, biodiversity conservation and rural bio-entrepreneurship under changing climate scenario" held at COA, CAU, Kyrdemkulai (Near Shillong), Meghalaya, India during December 7-9, 2021 and presented a lead paper and acted as a convener of a session (Organized by NAAS Regional Chapter-

Barapani, Meghalaya, International Union of Organic Agriculture, Shillong and CoA, CAU, Kyrdemkulai, Meghalaya).

Lead Paper presentation in 5th International Agronomy Congress (IAC) 2021 on "Agri-Innovations to combat food and nutritional challenges" held at PJTSAU, Hyderabad, Telengana, India during November 23-27, 2021 and presented a paper and received IAS GOLD MEDAL 2018.

Participated in Webinar on “Agricultural Census” organized by ICAR-IASRI, New Delhi on 07.10.2021.

Participated in National Webinar on “Comprehensive nutritional composition of oilseeds and fatty acid profile of edible oils available in the Indian market” organized by ICAR-DGR, Junagadh on 05.10.2021.

Participated in Webinar on “Rice area mapping and yield estimation assimilating remote sensing products with crop growth models” by Dr S Pazhanivelan, TNAU on 07.09, 2021 organized by ICAR-IIRR, Hyderabad and Society of Advancement of Rice Research, Hyderabad, India.

Participated in National Workshop on “ Bridging the yield gaps to enhance food grain production – A way forward, organized by ICAR and MS Swaminathan Research Foundation, Chennai through Virtual mode on August 26, 2021.

Participated in National Webinar on Integrated Farming System under the preview of Azadi Ki Amrit Mahotsav at ICAR-IIFSR, Modipuram on 12.08.2021.

Participated in International Webinar on Role of Legumes and Pulses in Sustainable Cropoping System of Hot Arid Zone held under the aegis of World Bank-ICAR funded National Agricultural Higher Education Project (innovation Grant) at Swami Keshwanand Rajasthan Agricultural University, Bikaner, India on dated July 17, 2021.

Participated in Inaugural Session of “Annual Zonal Review Workshop of KVKs of Rajasthan, Haryana, and Delhi”, July 01, 2021, ICAR-ATARI, Zone II, Jodhpur, Rajasthan.

Participated in NAAS collaborated ICAR-IISS organized National Webinar on Nanotechnology in Agriculture: Opportunity and Challenges, 21.06.2021.

Participated in "Launch Inauguration of Agri Udaan 4.0" on May 17, 2021 by NAARM, Hyderabad (AGRI UDAAN is a Food & Agribusiness Accelerator organizing by a-IDEA, Technology Business Incubator of ICAR-NAARM, supported by the National Bank for Agriculture and Rural Development (NABARD), GoI.

Participated as Convener and Panelist in Pulse WebCon 2021 on National Webinar on “Sustaining Pulse Production for Self Sufficiency and Nutritional Security” held during February 09-11, 2021 Organized by Indian Society of Pulses Research and Development (ISPRD), ICAR-Indian Institute of Pulses Research (IIPR), Kanpur 208 024, Uttar Pradesh, India In Collaboration with Indian Council of Agricultural Research (ICAR), New Delhi, India at IIPR Kanpur.

Harish G

G. Harish*, A. Naganagoud, A.G. Sreenivas, Somashekar, Sharangouda Hiregoudar and B. Kisan (2021) Bio efficacy of nonoparticles of sweet flag rhizome powder on Callasobruchus analis. 4th International Conference on Current Approaches in Agricultural, Animal Husbandry and Allied Sciences for Successful Entrepreneurship (CAAAAHASSE-2021) 13-15 March, 2021.

Harish G, Nataraja M V, Ananth Kurella and Savaliya S D (2021) Integrated community approach: For successful management of white grubs in peanut. International Web Conference on Innovative and Current Advances in Agriculture and Allied Sciences-2021, 20-21, July, 2021 Meerut, Uttar Pradesh

G. Harish, A. Naganagoud, A.G. Sreenivas, Somashekar, Sharangouda Hiregoudar and B. Kisan (2021) Studies on population build up and damage potential of major stored grain insect pest. VI International Conference in Hybrid Mode on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2021) 13-15th December 2021

International webinar on 'Desert locust Schistocerca gregaria (Forskål) International scenario and a potential threat to India' on 02.07.2021 organized by

National Institute of Plant Health Management, Hyderabad

International Webinar on "Sustainable Groundwater Management: Current Challenges Around the Word" on 30th July 2021 organized by Department of Soil and Water Engineering, CTAE, MPUAT, Udaipur.

International webinar on Phytosanitary Strategies for Food Security and Market Access of Fruits and Vegetables on 26th August 2021 organized by National Institute of Plant Health Management Rajendranagar, Hyderabad

International webinar on Climate Smart Agriculture from Multi-Omics Perspective on 17th September 2021 organized by Bioingene

Attended "National Seminar (hybridmode) on"Rice fallow management in Eastern India" organized by the ICAR-Research Complex for Eastern Region, Patna, Bihar on 26th August, 2021.

National Conference on "Oil Palm - A right choice towards self-sufficiency in edible oil production" on 06th September 2021 organized by ICAR- IIOPR, Pedavegi

International Webinar Conference on "Alternate Cropping Systems for Climate change and Resource Conservation" from 29 September to 01 October 2021 organized by ICAR-Indian Institute of Farming Systems Research Modipuram, Meerut-250110

Conservation" from 29 September to 01 October 2021. organized by ICAR-Indian Institute of Attend International Webinar Conference on "Alternate Cropping Systems for Climate Change and Resource Farming Systems Research Modipuram, Meerut-250110

International webinar on "Fighting the Hunger using Smart Technology" through virtual mode on 26.10.2021 organized by ICAR-IIOPR, Pedavegi, Andhra Pradesh

National workshop on "Self-sufficiency on oilseeds" at Gandhinagar On 22.12.2021 organized by Government of Gujarat.

Kona Praveen

Praveen Kona, Mahatma M.K., Aman Verma, Gangadhara K., Ajay B.C., Narendra Kumar, Kirti Rani, Bera S.K., Lokesh Kumar T., Chavada Zarana. 2021. Influences of genotype and location interactions on agronomical and biochemical traits of groundnut. International Web Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2021), pp: 61. http://krishi.icar.gov.in/jspui/handle/123456789/68915

Praveen Kona, Mahatma M. K., Gangadhara K., Ajay B.C., Narendra Kumar, Kirti Rani, Bera S.K., Lokesh Kumar T., Solanki K.D and Kishan P. Gajera. 2021. Evaluation of released cultivars for blanchability and sugar content in groundnut (Arachis hypogaea L.). Souvenir 5th International Conference on Advances in Agriculture, Environmental and Biosciences for Sustainable Development (AAEBSSD-2021). pp: 192-193. http://krishi.icar.gov.in/jspui/handle/123456789/68914

Praveen Kona, Gangadhara K., Ajay B.C., Narendra Kumar, Mahatma M. K., Kiran Kumar Reddy. 2021. PBS 29079B- A Novel Advanced Breeding Line With Large Seed Size In Groundnut (Arachis hypogaea L.). International Conference on "Current Approaches in Agricultural, Animal Husbandry and Allied Sciences for Successful Entrepreneurship (CAAAHASSE-2021).pp:76-77. http://krishi.icar.gov.in/jspui/handle/123456789/46385.

Gangadhara K, Sushmita Singh, Kirti Rani, Praveen K., Ajay, B.C., Narendra Kumar, Bera, S.K. and Gor, H.K. 2021. Multiyear evaluation of fresh seed dormancy and pod yield in groundnut (Arachis hypogea L.). International Web Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2021), pp: 27. http://krishi.icar.gov.in/jspui/handle/123456789/68916

Narendra Kumar

Narendra Kumar, Dutta R, Kona P, Ajay B.C, Rani K and Bera SK (2021). Identification of novel sources of resistance genotypes for Alternaria leaf blight in groundnut (Arachis hypogaea L.). Abstract in: 4th International conference on Current Approaches In Agricultural, Animal Husbandry And Allied Sciences For Successful Entrepreneurship (CAAAHASSE-2021) from 13-15 March 2021 by Virtual mode. pp.65.

Narendra Kumar, Ram Dutta, Praveen Kona, Ajay B.C, Kirti Rani and SK Bera (2021). Assessment of economic losses caused by Alternaria leaf blight in groundnut (Arachis hypogaea L.). Abstract in: International Symposium on "Advances In Plant Biotechnology And Genome Editing" (APBGE-2021)" from 8-10 April 2021 by Virtual mode. pp.121-122

Narendra Kumar, Praveen Kona, Ajay B.C, Kirti Rani and SK Bera (2021). Evaluation of groundnut cultivars for resistance of collar rot. Abstract in: 5th International Conference on Advances in Agriculture, Environmental and Biosciences for Sustainable Development (AAEBSSD-2021)" from 5-7 August, 2021 by Virtual mode. pp.168

Narendra Kumar, R. Dutta, Ajay B.C., Gangadhara K., Praveen Kona, Kirti Rani and S.K. Bera (2021). Identification of novel genetic stock for resistance of collar rot in groundnut. Abstract in: International Web Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2021) from 13-15 December 2021 by Virtual mode. pp.53.

Gangadhara K, Sushmita Singh, Kirti Rani, Praveen K., Ajay, B.C., Narendra Kumar, Bera, S.K. and Gor, H.K. (2021). Multiyear evaluation of fresh seed dormancy and pod yield in groundnut (Arachis hypogaea L.). Abstract in: International Web Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2021) from 13-15 December 2021 by virtual mode. pp.27.

Papa Rao Vaikuntapu

Participated in the international "Plant Genome Engineering Symposium 2021 (PGES2021)" organized by UC Berkeley on 20th May.

Participated in Bio-Imaging Workshop: X-Ray Fluorescence Microscopy (XFM) by Plant Cell Atlas Consortium, Carnegie Institution for Science, Stanford on 2nd March.

Rajanna GA

Presented paper/oral presentation in Fifth International Agronomy Congress (IAC) on "Agri-Innovations to Combat Food and Nutrition Challenges" from 23-27 November 2021 held at PJTSAU, Hyderabad, Telangana, India.

Sushmita

Sushmita Singh, Amritlal Singh, Kiran Reddy, Mahesh Mahatma and Gangadhara K. (2021). Zn-efficient groundnut cultivars maintain higher photosynthesis, chlorophyll content, nutritional quality and pod yield. In: 5th International Conference on "Advances in Agriculture, Environmental and Biosciences for Sustainable Development (AAEBSSD-2021)" from 5-7th August, 2021.

Sushmita Singh, Amritlal Singh, C.B. Patel, Vidya Chaudhari, L.K. Thawait, Gangadhar K., Narendra Kumar, Praveen Kona and Kirti Rani (2021). A novel genetic stock identified and characterized for tolerance to Iron deficiency chlorosis at early growth stages in Groundnut. In: National Conference of Plant Physiology on "Frontiers of Plant Physiology for Climate Smart Agriculture" December 09-11, 2021, organized by ICAR-National Institute of Abiotic Stress Management, Baramati, Pune and Indian Society for Plant Physiology, New Delhi

Kiran Reddy

Gangadhara K, Kiran K Reddy, Praveen Kona, Sushmita S, Anant Kurella. 2021. Dynamics in leaf nutrient, physiological parameters and surface temperatures in short duration spanish bunch groundnut genotypes—A time lapse study. In International conference on current approaches in Agricultural, Animal Husbandry and Allied sciences for successful entrepreneurship (CAAAHA SSE-2021), organized by AEDS, Rampur and CAIE, RVSKVV, Gwalior, MP.

Kiran Reddy, Praveen Kona, Anant kurella, Gangadhara K. 2021. Changes in plant and soil nutrient content, soil enzymes in susceptible and resistant peanut cultivars to late leaf spot (LLS). In International conference on current approaches in Agricultural, Animal Husbandry and Allied sciences for successful entrepreneurship (CAAAHASSE-2021), organized by AEDS, Rampur and CAIE, RVSKVV, Gwalior, MP.

Praveen Kona. Gangadhara K, Ajay B.C, Mahatma, M.K., K.K. Reddy. 2021. PBS29079B-A novel advanced breeding line with large seed size in groundnut. In International conference on current approaches in Agricultural, Animal Husbandry and

Allied sciences for successful entrepreneurship (CAAAHASSE-2021), organized by AEDS, Rampur and CAIE, RVSKVV, Gwalior, MP.

Raja Ram Choudhary, Ram A Jat and Kiran Reddy. 2021. Effect of Tillage, residue and nitrogen management on soil biological properties and yield of groundnut in groundnut-wheat system. In International conference on current approaches in Agricultural, Animal Husbandry and Allied sciences for successful entrepreneurship (CAAAHASSE-2021), organized by AEDS, Rampur and CAIE, RVSKVV, Gwalior, MP.

Kiran K Reddy, Ram A Jat, Raja Ram Choudhary. 2021. Phosphorus uptake patterns as affected by combinations of NPK dosages and PSB+Micronutrient application in groundnut. In International conference on soil and water resource management. Feb 2021. Department of soil and water Engineering, CoTE, MPUAT, Udaipur

Kiran K Reddy. Sushmita S and Raja Ram Chaudhary. 2021. Optimization of NPK doses incultivars TLG-45 and GJG-22 for kharif groundnut production system. In International web conference in Agriculture and Allied sciences (ICAAAS-2021). 19-21 July 2021. Organized by SSDAT, Meerut, U.P.

Raja Ram Choudhary and Kiran K Reddy. 2021. Effect of nutrient management practice son soil biological and chemical properties in groundnut. In International web conference in Agriculture and Allied sciences (ICAAAS-2021). 19-21 July 2021. Organized by SSDAT, Meerut, U.P.

Gangadhara, K, Dagla, M.C., Kona Praveen, Ajay, B.C., Narendra Kumar, Sushmita., Kirti Rani., Kiran Kumar Reddy and Gor, H.K. 2021. EMS induced variability for pod yield in groundnut (*ARACHIS HYPOGAEA* L.). In International web conference in Agriculture and Allied sciences (ICAAAS-2021). 19-21 July 2021. Organized by SSDAT, Meerut, U.P.

Kiran Reddy, Sushmita S, Raja Ram Choudhary and PV Zala. Effect of different levels of applied phosphorus (O2O5) on dry pod yield and shoot dry weight of groundnut in 36 spanish bunch cultivars. In 3rd International conference (hybrid mode) on food, agriculture and innovations 'ICFAI-2021' 24-26th December, 2021, Ranchi, Jharkhand

Raja Ram Choudhary

Raja R. Choudhary, Ram A Jat and Kiran K. reddy (2021). Effect of tillage, residue and nitrogen management on soil biological properties and yield of groundnut in groundnut-wheat cropping system. Abstract in Current Approaches in Agricultural, Animal Husbandry and Allied Sciences for Successful Entrepreneurship (CAAAHASSE-2021) being held from 13-15 March, 2021 by virtual mode page 81-82.

Raja Ram Choudhary and Kiran K Reddy (2021) Effect of nutrient management practices on soil biological and chemical properties in groundnut. Abstract in: Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2021) being held from 19-21 July, 2021 by virtual mode and organized by Society for Scientific Development in Agriculture and Technology, Meerut (U.P.), India.

Kiran Reddy, Sushmita, Raja Ram Choudhary and PV Zala (2021). Effect of different levels of applied phosphorus (P_2O_5) on dry pod yield and shoot dry weight of groundnut in 36 Spanish bunch cultivars. Held during 24-26 December, 2021 at Ranchi, Jharkhand through hybrid mode page 258

Lectures delivered

Chandra Sekhar Praharaj

Lead lecture delivered in Agri-Vision programme on Krishi Aur Atmanirbhar Bharat where lecture on technological intervention towards sustaining pulses production in India on dated 24.3.2021 at CSAUAT, Kanpur where>200 persons belonging to faculty and students participated.

MK Mahatma

Delivered an online expert lecture on the topic “Groundnut Quality & Value Addition” on 30.12.2021 at “14.30-15.30 hrs during Swachhta Pakhwada organised by ICAR-IIOR, Hyderabad

Sushmitha

A lecture on “Nutrient deficiencies in Groundnut and their management” was delivered in a training (11-12th June, 2021) held at GB Pant University of Agriculture and Technology, Pantnagar.

Kiran Reddy

Lecture delivered on “Crop production practices for higher and sustainable yield of Groundnut" in a training (11-12th June, 2021) held at GB Pant University of Agriculture and Technology, Pantnagar.

Ananth Kurella

"Integrated Disease management (IDM) in Groundnut" in a training (11-12th June, 2021) held at GB Pant University of Agriculture and Technology, Pantnagar.

Meetings attended

Chandra Sekhar Praharaj

Participated in Virtual Group Meeting of AICRP on Rabi Pulses (AICRP on Chickpea and MULLaRP Crops) held at ICAR-IIPR, Kanpur during August 16-17, 2021. Also acted as Conveners in Session III: Crop Production of AICRP on Chickpea and Session VI: Crop Production of AICRP on MULLaRP.

Participated in Virtual Group Meeting of AICRP on Kharif Pulses (AICRP on Pigeonpea, MULLaRP and Arid Legumes) (26th Annual Kharif Pulses Group Meet programme) held at ICAR-IIPR, Kanpur during May 27-28, 2021.

Participated in 23rd IMC of ICAR-DGR, Junagadh through Video conferencing on 19.7.2021.

Participated in Brain Storming Meeting on "Intensification and sustenance of pulses in North Hill Zone of India" organized by ICAR-IIPR, Kanpur at HPKVV, Palampur on 24.09.2021.

Participated in Task Force Committee Meeting under Agro-climatic zone V –Upper Gangetic Plains consisting of 40 districts of Uttar Pradesh under the chairmanship of Dr DR Singh, VC, CSAUAT, Kanpur on 13.09, 2021.

Training programmes organized

Kiran Reddy

Co-organized training program on "Improved production technologies for summer groundnut production of Saurashtra Region" held from 03-05 March 2020 at ICAR-DGR, Junagadh

Co-organized training program on "Climate resilient technologies for groundnut production" held from 08-11 March 2021 at ICAR-DGR, Junagadh

Co-organized training program on "Sensitization of farmers for improved groundnut production technologies" held from 27-29 January 2021 at ICAR-DGR, Junagadh

Co-organized field day in Toraniya village on 22.03.2021. 150 farmers participated in the event

Co-organized Three day training programme-cum-kisan Gosthi on "Improved Technologies and practices for Groundnut in three MGMG villages of ICAR-DGR (Samadhiyala, Arniyala, Najapur) under ICAR-Seed project during 08-10 February 2021

Co-organized training program on "Improved practices for remunerative kharif groundnut" held from 28-30 June 2021 at ICAR-DGR, Junagadh

17 FLD's were allotted and conducted in Bhilka and Toraniya villages

Organized "Tree plantation campaign and awareness program" at ICAR-DGR on 16 July 2021

Organized "Virtual Awareness Campaign-cum-Kisan Goshti" on "Balanced Use of Fertilizers" on 18.06.2021 at ICAR-DGR

Organized "World Water Day" on 22 March 2021 in Toraniya and Bhilka villages of Junagadh district where 150 farmers have participated

Awards/ Recognitions

Chandra Sekhar Praharaj

Received ISA GOLD MEDAL AWARD (2018) for outstanding contribution in research in Agronomy Discipline by Indian Society of Agronomy) and was conferred on him during 5thInternational Agronomy Congress held at PJTSAU, Hyderabad during November 23-27, 2021.

Received FIRST BEST PAPER AWARD (POSTER) at National Web Conference on "Sustaining Pulses Production for Self-sufficiency and Nutritional Security" at ICAR-IIPR, Kanpur during February 9-11, 2021 on an article "Status of Farm Mechanization for different operations in pulses" by Man Mohan Deo, Prasoon Verma and CS Praharaj on the eve of Pulse WebCon 2021 organized by ISPRD & ICAR-IIPR, Kanpur and ICAR, New Delhi.

Received REVIEWER EXCELLENCE AWARD (2021) in recognition of significant and outstanding contribution to the Journals viz., Indian Journal of Agricultural Research and Legume Research- An

International Journal for the last so many years (Certificate received from the Editors of ARCC Journals of Agricultural Research Communication Centre, Kernal, Haryana).

Received SRIRAM AWARD 2020 (Certificate and First PRIZE) from FAI 2020 for Best Article in KHAD PATRIKA,INDIA.

Received recognition as Expert Reviewer for article collection titled "Agricultural Diversification: Benefits and Barriers for Sustainable Soil Management" hosted by Frontiers in Environmental Science - Editorial Office, Frontiers, Avenue du Tribunal-Fédéral 34 1005 Lausanne Switzerland, info@frontiersin.org frontiersin.org – Publishing Development (23.12.2021).

Nominated as JOURNAL EDITOR for Indian Journal of Agronomy by ISA, New Delhi 2020-21.

Selected/elected as JOINT SECRETARY in Indian Society of Pulses Research and Development (ISPRD).

Coordinator for Celebration of World Pulses Day at ICAR HQ, Krishi Bhawan, New Delhi for inauguration of Office cum Building at Bhopal and Bikaner and Laying of Foundation stone at IIPR RS Khordha by Hon'ble Union Minister of Agriculture and Farmers Welfare on behalf of Director, IACR-IIPR, Kanpur on 10.02.2021. This Function was addressed by Hon'ble State Agriculture Minister Dr Kailash Choudhary and Dr T Mohapatra Secretary DARE and DG ICAR, Dr TR Sharma, DDG CS and DR NP Singh Director ICAR, IIPR Kanpur.

Panelist and convener in National Web Conference on "Sustaining Pulses Production for Self-sufficiency and Nutritional Security" held at ICAR-IIPR, Kanpur, February 9-11, 2021.

MENTOR SCIENTIST for Module III Certified Farm Advisor MANAGE PROGRAMME, Hyderabad.

Received an Appreciation Certificate following Reporting (Rapporteur) in the Technical Session on Plenary lecture -2 (Chairman: Dr Dr Arvind Kumar, DDG, ICRISAT, Telengana, India) during 5th International Agronomy Congress (IAC) on "Agri-Innovations to combat food and nutritional challenges" held at PJTSAU, Hyderabad, Telengana, India during November 23-27, 2021 and presented summary and recommendation of the session.

Member of Institute Management Committee (IMC) of ICAR-Directorate of Groundnut Research, Ivnagar Road, Junagarh 362001 (Gujarat) for a period of 3 years with effect from 25.12.2020 to 24.12.2023.

Convener in Session IV (Crop Production of AICRP on Pigeonpea) and Session VI (Crop Production ofAICRP on MULLaRP and Arid Legumes) in Virtual Group Meeting of AICRP on Kharif Pulses (26th Annual Kharif Pulses Group Meet programme) held at ICAR-IIPR, Kanpur during May 27-28, 2021.

Convener and Panelist in Session V: Crop Intensification, diversification and resource conservation of National Web Conference on "Sustaining Pulses Production for Self-sufficiency and Nutritional Security", ICAR-IIPR, Kanpur, February 9-11, 2021.

Convener in Poster Session 5: Crop Intensification, diversification and resource conservation of National Web Conference on "Sustaining Pulses Production for Self-sufficiency and Nutritional Security" held at ICAR-IIPR, Kanpur during February 9-11, 2021.

Harish G

Best Oral Presentation Award for "Integrated community approach: for successful management of white grubs in peanut" in the International Web Conference (ICAAAS 2021) held in July 19-21, 2021. Organized by Society for Scientific Development in Agriculture and Technology Meerut, Uttar Pradesh

Received "Scientist of the year award" in the International Web Conference (ICAAAS 2021) held in July 19-21, 2021. Organized by Society for Scientific Development in Agriculture and Technology Meerut, Uttar Pradesh

Best Oral Presentation Award for "Studies on population build up and damage potential of major stored grain insect pest" in the International web Conference on Global Research Initiatives Sustainable Agriculture & Allied (GRISAAS-2021) held during 13-15th December, 2021. Organized by Society for Scientific Development in Agriculture and Technology Meerut, Uttar Pradesh.

Praveen Kona

Registered PBS 29079B genotype as novel source for high Hundred Kernel Weight (85.36 g) under Plant germplasm registration committee of ICAR on 24th December, 2021.

Kirti Rani

A novel germplasm ER9-700(INGR21018) has been registered by Plant Germplasm Registration committee (PGRC) of ICAR as leaf rust resistant as on 18 March, 2021.

Narendra Kumar

Best Poster Presentation Award on "Identification of novel genetic stock for resistance of collar rot in groundnut" received in International web Conference (GRISAAS-2021) held during 13-15th December, 2021.

Papa Rao Vaikuntapu

Received young scientist award from "Andhrea Pradesh Akademi of Sciences (APAS) on 12th March 2021 for the year of 2020.

Rajanna GA

Received best oral/rapid fire award in Fifth International Agronomy Congress (IAC) on "Agri-Innovations to Combat Food and Nutrition Challenges" from 23-27 November 2021 held at PJTSAU, Hyderabad, Telangana, India.

10 Important Events

"FIT INDIA FREEDOM RUN 2.0" organized on 29 September 2021

In reference to Office order F.No.2l -5112021-CDN Date: -23. 08.2021 from Under Secretary (GAC), ICAR and guidelines given by Government of India Ministry of Youth and sports Department of Sports. FIT India Mission was conceptualized FIT INDIA FREEDOM RUN 2.0 to commemorate the 75th Independence Day - "Azadi Ka Amrit Mahotsav". Nationwide campaign on the concept of "Physical/Virtual Run" in continuum from 13th August to 2nd October 2021 to encourage fitness. In this regard ICAR- Directorate of Groundnut Research, Junagadh, Gujarat had organized "FIT INDIA FREEDOM RUN 2.0" on 29th September 2021 at 7:30 Am. DGR staff actively participated in

the event. 95 persons (84 men and 11 women) had registered for the event, but due to heavy rains during previous night only 67 (63 men and 4 women) took part in the event. Sh. Suresh Ragavji (First), Shri N.K. Chudasama (Second) and Sh. Amin Pirmahamad (Third) were winners in above 45 years category, Suhil Ahmad (First), Sh. Lokesh Kumar (Second) and Sh. Anupam Chaubey (Third) were winners in under 45 years category. Smt. Shanta Karshan Odedara (first), Manjula Chiman (Second) and Smt. Roshan Allarakha (Third) are winners in women category.

World food day and 'Mahila Kisan Divas' organized at ICAR-DGR on 16th October, 2021

ICAR-Directorate of Groundnut Research organized one day "Kisan gosthi, Exhibition and Field Day" on 16 October 2021 to celebrate "Mahila Kisan Divas" and "World food day" as a part of celebration of "Azadi ka Amrut Mahotsav". In this program around 27 SC women farmers from Bilkha Village, 13 SC women farmers from Indra Village, Junagadh District, had participated. Dr. Harish G was Convener, Shri Ananth Kurella and Dr. Sushmita were Co-conveners of this program. Lectures were organized on food and nutritional values of groundnut. The program began with ICAR

song followed by a short video on groundnut production technologies shown to farmers. Dr. Sushmita Singh gave lecture on Nutritional values of groundnut and their by-products and Dr. Kirti Rani explained about High oleic groundnut lines for food and nutritional security. Dr. P V Zala explained about importance of health, hygiene and nutrition in daily life (in Gujarati).

After the lectures, farmers were taken to exhibition hall of ICAR-DGR, where Dr. Papa Rao (Convener) and Dr. Kiran Kumar Reddy, Dr. Chandramohan (Co-convener) explained about the varieties and technologies displayed in the exhibition hall. Farmers were taken to seed production plots of Girnar 4 and 5 where Dr. Kirti Rani explained about importance of these varieties in field, and then farmers also visited GRS plots where more than thousand germplasm were sown. Farmers were very enthusiastic and interacted with scientists regarding varieties and their yield potential. The concluding remarks were given by Director, DGR and the program ended with distribution of farm kits to the SC farmers.

42nd Foundation day celebration

The 42nd Foundation day was celebrated at ICAR-DGR on 1st October 2021. Dr. S.K. Bera, Director (Acting), ICAR-DGR gave the opening remarks and mentioned about the history and recent achievements of DGR. Guest of Honor of the function, Dr. Narendra Kumar Gontia, Principal & Dean, College of Agricultural Engineering and Technology, Junagadh Agricultural University highlighted the need to reduce the import dependence on edible oils and emphasized on value

addition at the farmer's level to improve the farm income. Chief Guest of the function, Prof. (Dr.) Chetan Trivedi, Vice Chancellor, Bhakta Kavi Narsinh Mehta University spoke about the ethics of working in the organization like dedication, punctuality, sincerity, devotion to work and self-satisfaction which will improve the organization output. He also emphasized on the need to spread the scientific achievements through social media for quick uptake by the stakeholders. Six employees of DGR were felicitated for their forthcoming superannuation. Overall the program was a grand success.

Annual Group Meeting of All India Coordinated Research Project on Groundnut at ICAR- DGR

Annual Group Meeting (AGM) of All India Coordinated Research Project on Groundnut was held at ICAR-DGR on May 11-12, 2021 through online mode. Dr. A. L. Singh, Director ICAR-DGR, Junagadh welcomed Dr T. R. Sharma, DDG (CS) and the chairman of the session and Dr. Sanjeev Gupta, ADG (O&P) and the co-chairman, along with all the Directors of various Institutes, the experts, scientists from AICRP-G and DGR. About 120 participants attended the Annual General meeting of AICRPG via video conferencing. Dr T.R. Sharma, DDG (CS) addressed the participants emphasizing that oilseeds and pulses are big challenges of the country, hence may be given utmost priority. The Chairman appreciated the release of two bio-fortified groundnut varieties, Girnar 4 and Girnar 5. He mentioned that pre-breeding should be given major emphasis to broaden the genetic base of the groundnut crop and take up targeted breeding

approaches with centre specific objectives. Priorities target to develop high oleic varieties as well as high Fe and Zn content varieties. Dr. Sanjeev Gupta, ADG (O&P), ICAR welcomed the participants and highlighted that focus should be on management of white grub and termite especially in Rajasthan. A technical bulletin on their management should be published. Drought tolerant varieties need to be identified and promoted in seed chain. Strengthening work on virus resistance, particularly PBND and PSND, and developing cost effective kits to diagnose the aflatoxin contamination in groundnut should also be given priority.

International Yoga-day celebrated at ICAR-DGR on 21st June 2021

ICAR- Directorate of Groundnut Research, Junagadh has celebrated International Yoga Day on 21st June 2021 to create and spread awareness on yoga and its role in boosting immunity, which is the need of the hour. “Yoga for well-being” was the theme of the yoga day. Dr. Ananth Kurella (Scientist, Plant Pathology) acted as Nodal officer and

Chairman of the event. In this regard, the International Yoga Day was organized by conducting activities like the Essay Writing competition on “How to Increase Immunity against COVID-19 with Yoga Asanas” among the staff members. Physical

1st Prize- Yatin Karia

2nd Prize-Suresh Sachaniya

3rd Prize-Jignesh Parmar

4th Prize- Keval

Gift distribution to the winners of Essay competition

yoga by staff members was done at their respective quarters/houses, and a lecture on "Role of Yoga in COVID-19 situation by a certified yoga trainer (Jayashriben Lashkari), Junagadh via zoom meeting was also held on 21st June 2021. About 50 staff members have actively participated in all the activities and did their part in creating awareness on yoga to their family members and neighbors. Prizes were distributed to the winners and consolation prizes were given to all the participants. Overall the program was a grand success.

नगर राजभाषा कार्यान्वयन समिति (नराकास)-जूनागढ़ की वर्ष 2021 की प्रथम छमाही बैठक

नगर राजभाषा कार्यान्वयन समिति' (नराकास)-जूनागढ़ की वर्ष 2021 की प्रथम छमाही बैठक, भाकृअनुप-मूँगफली अनुसंधान निदेशालय, जूनागढ़ द्वारा, दिनाँक 22 अप्रैल, 2021 को कोरोना महामारी से उत्पन्न परिस्थितियों के कारण ऑनलाईन आयोजित की गयी | बैठक में इस निदेशालय सहित राजभाषा विभाग, क्षेत्रीय कार्यान्वयन कार्यालय (पश्चिम), मुम्बई तथा नराकास जूनागढ़ के सदस्य कार्यालयों के अधिकारियों एवं कर्मचारियों ने ऑनलाईन भाग लिया | यह बैठक डॉ. ए. एल. सिंह, निदेशक, भाकृअनुप-मूँगफली अनुसंधान निदेशालय एवं अध्यक्ष, नगर राजभाषा कार्यान्वयन समिति, जूनागढ़ की अध्यक्षता में आयोजित की गयी | बैठक का संयोजन एवं समन्वयन डॉ. सुष्मिता, हिंदी अधिकारी एवं नराकास सचिव, भाकृअनुप-मूँगफली अनुसंधान निदेशालय, जूनागढ़ द्वारा किया गया | बैठक में भाकृअनुप-मूँगफली अनुसंधान निदेशालय, जूनागढ़ के अलावा जिन नराकास-जूनागढ़ सदस्य कार्यालयों ने भाग लिया, वे इस प्रकार है; केन्द्रीय विद्यालय जूनागढ़, बैंक आफ बड़ौदा, यूको बैंक जूनागढ़, यूनियन बैंक ऑफ इंडिया, बैंक ऑफ महाराष्ट्र, भारतीय रेलवे, जूनागढ़, भारतीय विमानपत्तन प्राधिकरण केशोद, भारतीय डाक विभाग जूनागढ़, जवाहर नवोदय विद्यालय जूनागढ़ के अधिकारी एवं कर्मचारी उपस्थित रहें | डॉ. महेश कुमार महात्मा, प्रधान वैज्ञानिक एवं उपाध्यक्ष, राजभाषा कार्यान्वयन समिति, भाकृअनुप-मूँगफली अनुसंधान निदेशालय जूनागढ़ के द्वारा इस निदेशालय एवं अन्य नराकास-जूनागढ़ सदस्य कार्यालयों से प्राप्त छमाही रिपोर्ट को संकलित करके प्रस्तुत किया गया| डॉ. सुष्मिता भट्टाचार्या, उपनिदेशक (कार्यान्वयन), ने इस बात पर बल दिया कि सभी सदस्य कार्यालयों द्वारा धारा ३(३) के अंतर्गत जारी किये जाने वाले कागजात आवश्यक रूप से हिंदी/ द्विभाषी में होना ही चाहिए, नियम 5 का अनुपालन होना चाहिए तथा क और ख क्षेत्रों में होने वाला पत्राचार शत प्रतिशत हिंदी में होना आवश्यक है | कार्यालयों में छमाही के दौरान, राजभाषा कार्यान्वयन समिति दो तिमाही बैठक होना अनिवार्य है | इसी दौरान दो कार्यशालाएँ भी होना चाहिए जिसमें अधिक से अधिक कर्मचारियों एवं अधिकारियों को हिंदी भाषा के लिये प्रशिक्षित किया जाना चाहिये | श्री रनवीर सिंह, मुख्य तकनीकी अधिकारी एवं सदस्य राजभाषा कार्यान्वयन समिति जूनागढ़ ने अपने धन्यवाद ज्ञापन मे निदेशालय के राजभाषा कार्यान्वयन समिति के सदस्यों एवं सभी सदस्य कार्यालयों के

अधिकारियो एवं कर्मचारियों का आभार प्रकट किया | अंत में अध्यक्ष महोदय ने वर्ष 2021 की 'नगर राजभाषा कार्यान्वयन समिति' (नराकास)-जूनागढ़ की प्रथम छमाही बैठक को संपन्न घोषित किया गया |

Vigilance Awareness Week Celebrated at ICAR-DGR

Vigilance Awareness Week was celebrated at ICAR-DGR from 26.10.2021 to 01.11.2021. The vigilance

week started with pledge taking ceremony by Dr. C.S Praharaj, Principal Scientist, Crop Production, ICAR-DGR and DGR staff on 26.10.2021. On 27.10.2021, a talk on "preventive vigilance" was given by Sh. Rami Reddy, Manager (Admin.), CAO, DAE, NIRD, Hyderabad. On 28.10.21, a talk on "Purchase Procedures" was given by Sh. Z.H. Khilji, CFAO, NAARM, Hyderabad. On 29.10.21, an elocution competition on "Independent India @75: Self Reliance with Integrity", was held, in which around 25 staff participated. On 30.10.21, essay writing competition on "Self Reliance with Integrity" was held, in which about 22 staff participated. The closing ceremony was held on 01.11.21, in which the winners were given prizes and the programme ended with the concluding remarks by Dr. KK Pal, Vigilance Officer, ICAR-DGR.

Swachhata Pakhwada organized at ICAR-DGR during 16-31st December 2021

"Swachhta Pakhwada" was organized during 16-31st December, 2021 at ICAR-DGR. The fortnightly programme was coordinated by Dr. C.S. Praharaj, PS (Agronomy), ICAR-DGR. The first day started with Swachhta pledge by the DGR staff and then a sequence of activities was undertaken daily. The DGR staff participated with full enthusiasm and ensured cleaning in office premises, guest house area, residential area and children park. There were a number of other important activities like creating awareness about tree plantation, sanitization, mask distributions and waste management. A quiz competition was also organized on the theme "*Cleanliness: Make this planet cleaner to live life healthier*" wherein enthusiastic participants competed for the first, second and third prizes. The

DGR staff participated with full enthusiasm and the quiz was successfully conducted. The concluding function was organized on 31st December, 2021. Prizes (for the winners of Quiz competition) and certificates for satisfactory completion of various work/activities were distributed to the staff of DGR family. The programme was a grand success.

11 Staff List – 2021 / General Information / Finance & Accounts

1. Staff List 2021

S.No	Name of employee	Designation
1	Dr. T. Radhakrishnan	Director (Retired -31.01.2021)
2	Dr. A.L. Singh	Director (Acting) (01.02.2021 to 31.07.2021) (Retired -31.07.2021)
3	Dr. S.K. Bera	Director (Acting) (from 01.08.2021)
4	Dr. C.S. Praharaj	Principal Scientist (Agronomy)
5	Dr. K.K. Pal	Principal Scientist (Microbiology)
6	Dr. Rinku Dey	Principal Scientist (Microbiology)
7	Dr. M. K. Mahatma	Principal Scientist (Plant Biochemistry) (Transferred-08.10.2021)
8	Dr. G. Harish	Senior Scientist (Entomology)
9	Dr. Narendra Kumar	Senior Scientist (Plant Breeding)
10	Dr. B.C. Ajay	Senior Scientist (Plant Breeding)
11	Sh. M.V. Nataraja	Scientist (Senior Scale) (Entomology)
12	Dr. K. Gangadhar	Scientist (Plant Breeding) (Transferred-25.01.2021)
13	Dr. S. Chandramohan	Scientist (Senior Scale) (Plant Biotechnology)
14	Dr. K.K. Reddy	Scientist (Senior Scale) (Soil Science)
15	Dr. Kona Praveen	Scientist (Senior Scale) (Plant Breeding)
16	Dr. Sushmita Singh	Scientist (Senior Scale) (Plant Physiology)
17	Sh. Ananth Kurella	Scientist (Plant Pathology)
18	Sh. Rupak Jena	Scientist (Nematology) (Transferred-23.01.2021)
19	Dr. Aman Verma	Scientist (Plant Biochemistry) (Transferred-30.01.2021)
20	Dr. Raja Ram Choudhary	Scientist (Agronomy)
21	Dr. Kirti Rani	Scientist (Plant Breeding)
22	Dr. Papa Rao Vaikuntapu	Scientist (Biotechnology)
23	Dr. G.A. Rajanna	Scientist (Agronomy)
24	Sh. P.V. Zala	Chief Technical Officer
25	Dr. M.V. Gedia	Chief Technical Officer
26	Sh. Ranvir Singh	Chief Technical Officer
27	Dr. S.D. Savaliya	Chief Technical Officer
28	Mrs. V.S. Chaudhari	Chief Technical Officer
29	Sh. D.R. Bhatt	Assistant Chief Technical Officer (Retired -30.06.2021)
30	Sh. R.D. Padvi	Technical Officer

S.No	Name of employee	Designation
31	Sh. H.V. Patel	Technical Officer (Retired -28.02.2021)
32	Sh. C.B. Patel	Technical Officer
33	Sh. N.M. Safi	Technical Officer (Driver)
34	Sh. Lokesh Kumar	Technical Officer
35	Sh. Pitabas Dash	Senior Technical Assistant
36	Sh. M.A. Shaikh	Driver
37	Sh. D. M. Sachaniya	T-1
38	Sh. M.B. Shaikh	T-1
39	Sh. K.T. Kapadia	T-1
40	Sh. V.N. Kodiatar	T-1
41	Sh. Indraraj Meena	Administrative Officer (Transferred-13.10.2021)
42	Sh. Amit Kumar	Finance & Accounts Officer (Transferred-14.10.2021)
43	Sh. R. T. Thakar	Assistant Administrative Officer (Retired –28.02.2021)
44	Sh. Anupam Chaubey	AAO (on deputation)
45	Sh. Y.S. Kariya	Personal Secretary
46	Sh. L.V. Tilwani	Personal Assistant
47	Sh. M.B. Kher	Security Supervisor (Retired -31.05.2021)
48	Mrs. Santha Venugopalan	Assistant
49	Sh. C.G. Makwana	Assistant
50	Sh. P. N. Solanki	Upper Division Clerk (Retired -31.12.2021)
51	Sh. J.G. Agravat	Skilled Support Staff
52	Sh. V.M. Chawada	Skilled Support Staff
53	Sh. G.S. Mori	Skilled Support Staff
54	Mrs. D.S. Sarvaiya	Skilled Support Staff
55	Sh. P.M. Solanki	Skilled Support Staff
56	Sh. N.G. Vadher	Skilled Support Staff
57	Sh. B.J. Dabhi	Skilled Support Staff
58	Sh. C.G. Moradia	Skilled Support Staff
59	Sh. D.A. Makwana	Skilled Support Staff
60	Sh. Jay R. Purohit	Skilled Support Staff
61	Sh. M.B. Kandoliya	Skilled Support Staff
62	Sh. Pola Haji	Skilled Support Staff
63	Sama Roshan Allarakha	Skilled Support Staff
64	Sumara Amin Pirmahamadbhai	Skilled Support Staff
65	Dafada Ratanben Govindbhai	Skilled Support Staff
66	Hariyani Hitendra Jejerambhai	Skilled Support Staff

S.No	Name of employee	Designation
67	Vachhani Jagadishbhai Ratilal	Skilled Support Staff
68	Solanki Bharatiben Karshanbhai	Skilled Support Staff
69	Jotaniya Bharat Khimajibhai	Skilled Support Staff
70	Odedra Shanta Karshan	Skilled Support Staff
71	Sachania Sureshkumar Raghav	Skilled Support Staff
72	Makawana Babubhai Kalubhai	Skilled Support Staff
73	Shihora Rajesh Naran	Skilled Support Staff
74	Seta Hanifbhai Habibbhai	Skilled Support Staff
75	Gohel Jyotsanaben Babubhai	Skilled Support Staff
76	Sumara Bhikhubhai Jamalbhai	Skilled Support Staff

2. Staff position as on 01.01.2021 to 31.12.2021

Category	Sanctioned Strength (as on 31.12.2021)	Filled (as on 31.12.21)	Vacant (as on 31.12.21)
Scientific	35+01 RMP	17	18 + 01 RMP
Technical	39	14	25
Admn.	18	5	13
SSS	30	26	04

3. IMC held on 19.07.2021

S. No.	Institute Management Committee	Designation	Period
1	Director, ICAR-DGR, Junagadh	Chairman	Ex-Officio
2	Assistant Director General (OP), ICAR, KB, New Delhi	Member	06.08.2016 to 5.08.2020
3	Dr. Akshay Talukdar, PS, Division of Genetics, IARI, New Delhi	Member	25.12.2020 to 4.12.2023
4	Dr. R.D. Prasad, PS, IIOR, Hyderabad	Member	25.12.2020 to 4.12.2023
5	Dr. C.S. Praharaj, PS, IIPR, Kanpur	Member	25.12.2020 to 4.12.2023
6	Dr. V.P. Chovatia, Director of Research, JAU, Junagadh	Member	06.09.2018 to 5.09.2021
7	Director of Agriculture (Gujarat), Krishi Bhavan, Gandhinagar, Gujarat	Member	06.09.2018 to 5.09.2021
8	Director of Agriculture (Rajasthan), Pant Krishi Bhavan,Jaipur, Rajasthan	Member	06.09.2018 to 5.09.2021
9	Shri Mahendrabhai Pithiya, Talala	Member	06.09.2018 to 5.09.2021
10	Shri Vraj Lal Hirpara, Junagadh	Member	06.09.2018 to 5.09.2021
11	Finance & Accounts Officer ICAR-CSWRI, Avikanagar, Rajasthan	Member	06.09.2018 to 5.09.2021
12	Administrative Officer, ICAR-DGR, Junagadh	Member Secretary	Ex-Officio

4. DPC

1. DPC Held on 11-06-2021 for Technical Staff, 02 employees
2. DPC Held on 26.07.2021 for Scientific Staff, 03 employees
3. DPC Held on 22.11.2021 for Technical Staff , 01 employee
4. DPC Held on 26-11-2021 for Scientific Staff, 01 employee
5. DPC Held on 08-12-2021 for Assistant Chief Technical Staff, 01 employee
6. DPC Held on 21-12-2021 for Technical Staff, 01 employee

5. Retirement

1. Dr. T. Radhakrishnan, Director, 31.01.2021
2. Sh. R.T. Thakar, AAO, 28.02.2021
3. Sh. H.V. Patel, Technical Officer, 28.02.2021
4. Sh. M.B. Kher, Security Supervisor, 31.05.2021
5. Sh. D.R. Bhatt, ACTO, 30.06.2021
6. Dr. A.L. Singh, Director (Acting), 31.07.2021
7. Sh. P.N. Solanki, UDC, 31.12.2021

6. Transfers

1. Dr. C.S. Praharaj, PS (Agronomy), ICAR-IIPR, Kanpur to ICAR-DGR, Junagadh on 04.10.2021
2. Dr. Gangadhara K., Scientist (Genetics & Plant Breeding), ICAR-DGR, Jungadh to ICAR-CTRI Rajamundry on 25.01.2021
3. Shri Rupak Jena, Scientist (Nematology), ICAR-DGR, Junagadh to ICAR- National Rice Research Institute, Cuttack on 23.01.2021
4. Dr. Aman Verma, Scientist (Plant Biochemistry), ICAR-DGR, Junagadh to ICAR- CAZRI, Jodhpur on 30.01.2021
5. Dr. M.K. Mahatma (Plant Biochemistry), ICAR-DGR, Junagadh to NRCSS, Ajmer on 08.10.2021
6. Sh. Indraraj Meena (AO), ICAR-DGR, Junagadh to ICAR-CAZRI, Jodhpur on 13.10.2021
7. Sh. Amit Kumar (FAO), ICAR-DGR, Junagadh to ICAR-DRMR, Bharatpur on 14.10.2021

7. Institute Joint Staff Council

Chairman:- Director, ICAR-DGR, Junagadh, Gujarat

Members: Staff side

1. Shri Y.S. Karia, Member CJSC
2. Shri R.D. Padvi, TO
3. Shri Pitabas Dash, TO
4. Shri C.G. Moradia, SSS
5. Shri Jay Purohit, SSS

Members: Office side

1. Dr. R. Dey, Pr. Scientist, DGR, Junagadh
2. FAO, DGR, Junagadh
3. AO, DGR, Junagadh

8. Contractual Staff

S.No	Position	Nos.
1.	RA	03
2.	SRF	02
3.	YP-2	01
4.	YP-1	22
5.	Data Entry Operator	01
6.	Security Staff -Ex. Army	22
7.	Cleaning Staff	06
8.	Farm Tractor Driver	04
9.	Reception	05
10.	Electrician	03
11.	DPL	08

9. Research Advisory Committee of ICAR-DGR

S.No	Name	Nominated as
1.	Dr. A. Bandyopadhyay, Former N ational Coordinator,NAIP, ICAR	Chairman
2.	Dr. B.B. Singh, Former ADG (O&P), ICAR	Member
3.	Dr. I.U. Dhruj, Associate Director of Research (Rtd), Junagadh Agricultural University, Junagadh , Gujarat	Member
4.	Dr. L.M. Garnayak, Former Dean, College of A griculture, Orissa University of Agriculture And Technology, Bhubaneshwar	Member
5.	Prof. P.B. Kirti, Faculty of Basic Sciences and Humanities, Rajendra Prasad Central Agricultural University, Pusa - Samastipur, Bihar	Member
6.	Director, ICAR-Directorate of Groundnut Research, Junagadh, Gujarat	Member
7.	ADG(OP), ICAR, Krishi Bhawan, New Delhi	Member
8.	Shri Mahendrabhai Pithiya, Talala, Dist. Gir Somnath, Gujarat	Member
9.	Shri Vrajlal (Vajubhai) Jivabhai Hirpara, Nehru Park, Junagadh	Member
10.	Dr. S.K. Bera, Principal Scientist, ICAR- DGR, Junagadh	Member Secretary

10. Institute Research Committee

Chairman

Director, ICAR-DGR, Junagadh

Member Secretary

Dr. Rinku Dey, Principal Scientist (Microbiology), ICAR-DGR, Junagadh

Members

All Scientists

Finance & Accounts

ICAR-DGR

Budget	Allocation 2021-22 (in lakhs)	Total Expenditure Until Dec. 31, 2021 (in lakhs)
Establishment charges	692.95	550.62
Wages	34.22	34.22
Admininstrative Expenses	330.45	196.18
Pension	198.68	174.87
T.A.	15	10.28
Research and Operational Expenses	193.55	124.02
HRD	0	0
Works	126.06	116.88
Equipment	55.42	6.43
Furniture	2.13	2.13
IT	0.00	0
Books	0.00	0
Vehicle	0.00	0
Miscellaneous	15.00	4.39
TSP	26.00	21.75
NEH capital	12.20	0
SCSP	90	53.9
Total	**1791.66**	**1295.67**

AICRPG

Budget	Allocation 2021-22 (in lakhs)	Total Expenditure Until Dec. 31, 2021 (in lakhs)
Capital	15.26	0
Pay & Allowance	722.76	512.39
TA	13.90	10.20
Recurring Contigency & Need Based Research	190.10	98.34
TSP	45.00	37.50
NEH	0.00	0.00
Total	**987.02**	**658.43**

भाकृअनुप
ICAR

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

Agrisearch with a human touch