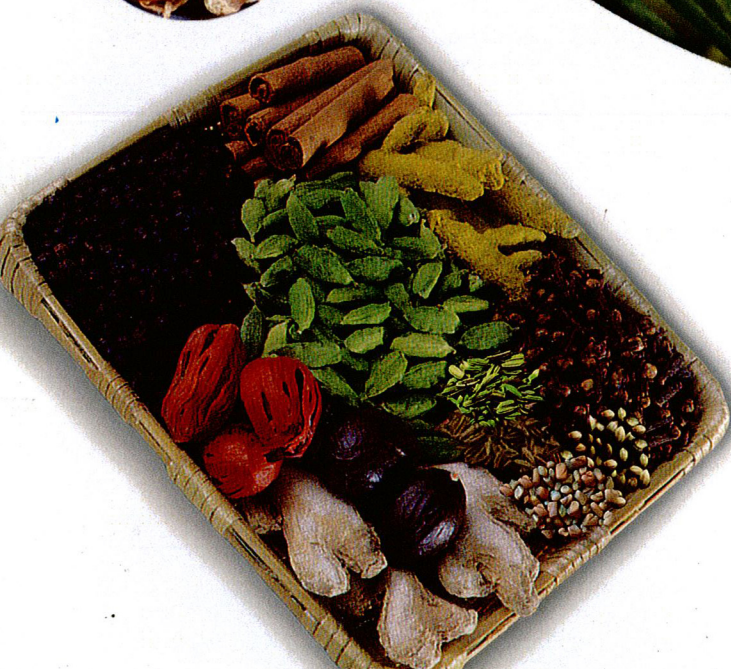




वार्षिक रिपोर्ट Annual Report 2011-12

अखिल भारतीय समन्वित मसाला अनुसंधान परियोजना ए आई सी आर पी एस
All India Coordinated Research Project on Spices

डाटाफाइ



भारतीय मसाला फसल अनुसंधान संस्थान
(भारतीय कृषि अनुसंधान परिषद्)
मेरिकुन्नु पी. ओ., कोषिकोड, केरल, भारत

Indian Institute of Spices Research
(Indian Council of Agricultural Research)
Kozhikode - 673012, Kerala, India



Published by

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Cover Design

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Correct Citation

All India Coordinated Research Project on Spices
Annual Report, 2011-12
Indian Institute of Spices Research
Calicut, Kerala

Printed at

K.T. Printers Mukkam

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परियोजना समन्वयक की रिपोर्ट

अखिल भारतीय समन्वित मसाला अनुसंधान परियोजना (ए आई सी आर पी एस) का मुख्यालय भारतीय मसाला फसल अनुसंधान संस्थान, कोषिकोड में स्थित है। इस परियोजना के अन्तर्गत भारत के 12 राज्यों में मसालों के लिये उपयुक्त विभिन्न कृषि जलवायु क्षेत्रों में 14 केन्द्र थे जो अब बढ़ कर 21 राज्यों में 34 केन्द्र हो गये हैं। जिनमें 19 नियमित, 8 सहयोगी तथा 7 अवैतनिक केन्द्र हैं। इसकी अधिदेश फसलें काली मिर्च (9 केन्द्र), छोटी इलायची (4 केन्द्र), सौंफ (9 केन्द्र), मेथी (12 केन्द्र), वृक्ष मसाले जैसे लौंग, जीरा तथा जायफल (प्रत्येक के 3 केन्द्र) हैं। वर्ष 2011-12 के लिये इस परियोजना का XI वीं योजना के अन्तर्गत बजट 1637.5 लाख रुपये था जिसमें 656.50 लाख रुपये की भारतीय कृषि अनुसंधान परिषद, नई दिल्ली की भागीदारी थी। विभिन्न केन्द्रों में अधिदेश फसलों पर आनुवंशिकी, फसल सुधार, फसल उत्पादन तथा फसल संरक्षण जैसे प्रमुख विभागों के अन्तर्गत लगभग 110 शोध कार्यक्रम आयोजित किये गये।

काली मिर्च

काली मिर्च जननद्रव्यों को एकत्रित करके लगभग सभी काली मिर्च पर कार्य करने वाले केन्द्रों में संरक्षण किया जा रहा है। पन्नियूर के काली मिर्च के जननद्रव्यों अक्सेशनों का मूल्यांकन करने पर कल्टिवर अंकमाली तत्पश्चात् आई सी पी 48 में अधिक हरी बेरी की उपज अंकित की गयी।

यारकाड में दो अक्सेशन 57 तथा 33 लगातार अच्छा प्रदर्शन कर रहे हैं। पन्नियूर में कल्टिवर 5489 आशाजनक थे, वही सिरसी तथा अम्बलावयल में पन्नियूर I की अधिक शुष्क उपज (कमशः 1.20 कि. ग्राम तथा 1.54 कि. ग्राम) अंकित की गयी। सिरसी में आई आई एस आर थेवम पर रनर शूट को रूट स्टॉक के रूप में कलम बंध करने पर अधिक उंचाई तथा पत्तियों की संख्या अधिक थी। पन्नियूर, पेचीपारी तथा सिरसी में जैविक खेती के अन्तर्गत एकीकृत पोषण प्रबन्धन में बेरी की अधिक उपज प्राप्त हुई। सिरसी में काली मिर्च की प्रजाति आई आई एस आर शक्ति में *फाइटोफथोरा* खुर गलन के प्रति सहिष्णुता का जीवाणु के धौल (आई आई एस आर 6 तथा आई आई एस आर 859) का छिडकाव (21/बेल) तथा रूट जोन को भिगोना (31/बेल) तथा मृदा में मानसून के समय (अगस्त 2011) तथा मानसून से पहले (जून 2011) में *ट्राइकोडरमा हरज़ियानम* (MT CC 5179) 50 ग्राम/बेल की दर से तथा एक कि. ग्राम नीम केक से उपचारित करने पर अन्य रोगों की कमी अंकित की गयी। सिरसी में 0.1% केनामाइसिन (100%) + मेनकोज़ेब 50% का छिडकाव तथा मूल के आस पास डालने तथा *ट्राइकोडरमा हरज़ियानम* (MT CC 5179) को 50 ग्राम/बेल तथा 1 कि. ग्राम नीम केक से मृदा उपचारित करने पर पत्तियों में पीलापन की कमी तथा अधिक उपज (3 कि. ग्राम/बेल) प्राप्त हुई। सिरसी में 0.1% फेनामिडन + मेनकोज़ेब (50%) (सेक्टिन) डालने



के फलस्वरूप बेलों के पीलापन (7.34 पी डी 1) में कमी होती है तथा अधिकतम उपज (3.12 कि. ग्राम/बेल) भी प्राप्त होती है।

काली मिर्च के सहायक वृक्ष ईरीथ्रीना की दो उपजातियों ई. इण्डिका तथा ई. फुस्का पर गाल वास्प की पूर्णतः क्षेत्र में समस्या अंकित की गयी जबकि ई. सुबुमवान्स में इस का कोई प्रभाव अंकित नहीं किया गया।

छोटी इलायची

कल्टीवर्स प्रजाति परीक्षण में, पाम्पाडुमपारा में PS -21 की अधिकतम शुष्क कैप्सूल उपज (597 ग्राम/पौधा) तथा मुडिगेरी में MCC 309 में (290 कि. ग्राम/हे) तत्पश्चात् PS -27 में (280 कि. ग्राम/हे) अधिकतम शुष्क कैप्सूल की उपज प्राप्त हुई। एक अन्य परीक्षण में, सकलेशपुर में IC 34987 में (958 ग्राम) तत्पश्चात् SKP 164 (61-2%) में प्रति पौधा अधिक उपज प्राप्त हुई। उर्वरक के 100% संस्तुत मात्रा के साथ साथ 91/क्लम्प/दिन को रिसावदार सिंचाई करने पर (180.15 कि. ग्राम/हेक्टर) उपज प्राप्त हुई जो कि उर्वरकों की संस्तुत मात्रा (75%) के साथ-साथ 91/क्लम्प/दिन सिंचाई करने पर लगभग समान उपज (179.78 कि. ग्राम/हेक्टर) प्राप्त हुई। मुडिगेरी में जैविक खेती की संस्तुति के आधार पर शुष्क कैप्सूल की अधिक उपज (230.66 कि. ग्राम/हे.) प्राप्त हुई। कीटनाशक सूत्रकृमि हेटरोरहेबडाइटिस इण्डिका अकेला तथा इमाडेक्लोपिरिड (0.06%) के साथ उपचारित करने पर इलायची की रूट गिरव के विरुद्ध आशावान थे। मुडिगेरी में नये कीटनाशक

मीथेमाइल 1.5 ग्राम/लितर की दर से तथा एसीटामाइपरिड 0.5 ग्राम तथा ईमाइडाक्लोपिरिड 0.5 मि. लि. की दर से नियन्त्रण की तुलना में अधिक प्रभावशाली थे। पाम्पाडुमपारा में बावस्टिन (0.2%), जैविक नियन्त्रण कारक, ट्राइकोडेरमा हरज़ियानम (50 ग्राम) + 1 कि. ग्राम नीम केक को आधारीय प्रयोग + जीवाणु संघटकों का छिडकाव तथा ट्राइकोडेरमा हरज़ियानम (50 ग्राम) + 1 कि. ग्राम नीम केक + *प्स्यूडोमोनास फ्लोरिसेंस* 10^8 (cfu/g) का छिडकाव द्वारा प्रभावकारी प्रबन्धन किया।

बडी इलायची

पश्चिम बंगाल राज्य के दार्जिलिंग तथा सिक्किम जिले का सर्वेक्षण करके 19 अक्सेशनों को संचयन करके कवी के जननद्रव्य संरक्षणशला में संरक्षित किया तथा इनमें से 13 के IC नम्बर भी प्राप्त हो गये है। चौदह रोग मुक्त निसतारत (अंगमारी कारक कोलेटोटाइकम गिलोस्पोरोरिडिसै) को पश्चिम बंगाल के पहाडी क्षेत्रों दार्जिलिंग एवं सिक्किम से संचयन किया। बरलानगी प्रजाति की 75% छाया वाले स्थान पर खेती करने पर अधिकतम वृद्धि एवं उपज (253 कि. ग्राम/हे.) प्राप्त हुई। गैंगटोक में पत्तियों का कैटरपिल्लर, शूट फलाई तथा तना भेदक के विरुद्ध नीमविसीडिन (3 मि. लि./लितर) तथा बैसिलस थ्यूरेनज़िस (2 ग्राम/लि.) प्रभावशाली थे।

अदरक

पोटांगी में कल्टिवर प्रजाति परीक्षण में अदरक (*V₁E₄-5*) की अधिक उपज प्राप्त हुई जबकि पुन्डीबारी तथा कुमारगंज

में अधिकतम उपज क्रमशः NDG₁ की 17 टन/हे. तथा V₂E₃-2 की 14 टन/हे. प्राप्त हुई। सोलन में प्रारंभिक मूल्यांकन परीक्षण में जीन प्रकार SG-26/4 (27.8 टन/हे.) SG-908 (27.6 टन/हे.) तथा SG-08/04 (26.7 टन/हे.) अधिक उपज वाले थे।

सोलन में अदरक की गुणवत्ता पर जीन प्रकार X पर्यावरण पारस्परिक सम्बन्धों पर प्रयोग किया गया। स्थानीय कल्टिवर्स SG 827 की अधिकतम उपज 21.67 टन/हेक्टर अंकित की गई। चिन्तापल्ली में वरदा की 22-24 टन/हेक्टर, पोटांगी में V₁E₈ की 21-60 टन/हेक्टर, मिज़ोरम के हिमगिरी में 18 टन/हेक्टर, कैनके में सुप्रभा की 28.4 टन/हेक्टर, पासीघाट में सुरभी की 24.2 टन/हेक्टर, अप्पंगला में महिमा की 15.76 टन/हेक्टर, पुन्डीबारी में जी सी पी 5 की 11.7 टन/हेक्टर, कल्याणी में गौरुवाथन स्थानीय की (25.18 टन/हेक्टर) अधिकतम उपज प्राप्त हुई। पुन्डीबारी में सुप्रभा में अधिकतम शुष्क मेटर (18.26%) तथा ओलीओरेसिन (6.8%) जबकि सुरभी में अधिकतम महत्वपूर्ण तेल (1.8%) तथा महिमा में अपरिपक्व तन्तु (5.2%) की मात्रा अधिक थी। सोलन में चौदह उत्तम संचयनों के महत्वपूर्ण तेल एवं ओलिओरेसिन की मात्रा के लिये मूल्यांकन किया गया। अधिक उपज वाले संचयन SG-26/04 तथा SG-908 में शुष्क मेटर, महत्वपूर्ण तेल, ओलिओरेसिन तथा अपरिपक्व तन्तु की मात्रा हिमगिरी नियन्त्रण की तुलना में अधिक थी। कुमारगंज में एकीकृत पोषण तत्व पद्धति में अधिकतम उपज, जबकि रायगढ में जैविक पोषण तत्व पद्धति तथा पुन्डीबारी तथा पोटांगी में अजैविक पोषण तत्व पद्धति में अधिकतम उपज अंकित की गयी।

सोलन, चिन्तापल्ली, पुन्डीबारी तथा रायगढ में प्रकन्द को मेटालेक्सिल मैन्कोज़ेब द्वारा उपचारित करने पर मन्द गलन रोग की कमी तथा अधिक उपज अंकित की गयी। पाम्पाडुमपारा, पुन्डीबारी, अम्बलावयल तथा रायगढ में बन्दगोभी का उपयोग करके जैविक धूमीकरण करके मन्द गलन रोग का आपतन कम तथा अधिकतम उपज अंकित की गयी। सोलन तथा पुन्डीबारी में सरसों तथा बन्दगोभी का उपयोग करके जैविक धूमीकरण, जीवाणु म्लानी रोग के प्रबन्धन के लिये किया गया।

हल्दी

कुमारगंज में शीघ्र परिपक्व होने वाले 30 जननद्रव्य अक्सेशनों का मूल्यांकन करने पर NDH-4 (35 टन/हे.) तथा NDH-79 (35 टन/हे.) अधिक आशावान थे। मध्यम अवधि में परिपक्व होने वाले 80 जननद्रव्यों का मूल्यांकन करने पर NDH-98 (42.14 टन/हे.) तथा NDH-14 (35.24 टन/हे.) की अधिक उपज प्राप्त हुई। पोटांगी में TU No.6, पुन्डीबारी में TCP-90, कामरपली में CLI-316, रायगढ में IT-13, पासीघाट में CHFT-8 तथा CHFT-32 जननद्रव्यों की अधिकतम उपज अंकित की गयी। प्रारंभिक मूल्यांकन परीक्षण करने पर कुमारगंज में NDH-18 की, पोटांगी में PTS-47 (22 टन/हे.) , पुन्डीबारी में TCP-64 की अधिकतम उपज अंकित की गयी। जीन प्रकार X पर्यावरण के पारस्परिक प्रभाव का अध्ययन करने पर चिन्तापल्ली में रामो प्रजाति, कुमारगंज में NDH-18, कामरपली में दुगरिल्ला रोड, पुन्डीबारी में आई आई एस आर केदारम, मिज़ोराम में RCT 1, कल्याणी में राजेन्द्र सोनिया, कोयम्बतोर में दुगरिल्ला, रायगढ में सुरंजना



की अधिकतम उपज अंकित की गयी। पुंडिबारी तथा रायगढ में एकीकृत पोषण तत्व पद्धति में अधिकतम उपज प्राप्त हुई।

कोयम्बटूर तथा कारपाली में दिन में एक बार रिसावदार सिंचाई (क्रमशः 60% P E तथा 80 % P E) करने पर अधिकतम उपज अंकित की गयी। कोयम्बटूर तथा कामरपली में हल्दी में हफते में एक बार रिसादार विधि द्वारा 100% आर डी एफ फर्टीगेशन को मानकीकृत किया गया। धोली में सूक्ष्म पोषण तत्वों को 25 कि.ग्राम/है जबकि पुंडिबारी में बोरोन को 25 कि.ग्राम/है. तथा कुमारगंज में जिंक को 25 कि. ग्राम/हे. की दर से मृदा में प्रयोग करने पर अधिकतम उपज (क्रमशः 20.67 टन/है. तथा 30 टन/है.) अंकित की गयी।

चिंतापल्ली एवं कोयम्बटूर में प्रकन्द के आकार का अध्ययन करने पर ज्ञात हुआ कि, बीज प्रकन्दों का आकार (30-40 ग्राम) को सीधे खेतों में बुआई करके अधिकतम उपज प्राप्त होती है। हल्दी को संसाधन करने के लिये परम्परागत गरम पानी विधि 40, 60 तथा 90 मिनट तक उबालते हैं तथा संशोधित विधि अनुसार गरम पानी में 30,45,60 तथा 90 मिनट तक उबालने पर सूखने में 10 दिन का समय लेते हैं। परन्तु प्रकन्दों को गरम पानी में 10 मिनट तक डुबोकर उन्हें सुखाने के लिये 13 दिन का समय लगता है।

प्रोपीकोनाज़ोल (0.1%) का छिडकाव 45 तथा 90 दिनों पर जबकि पुंडिबारी तथा कुमारगंज में प्रकन्द उपचारण के साथ -साथ हेक्साकोनाज़ोल (0.1%) का रोपण के 45 तथा

90 दिन पश्चात् छिडकाव करने पर पर्ण चित्ती तथा पर्ण छाला रोग का आपतन कम अंकित किया गया। चिंतापल्ली में प्रकन्द उपचारण के साथ साथ प्रोपीकोनाज़ोल (0.1%) का छिडकाव रोपण के 45 तथा 90 दिनों बाद करने पर पर्ण चित्ती रोग का आपतन कम अंकित किया गया। रायगढ तथा पोटांगी में प्रकन्दों को कार्बेन्डाज़िम + मेन्कोज़िब (1:1) से उपचारण करने तथा 0.1% का छिडकाव करने पर रोग आपतन कम अंकित किया गया।

वृक्ष मसाले

यारकाड, दापोली, तथा पीचिपारी में वृक्ष मसालों जैसे जायफल, दालचीनी, कैसिया तथा लौंग के जननद्रव्यों को एकत्रित करके उनका चरित्रांकन करके अनुरक्षण किया जा रहा है। पीचिपारी में लौंग के 24 अक्सेशनों में से S A 13 में अधिकतम वृक्ष लंबाई (8.22 मीटर), शुष्क उपज (3.89 कि. ग्राम/वृक्ष), लौंग तेल (2.78%) तथा ओलिओरेसिन (2.56%) की मात्रा अंकित की गयी। जायफल अक्सेशनों में से, MF-4 में फलों की संख्या (999/वृक्ष), फल का भार (73.45 ग्राम) तथा शुष्क जावित्री की उपज (419 ग्राम) अंकित की गयी। दालचीनी अक्सेशनों में से, CV-5 में अधिकतम शुष्क छाल उपज (545 ग्राम/वृक्ष), जबकि स्थानीय नियन्त्रण में इसकी उपज 280 ग्राम/वृक्ष अंकित की गयी। लौंग में अक्सेशन SA3 अधिक उपज (2.95 कि. ग्राम/वृक्ष) के लिये आशावान थे। पीचीचारी में जायफल की कल्टिवर्स प्रजाति परीक्षण में अक्सेशन A9/150 में वृक्ष लंबाई (1.98 मीटर, तने की मोटाई (11.81 से. मी.) पत्तियों का भार (390 ग्राम/वृक्ष) तथा छाल की उपज

(226 ग्राम/वृक्ष) थी।

धनिया

धोली में आशाजनक अक्सेशनों में से, RD 418 अधिकतम उपज (18 ग्राम/पौधे) अंकित की गयी। गुंटूर में इकसठ जननद्रव्यों का मूल्यांकन करने पर LCC-272, LCC-268, LCC-262, LCC-275 तथा LCC-276 में तुलनात्मक नियन्त्रण (4.02 कि.ग्राम/पौधा) की अपेक्षा अधिक उपज थी।

कल्टिवर्स प्रजाति परीक्षण में, COR-29 की जगुदान तथा गुंटूर, COR-27 की जोबनेर, COR-31 की राइगढ, COR-33 की पंतनगर तथा जबलपुर, COR-32 की हिसार तथा COR-26 की उदयपुर में अधिकतम उपज अंकित की गयी। एक अन्य सी वी टी म, गुंटूर में धनिये की पत्ती जबकि कोयम्बटूर तथा पेरियकुलम में LCC-43 में पत्तियों की उपज अधिक अंकित की गयी।

धनिया बीज के लिये प्रारंभिक मूल्यांकन परीक्षण में, जोबनेर में UD-61, धोली में RD-377, जगुदान में JCR-380, हिसार में DH-281 तथा DH-314, कुमारगंज में ND-50 R38, गुंटूर में LCC 219 तथा पंतनगर में PD(S)-21 आशाजनक थे। पंतनगर में धनिया पत्ती के लिये किये गये आई ई टी में, PD (L) -51 तत्पश्चात् PD(L) -11 में अधिकतम उपज अंकित की गयी। जोबनेर में 14 अक्सेशनों को बाष्पशील तेल के लिये मूल्यांकन करने पर COR-27 में 7.371/हेक्टर तत्पश्चात् COR-34 में 6.501/हेक्टर की मात्रा थी। जोबनेर में 10 अक्सेशनों में से, UD-63 (7.731/हेक्टर) तत्पश्चात् UD-565 में (6.831/हेक्टर) बाष्पशील तेल की अधिकतम मात्रा

अंकित की गयी। जोबनेर में शुष्क क्षेत्रों के लिये UD-115 को उच्च उपज के लिये चिन्हित किया गया। कोयम्बटूर, धोली, हिसार तथा रायगढ में एकीकृत पोषण तत्व प्रबन्धन में जबकि गुंटूर तथा कुमारगंज में रासायनिक उर्वरकों में अधिकतम उपज अंकित की गयी। कोयम्बटूर, में जिंक सल्फेट को 0.5% की दर से पत्तियों पर छिडकाव करने पर अधिकतम उपज (772.44 कि. ग्राम/हे.) जबकि धोली में सूक्ष्म तत्वों को 25 कि. ग्राम/हेक्टर की दर से मृदा में डालने पर अधिकतम उपज (2.42 टन/हे.) प्राप्त हुई। पंतनगर तथा कोयम्बटूर, में तने की गांठ रोग को नियन्त्रण करने के लिये प्रोपीकोनोजोल से बीजों को उपचारित करने की तकनीक विकसित की गयी। जोबनेर में आई ई टी के अन्तर्गत VC 339 तथा VC 336 में क्रमशः 726.7 कि. ग्राम/हेक्टर तथा 671.88 कि. ग्राम/हेक्टर की अधिकतम उपज अंकित की गयी।

जीरा

जोबनेर में सी वी टी के अन्तर्गत जीरा 13 की अधिकतम उपज (687.5 कि. ग्राम/हेक्टर) तथा बाष्पशील तेल की मात्रा अंकित की गयी। जीन प्रकार UC 239 तत्पश्चात् UC 274 तथा UC 225 कम आर्द्र परिस्थितियों के लिये उत्तम थे। जोबनेर में *ट्राइकोडरमा हर्जियानम* (10 कि. ग्राम/हेक्टर.) + एफ. वाई.एम (3 टन/हे.) से उपचारित करने पर, जबकि जगुदान में मृदा सौरयीकरण + *ट्राइकोडरमा हर्जियानम* + 60 दिन बाद मैनकोज़िब का 0.25% की दर से छिडकाव करने पर म्लानी रोग आपतन कम अंकित किया गया।

**सौंफ**

कल्टिवर्स प्रजाति परीक्षण के अन्तर्गत जोबनर, धोली तथा जबलपुर में FNL 43 जबकि जगुदान में FNL 40, कुमारगंज में NDF5(Ch) तथा उदयपुर में FNL 42 अधिक उपज वाले थे। आई ई टी के अन्तर्गत जगुदान में JF 671-1(1273 कि.ग्राम/हेक्टर), हिसार में HF 151 (2182 कि.ग्राम/हेक्टर), कुमारगंज में NDF 46 (1371 कि.ग्राम/हेक्टर) की अधिक उपज अंकित की गयी। जोबनेर में आई ई टी के अन्तर्गत UF168 की अधिकतम बीज उपज (2306.67 कि.ग्राम/हेक्टर) अंकित की गयी। सी वी टी के अन्तर्गत बाष्पील तेलों की अधिकतम मात्रा FNL 46 (49.431/हेक्टर, तत्पश्चात् FNL 43 (46.99/ हेक्टर) में अंकित की गयी। जगुदान में विभिन्न प्रकार के कीटनाशक एवं वानस्पतिक को सीड मिडज़ के विरुद्ध मूल्यांकन करने पर, थायोमिथोसम 25 WG को 0.0084% की दर से 3 तथा 7 दिन पर छिडकाव करने पर सीड वास्प द्वारा पहुंचायी गयी हानि (8.73%) कम अंकित की गयी।

मेथी

सी वी टी के अन्तर्गत कोयम्बटूर में FGK 33 (467 कि.ग्राम/हेक्टर), धोली में राजेन्द्रा काठी (2270 कि.ग्राम/हेक्टर), गुंटूर में FKG 28 (525 कि.ग्राम/हेक्टर), जगुदान में FGK 37 (2410 कि.ग्राम/हेक्टर), जोबनर में CGK 37 (2410 कि.ग्राम/हेक्टर), जबलपुर में FGK 34 (1630 कि.ग्राम/हेक्टर) तथा रायगढ में FGK 27 (585 कि.ग्राम/हेक्टर) अधिक उपज वाले अंकित किये गये। आई ई टी के अन्तर्गत गुंटूर में LFC 98 (562 कि.ग्राम/हेक्टर) तथा जोबनेर में UM 126 (2373 कि.ग्राम/हेक्टर) उच्च उपज वाले थे। वर्ष 2010 में धोली में आई ई टी के अन्तर्गत RM 188 (2.19 टन/हेक्टर) जबकि हिसार में HM 425 (3 टन/हेक्टर) की अधिक उपज प्राप्त हुई। जोबनेर में Rmt-1, UM29, UM 13 सिंचाई आधारित परिस्थिति में अधिक उपज देते हैं। जबकि शुष्क अवस्थाओं में UM 36 तत्पश्चात् UM 26 तथा UM 10 आदर्श थे।

जोबनेर, हिसार तथा कुमारगंज में मेथी के बीजों FK 14+ FL18 को पी जी पी आर जैव संपूरण द्वारा उपचारित करने पर प्रभाव अंकित किया गया। वही गुंटूर में FL18 में बीज उपचारण करने पर अधिक उपज प्राप्त हुई।

विभिन्न परियोजनाओं के अन्तर्गत वर्ष 2011-12 में किये गये कार्यों की प्रमुख उपलब्धियां इस रिपोर्ट में प्रस्तुत की जा रही है।

(एम. आनन्दराज)

PROJECT COORDINATOR'S REPORT

The All India Coordinated Research Project on Spices (AICRPS) is located in Kerala with its headquarters at Indian Institute of Spices Research, Kozhikode, now 34 centres which include 19 regular, 8 coopting and 7 voluntary centers spread over 21 states of the country representing various agroclimatic zones suitable for spices. The number of centers working in mandate crop include black pepper (9 centers), small cardamom (4 centers), large cardamom (2 centers), Ginger (6 centers), turmeric (14 centers), cumin (2 centers), coriander (12 centers), cumin (2 centers), fennel (9 centers), fenugreek (12 centers), Tree spices viz., clove, cinnamon and nutmeg (3 centers each). The XI plan budget of AICRPS is Rs 1637.50 lakhs with Rs 656.50 lakhs (ICAR share) during 2011-12. Over 100 research programmes covering the 12 mandate spice crops are being carried out under the major areas of genetic resources, crop improvement, crop production, crop protection and Post harvest technology.

Black Pepper

The Germplasm of black pepper is collected, conserved and evaluated in Dapoli, Panniyur, Pechiparai, Pundibari, Sirsi, Yercaud. Preliminary evaluation of black pepper germplasm at Panniyur indicated the cultivar Angamali recorded maximum green berry yield followed by ICP 48. Two accessions Acc-57 and Acc-33 continued to perform well at Yercaud. In a CVT trial, black pepper Cul 5308 was the best and recorded maximum yield of 4.4 kg/ vine at Chintapalli and Pampadumpara. At Panniyur Cul 5489 was promising where as at Sirsi and Ambalavayal Panniyur-I recorded maximum dry weight of berries per standard (1.20 kg and 1.54 kg respectively). At Sirsi grafts of Panniyur-I runner shoots on IISR Thevam as rootstock recorded maximum height and number of leaves. Under organic farming integrated nutrient management recorded

maximum berry yield at Panniyur, Pechiparai and Sirsi whereas organic nutrient management recorded maximum berry yield at Yercaud. At Sirsi use of tolerant black pepper variety IISR Shakthi showed tolerance to *Phytophthora* foot rot and the diseases incidence was least in vines sprayed (2 liters/vine) and drenched (3 liters /vine) with consortium of bacteria (IISR 6 and IISR 859) (for growth, nematode and Phytophthora suppression) and soil application with *Trichoderma harzianum* (MTCC-5179) @50 g per vine with one kg of neem cake to the root zone during pre monsoon (June 2011) and post monsoon (Aug 2011). At Sirsi application of 0.1% Fenamidon + Mancozeb (50%) (Sectin) alone resulted in reduced yellowing of vines (7.34 PDI) and maximum yield (3.12 kg/vine).

The incidence of gall wasp, a serious pest attacking black pepper standards was recorded in two *Erythrina* species namely *Erythrina indica* and *Erythrina fusca* in all the places and no incidence was reported on *Erythrina subumbrans*.

Cardamom

In a CVT at Pampadumpara, PS -27 recorded maximum dry capsule yield (597 g/per plant) and in Mudigere MCC -309 recorded maximum dry capsules yield (290 kg/ha) followed by PS 27 (280.15 kg /ha). In another CVT at Sakleshpur, maximum per plant yield was recorded by IC 34987 (958 g/plant) followed by SKP 164 (948.8 g/plant). Application of irrigation water 9 liter/clump/day through drip along with 100% recommended dose of fertilizer recorded highest capsule yield (180.15 kg/ha) that was on par with irrigation 9 liter/ clump/day with 75% recommended fertilizer dose (179.78 kg/ha). Under organic farming, recommended package at Mudigere recorded maximum dry capsules yield (230.66 kg/ha). Entomopathogenic nematode *Heterohabditis indica*



alone or in combination with Imidacloprid (0.006%) effectively reduced the root grub population of cardamom. At Mudigere application of new insecticides such as Methomyl @ 1.5 g/l of water and Acetamiprid @ 0.5 gm and Imidacloprid @ 0.5 ml found to be effective and superior over standard check. Effective management of Pseudostem rot of cardamom using Bavisitn 0.2% and bio control agents, *Trichoderma harzianum* 50 g + 1 kg neem cake as basal application + consortium of bacteria as spray and application of *Trichoderma harzianum* 50 g + 1 kg neem cake as basal application and *Pseudomonas fluorescens* 10⁸ (cfu/g) as spray were evolved at Pampadumpara center.

Large Cardamom

Survey was conducted by ICRI, Gangtok in Sikkim and Darjeeling districts of West Bengal, 19 accessions of germplasm were collected and conserved of which IC numbers were received for 13 of them. Fourteen blight disease escapes (caused by *Colletotrichum gloeosporioides*) were collected from Sikkim and Darjeeling hills of West Bengal. Cultivation of Varlangey variety in 75% shade resulted in maximum growth and yield (253 kg/ha). Neem formulations like Nimbicidine @ 3ml/l and *Bacillus thuringiensis* @ 2g/l are found to be effective against leaf eating caterpillar, shootfly and stem borer of Large cardamom at Gangtok.

Ginger

The ginger accession V₁E₄-5 recorded maximum yield at Pottangi where as top yielders at Pundibari and Kumarganj were NDG-1 (17 t/ha) and V₂E₅-2 (14t/ha) respectively in the CVT. Under IET at Solan, the genotype SG-26/04 (27.8 t/ha), SG 908 (27.6 t/ha) and SG -08/04 (26.7 t/ha) were highest yielders.

In the experiment on genotype X environment interaction, local checks SG 827 recorded maximum yield of 21.67 t/ha at Solan, Varada (22.24 t/ha) at Chintapalli, V₁E₈ (21.60 t/ha) at Pottangi, Himgiri (18 t/ha) at Mizoram, Supraba (28.4 t/ha) at Kanke, Surabhi (24.2 t/ha) at Pasighat, Mahima (15.76 t/ha,) at Appangala, GCP 5 (11.7 t/ha) at Pundibari,

Gorubathan Local (25.18 t/ha) at Kalyani were the highest yielders. Regarding quality of ginger at Pundibari, Suprabha recorded maximum dry matter (18.26%) and oleoresin (6.8%), Surabhi had highest essential oil (1.8%) and Mahima registered maximum crude fiber (5.2%). Essential oil and oleoresin contents of forty best performing collections were analysed at Solan. High yielding collections SG-26/04 and SG-908 were found superior/comparable for dry matter, essential oil, oleoresin and crude fiber contents to the variety Himgiri. Integrated nutrient application produced maximum yield in ginger at Kumarganj and Raigarh whereas organic and inorganic nutrients application recorded maximum yield at Pundibari and Pottangi respectively.

At Solan, Chintapalli, Pundibari and Raigarh centers soft rot incidence in ginger was less and yield was high when rhizomes were treated with Metalaxyl Mancozeb. Biofumigation using cabbage resulted in lowest incidence of soft rot and maximum yield at Pundibari, Ambalavayal, Raigarh and Pampadumpara. Bio fumigation using mustard and cabbage evolved as a tool for the management of bacterial wilt in Solan and Pundibari.

Turmeric

Among the 30 early maturing germplasm accessions NDH 4 (35 t/ha) and NDH 79 (35 t/ha) were found to be promising. Out of 80 medium maturing germplasm accessions NDH -98 (42.14t/ha) and NDH-14 (35.24t/ha) were found to be superior for yield. Among 36 late maturing varieties NDH-8 exhibited maximum fresh yield (35.28t/ha). The germplasm accessions TU No-6 (Pottangi), TCP 90 (Pundibari), CLI-316 (Kammarpally), IT-13 (Raigarh), CHFT-8, CHFT-32 (Pasighat) were reported to be promising with high yield. In the CVT in Turmeric, RH-80 performed well at Coimbatore and Kumarganj, RH 9/90 was better performer at Pasighat, Patnagar and Navasari whereas TCP-70 performed well at Pundibari and Raigarh. In an IET on turmeric NDH-18 at Kumarganj, PTS-47



(22.t/ha) at Pottangi, (TCP-64) at Pundibari, recorded higher yield. In G X E interaction study, the turmeric varieties Roma (Chintapalli), NDH 18 (Kumarganj), Duggirala Red (Kammarapally), IISR Kedaram (Pundibari), RCT 1 (Mizoram), Rajendra Sonia (Kalyani), Duggirala (Coimbatore), Suranjana (Raigarh) recorded maximum yield. Integrated nutrient application produced maximum turmeric yield in Pundibari and Raigarh.

At Coimbatore and Kammarapalli water saving drip irrigation once in a day (at 60% PE and 80% PE respectively) recorded maximum yield. Fertigation, 100% RDF through drip –weekly once in turmeric was standardized at Coimbatore and Kammarapally. Soil application of micro nutrients @25 kg ha⁻¹ recorded maximum projected yield at Dholi whereas application of boron recorded the maximum yield (20.67 t/ha) at Pundibari and soil application of zinc @ 25 kg /ha recorded maximum yield (30 t/ha) at Kumarganj. Studies on the effect of rhizomes size at Coimbatore and Chintapalli indicated that mother rhizomes pieces (35-40 g) direct planting in the field recorded maximum yield at Coimbatore. Turmeric cured by traditional water boiling method for 40, 60, 90, minutes and those cured in improved steam boiler for 30, 45, 60 and 90 minutes took 10 days for drying. But in the case of rhizomes dipped in boiling water for 10 minutes and then dried, the drying time increased to 13 days.

Leaf spot and leaf blotch intensity was less in the treatment foliar spray with Propiconazole (0.1%) on 45 and 90 days (15.23 PDI) where as at Pundibari and Kumarganj rhizome treatment as well as foliar spray with Hexaconazole (0.1%) at 45 and 90 days after planting was the best. At Chintapalli rhizomes treatment with Propiconazole + foliar spray of Propiconazole (0.1%) on 45 and 90 DAP recorded lowest leaf spot incidence. At Raigarh and Pottangi, foliar diseases intensity was reduced when rhizomes treated with carbendazim + Mancozeb (1:1) and sprayed (0.1%) after 45 and 90 DAS.

Tree Spices

The germplasm of the tree spices which include nutmeg, cinnamon, cassia, and clove are collected maintained characterized and catalogued at Dapoli, Pechiparai and Yercaud centers. At Pechiparai among 24 accessions SA13 recorded highest tree height (8.22 m), dry bud yield (3.89 kg/tree), clove bud oil (2.78%) and oleoresin (2.56%). Among the nutmeg accession MF-4 recorded maximum number of fruits of 999/tree, highest single fruit weight (73.45g) and dry mace yield (419 g).

Among the cinnamon accessions CV-5 recorded the highest dry bark yield of 545 g per tree whereas local check recorded only 260g per tree. In clove, SA 3 was found to be promising in terms of yield characters (2.95 kg) of dry buds/ tree. In a CVT nutmeg at Pechiparai, accession A9/150 recorded maximum plant height of 1.98 m, stem girth 11.81 cm and maximum stem girth 40 cm, leaf yield 390 g/tree and bark yield 226 g /tree.

Coriander

At Dholi among the promising accessions, RD-418 recorded maximum yield (18 g/plant). Among the sixty one germplasm entries evaluated at Guntur LCC-272, LCC-268, LCC-262, LCC-275 and LCC-276 were found significantly superior in yield over the best check Sudha (4.02 g/plant). In a CVT 2009 maximum yield obtained was with COR 29 at Jagudan and Guntur, COR-27 at Jobner, COR-31 at Raigarh and COR-33 at Pantnagar and Jabalpur, COR-32 at Hisar and COR-26 at Udaipur. In a CVT, leaf type coriander during offseason LCC-232 recorded maximum green yield (2.59 t/ha) at Guntur and LCC-243 (4.77 kg / plot) at Coimbatore.

In an IET of coriander for seed purpose, UD-61 was found to be promising at Jobner, RD-377 at Dholi, JCR-379 and JCR-380 at Jagudan, DH-281 and DH-314 at Hisar, ND COR-38 at Kumarganj, LCC-219 at Guntur and PD(S)-21 at Pantnagar. In the case of



IET of coriander on leaf purpose, maximum fresh yield was recorded by PD (L) 51 followed by PD (L) -11 at Pantnagar. Among fourteen entries of coriander analysed for volatile oil content at Jobner the entry COR-27 ranked first (7.37l/ha) followed by COR-34 (6.50l/ha). Out of ten entries of coriander under IET analyzed for volatile oil at Jobner, maximum recorded by UD-663 (7.73l/ha) followed by UD-565 (6.83l/ha).

In identification of drought source in coriander at Jobner UD 10 was the best among the genotypes. In nutrient supplementation through organic manures in coriander integrated nutrient management recorded maximum yield at Coimbatore, Dholi, Hisar and Raigarh, where as recommended chemical fertilizer registered maximum yield at Guntur and Kumarganj. At Coimbatore spraying of 0.5% foliar spray of zinc sulphate recorded maximum grain yield (772.44 kg/ha) where as soil application of micro nutrient @ 25 kg/ha recorded more yield (2.42 t/ha) at Dholi. At Coimbatore and Pantnagar seed treatment of coriander with Propiconazole was a technology to control stem gall disease. In IET at Jobner, UC 339 recorded maximum yield (726.74 kg/ha) followed by UC 336 (671.88 kg/ha.)

Cumin

The cumin accession CUM-13 recorded maximum seed yield of 687.5 kg/ha and volatile oil in the CVT at Jobner. UC-239 followed by UC-274 and UC-225 were the best genotypes suited to limited moisture conditions. Application of *Trichoderma harzianum* @ 10 kg/ha+ FYM@3 t/ha resulted in the minimum wilt disease incidence (1.78%) and maximum seed yield 579 kg/ha at Jobner where as soil solarization + soil application of *Trichoderma harzianum* + spray of Mancozeb @ 0.25% at 60 DAS recorded low incidence of wilt at Jagudan.

Fennel

In the CVT of fennel, FNL 43 was the top yielder at Jobner, Dholi and Jabalpur where as at Kumarganj

NDF-5 (check), FNL 40 at Jagudan, FNL 42 at Udaipur, were the top yielders. In IET entries JF 671-1 (1273 kg/ha), HF 151 (2182 kg/ha), NDF 46 (1371 kg/ha) recorded maximum yield at Jagudan, Hisar and Kumarganj respectively. Under IET, UF 168 recorded maximum seed yield (2306.67 kg/ha) at Jobner. Under CVT maximum volatile oil yield was recorded by FNL 46 (49.43l/ha) followed by FNL 43(46.94 /ha). In the evaluation of different insecticides / botanical against seed midge, application of Thiamethoxam 25 WG @ 0.0084% recorded the least seed wasp damage (8.73%) at three and seven days after spraying at Jagudan.

Fenugreek

Under CVT accession FGK 33(467 kg/ha) at Coimbatore, Rajendra Kanthi at Dholi (2270 kg/ha), FGK 28 (525 kg/ha) at Guntur, FGK 35 (2276 kg/ha) at Jagudan, FGK 37 (2410 kg/ha) at Jobner, FGK 34 (1630 kg/ha) at Jabalpur, FGK 27 (585 kg/ha) at Raigarh were the top yielders.

Under IET at Guntur, LFC 98 (562 kg/ha), at Jobner UM 126 (2373 kg/ha) were the top yielders. Among IET trial 2010, RM 188 recorded (2.19 t/ha) maximum yield at Dholi where as HM-425 (3.0 t/ha) performed well at Hisar, RMT-1, UM29, UM13 were the top yielders in irrigated conditions at Jobner. Similarly in drought conditions UM 36, followed by UM 26, UM 10 was found to be ideal. Significant beneficial effect of PGPR bioformulations were obtained in Fenugreek by treating seeds with FK14 + FL18 at Jobner, Hisar and Kumarganj whereas seed treatment with FL18 recorded maximum yield at Guntur. The salient findings under different projects during 2011-12 are presented in the following pages.

M. Anandaraj

PROGRESS OF WORK AND ACHIEVEMENTS

BLACK PEPPER

PEP/CI/1 Genetic resources

PEP/CI/1.1 Germplasm collection, characterization, evaluation and conservation

(Panniyur, Dapoli, Pundibarai, Sirsi, Yercaud, Ambalavayal, Chintapalli)

Germplasm of black pepper is maintained in all the pepper centres of AICRPS (Table 1). The germplasm maintained at each centre is evaluated every year. During the year 2011, among six cultivars evaluated at Panniyur, the cultivar Angamali recorded maximum green berry yield (3.6 kg) followed by ICP 48 (3.1 kg) (Table 2). Number of spikes /vine was higher for Angamali (1077) whereas Spike length (17.3 cm)



and number of developed berries / spike (64.1) were more for ICP 48. The 100 berry weight was high for Josegiri II (12.7 g/vine) followed by ICP48 (11.2 g). The dry recovery percentage was more for Alakkodan (38).

Table 1. Black pepper germplasm collections maintained at various AICRPS centers.

Center	Indigenous				Exotic	Total
	Cultivated		Wild & related species			
	Existing	Addition (April 2011.to March 2012)	Existing	Addition (April 2011.to March 2012)		
Chintapalli	58	-	-	-	-	58
Dapoli	31	3	1	-	-	35
Panniyur	227	-	72	-	3	302
Pechiparai	10	4	2	-	-	16
Pundibari	19	-	8	2	-	29
Sirsi	125	-	1	-	1	127
Yercaud	127	7	3	-	-	137
Total	597	14	87	2	4	704


Table 2. Yield and attributing characters of promising germplasm lines maintained at Panniyur

Cultivars	Green berry yield (kg/ vine)	Number of Spike/Vine	Spike length (cm)	No. of developed berries/ spike	100 berry weight	Dry recovery (%)
Angamaly	3.601	1077	9.6	33.1	10.8	33
ICP 48	3.120	932	17.3	64.1	11.2	34
Chalakudy	2.710	764	12.2	32.0	10.8	31
Alakkodan	2.500	897	8.5	32.9	10.7	38
Karimunda	2.310	842	8.0	26.3	10.3	34
Josegiri II	2.320	281	9.0	18.9	12.7	37

At Dapoli three types of black pepper have been collected from Ratnagiri and Sindhudurg Districts and added in the germplasm for evaluation. Total germplasm consisting of 35 accessions have been maintained and are being evaluated for various morphological and yield characters.

At Pundibari 27 collections are being maintained and during 2011-12 two new collections were added from Terai region of West Bengal.

Totally 127 germplasm collected over the period are maintained at Sirsi. Fifteen promising accessions were planted to the standard during August 2011 and plants are in the initial stage of growth.

Out of 72 accessions being maintained at HRS, Yercaud, berry set was observed only in 28 entries during this year. The other accessions did not set berry. Acc.57 and 33 continued to perform well at Yercaud.

Though 47 black pepper accessions were collected at Ambalavayal all of them damaged due to drought / disease and fresh planting is to be carried out.

PEP/C1/3 Coordinated varietal trial (CVT)

PEP/CI/3.2 CVT 2000-SeriesV

(Chintapalli, Pampadumpara, Panniyur, Sirsi, Ambalavayal)

Among the 12 varieties evaluated at Chintapalli, maximum spike length was recorded by Cul.5489 (16.09 cm) followed by Panniyur-1 (Table 3). Significantly higher number of berries per spike was

noticed in Panniyur-1 (85.7) followed by Cul-5489 (74.89) and Cul-5308 (71.67). Maximum yield was registered by the accession Cul-5308 (4410.6 g/vine) followed by Panniyur-1 (3200.4 g/vine). In terms of fresh berry yield Cul-1041 (1270.0 g/vine), Cul-5489 (1253.6 g/vine) and HP-813 (1291.3 g/vine) were on par with each other.

At Pampadumpara the accession Cul -5308 registered significantly higher dry yield of black pepper per plant (766.51 g) followed by HP-1411 (527.92 g) and PRS 22 (408.43 g). Hundred berry weight as well as volume was the highest in Karimunda (6.44 g and 13.47ml).

At Panniyur out of 13 entries, maximum green berry yield /vine was recorded by Cul.5489 (2.25 kg/vine) followed by Cul 5308 (1.42 kg/vine). Cul.5489 was significantly superior to all other cultures /varieties with respect to number of spikes/vine (768) and spike length (13.8 cm).

Most of the entries started spiking and the dry berry yield was maximum in Panniyur-1 at Sirsi (1.20 kg/vine) followed by HP-105 (1.08 kg/vine), PRS-17 (0.85 kg/vine) and HP-34 (0.82 kg/vine) which significantly differed over others.

At Ambalavayal among different cultivars, Panniyur 1 recorded maximum spike length (15.28 cm), yield (1.54 kg/standard), number of spikes /standard (622.56), 100 berry weight (16.01g) and berry volume (17.42 cc). Cul 1041 recorded maximum number of berries /spike (149.73) followed by HP -105 (85.01).

Table 3. Performance of CVT-2000 Black pepper at Chintapalli

Variety	Length of Spike (cm)	No. of berries per spike	Fresh berry yield (g)
Cul-1041	10.14	50.45	1270.00
Karimunda OP	10.14	27.22	167.80
Cul-5489	16.09	74.89	1253.60
PRS-17	5.86	21.33	100.20
PRS-21	7.32	22.33	111.40
PRS-22	5.62	25.11	114.90
HP-34	9.15	43.67	679.70
Cul-5308	12.60	71.67	4410.60
HP-105	11.23	59.33	1018.60
HP-1411	11.81	54.11	530.90
HP-813	13.93	68.00	1291.30
Panniyur-1	14.79	85.78	3200.40
Sem \pm	0.35	1.32	122.56
CD 0.05%	1.04	3.90	361.78
CV %	5.67	4.55	17.99

PEP/CI/3.3 CVT 2006-Series VI

(Chintapalli, Pampadumpara, Panniyur, Dapoli, Sirsi, Yercaud)

At Chintapalli maximum plant height was noticed in Panniyur -1 (213.137 cm) that was on par with Panniyur-8 (212.73 cm). Maximum number of branches per plant was observed in HB 20052 followed by PRS-88 (9.1) and ACC-33(9.1).

Observations on plant growth parameters at Pampadumpara showed that all the ten entries did not vary significantly for leaf length, and internodal length. The ACC 33, Panniyur-1, ACC 106, Karimunda and ACC 57 showed good growth and vigour in the field.

The trial was started during 2007 at Panniyur .The planting of accessions were completed in 2009 and the growth parameters were recorded. The stand of the crop is satisfactory.

The trial was initiated during August 2008 at Sirsi, Accession HB-20052 and PRS-64 initiated spiking with 12 and 15 numbers, respectively.

In a varietal evaluation trial (CVT 2006) in black pepper nine varieties has been planted in November 2008 at Dapoli. Panniyur 1 recorded significantly higher plant

height (3.75 m) followed by C -1090 (3.70 m) and PRS 64 (3.50 m). The spiking has started in Panniyur - 1, PRS 64, HB 20052, ACC 106 and ACC 33.

At Sirsi plants are in initial growth stage. Among 12 entries, the height varied between 1.7 m and 3.6 m maximum was in Sirsi-1 (3.6 m). Accession HB-20052 and PRS-64 initiated spiking with 12 and 15 numbers, respectively.

At Yercaud the Acc. No.57 and Acc. No.33 of TNAU – Yercaud Centre; Acc No. 53 (Ademane pepper) and Acc. No. 106 (Kudragutta pepper) collected from Sirsi centre of Karnataka; PRS 64 and HB 20052 of PRS – Panniyur along with Panniyur 1 were planted at Yercaud on March 2011 and crop is in vegetative phase only.

PEP/C1/3.4 Evaluation of grafts, orthotropic and runner shoots in black pepper

(Sirsi, Ambalavayal, Yercaud, Thadiyankudsai, Panniyur)

Grafts and the rooted plants according to the treatments were planted to the arecanut live standards during 2010-11 at Sirsi. Plants are in initial establishment stage. However, the height and the number of leaves were



varied between 38–82 cm and 6-18 numbers in different treatments. The maximum and the minimum height (82 cm and 38 cm) as well as the leaf numbers (18 and 6) was observed in the treatment of rooted 3 node runner shoot and the grafts of Panniyur-1 orthotropic shoots on *Piper nigrum* var. IISR Thevam as rootstocks as well as grafts of Panniyur-1 runner shoots on *Piper nigrum* var. IISR Thevam as rootstocks and grafts of Panniyur-1 orthotropic shoots on *Piper nigrum* var. IISR Thevam as rootstocks, respectively.

At Ambalavayal the orthotropic shoots and runner shoots are planted in the poly bags for rooting .

The grafts are being made and getting established in the field at Panniyur.

At Yercaud the root stocks viz., *Piper Colubrinum*, Shakthi, Thevam was established in ES12 for mass multiplication. However, grafting has been initiated using ortho, plagio shoots on wild black pepper, planted and it needs continuous monitoring.

Three root stocks viz. *P.colubrinum*, IISR Sakthi and IISR Thevam with scion as Panniyur-1 was planted in

“D” block of HRS, Thadiyankudsai. The per cent establishment was higher in *P.colubrinum* x Panniyur -1 with five nodes runner (84%) followed by *P.colubrinum* x Panniyur -1 with three nodes runner (76%) and the least was observed in IISR Thevam x Panniyur-1 with 3 nodes of orthotropic shoots (44%). All the plants are in initial vine stage and other characters are too early to report.

PEP/CM/4 Nutrient management trial

PEP/CM/4.4. Development of organic package for spices based cropping system-Observational trial

(Chintapalli, Panniyur, Sirsi, Dapoli)

At Chintapalli among the two treatments, vines treated with inorganics (Recommended package of practices) showed maximum plant height (2.95 m), length of spikes (14.62 cm), maximum number of berries per spike (91) and highest fresh berry yield (1911.34 g/vine).

At Panniyur, recommended package recorded significantly higher green berry yield of 1.87 kg/vine compared to organic package which recorded green berry yield of 1.03 kg/vine (Table 4).

Table 4. Yield of Blackpepper in organic farming at Panniyur

Treatments	Spike yield (kg vine ⁻¹)	No. of spikes (No. vine ⁻¹)	Green berry yield (kg vine ⁻¹)	Dry pepper recovery (%)
Fully Organic	1.03	255	0.81	33.64
Integrated	2.29	555	1.81	35.01
Fully Inorganic	1.87	407	1.48	33.43
CD (0.05)	0.29	93	0.256	-
CV (%)	15.7	21	17.5	-
SEm ±	0.145	46	0.127	-

At Sirsi it was observed during 2011-12 that, the vines treated according to the recommended package of practices responded favourably and superior in its mean dry berry yield (1.03 kg/vine) to the vines treated with hundred percent organics (0.82 kg/vine).

At Dapoli the treatment, integrated package recorded maximum plant height (2.50 m/plant) followed by organic package (1.94 m/plant). Inorganic package

recorded lesser plant height (1.66 m/plant). The plants are at initial stage of growth and flowering started in all blocks.

PEP/CM/4.5 Organic farming in black pepper-2006

(Panniyur, Dapoli, Pechiparai, Sirsi, Yercaud)

The trial was started during the year 2006 at Panniyur.

During 2011-12, integrated treatment resulted in higher green berry yield of 1.81 kg/vine which was significantly superior to both - fully inorganic (1.48 kg/vine) and fully organic treatment (0.81 kg/vine).

At Pechiparai trial was imposed in an established

pepper garden (Table 5). The treatment consists of three integrated, fully inorganic and organic. Ten vines were selected per treatment. Integrated treatment (100 g *Azospirillum* + 100 g N + 40 g P₂O₅ + 140 g K₂O + FYM 10 kg per vine) recorded maximum yield (3.75 kg/vine).

Table 5. Yield of black pepper inorganic farming at Pechiparai

Treatments	Yield(kg/vine)	Cost benefit ratio
Fully organic	2.51	1:1.80
Integrated	3.75	1:2.90
Fully inorganic	2.98	1:2.20
CV (%)	0.03	—
SEm ±	0.16	—
CD (0.05)	0.52	—

The experiment has been restarted using *Thespecia populnea* standard and variety Panniyur -1 at Dapoli. The treatment integrated package recorded maximum plant height (2.36 m/plant) followed by fully organic package (1.70 m/plant). The treatment fully inorganic package recorded lowest plant height (1.14 m/plant). The plants are at initial stage of growth and flowering started in all the blocks.

At Sirsi during 2011-12, the vines treated with 100 percent integrated and 100 % inorganic treatments recorded significantly highest dry berry yield (1.10 kg/vine and 0.94 kg/vine, respectively) compared to those with 100 percent organics (0.87 kg/vine). Significantly maximum berry yield was recorded during 2010-11 also but the yield was on par during 2007-08 to 2009-10.

Application of FYM at 10 kg coupled with *Azospirillum* 50 g, Phosphobacteria 50 g and VAM 200 g per vine had resulted in high fresh berry yield (14.7 kg/vine), dry berry yield (4.3 kg/vine), high spike length (12.5 cm) and number of berries (72 berries/spike) at Yercaud.

PEP/CM/4.6 Standardisation of drip fertigation

(Panniyur)

Drip fertigation units were installed as suggested by Jain Irrigations and the trial was started during 2011-12 and fertilizers were applied.

PEP/CP/5 Disease Management Trial

PEP/CP/5.1 Adaptive trial on management of *Phytophthora* foot rot of black pepper in farmers field

(Ambalavayal)

There was no significant difference between treatments for disease incidence and yield. The control plot showed more yellowing and defoliation and death of vines compared to the treated plots with *Trichoderma* or Bordeaux paste.

PEP/CP/5.3 Trial on management of *Phytophthora* foot rot of black pepper in new plantation

(Dapoli, Panniyur, Chintapalli, Sirsi, Pampadumpara)

At Dapoli survival and growth of black pepper cuttings



of IISR-Shakthi, IISR-Thevam and Panniyur-1 and of the standards (*Ailanthus malabarica*) were satisfactory. So far, incidence of foot rot disease caused by *Phytophthora capsici* was not noticed during the first two years.

The trial was restarted in 2011 and plants are in establishing stage at Panniyur. The application of Akomin (Potassium phosphonate) and *Trichoderma harzianum* in Shakthi variety resulted in better plant height than other treatments.

Rooted cuttings of IISR Shakthi, IISR Thevam and Panniyur 5 were planted in the main field at Chintapalli. However due to transplantation shock and heavy down pour of rains immediately after planting, there was huge mortality of rooted cuttings (90%). Some of the left over excess cuttings of IISR-Thevam and Panniyur-5 were multiplied in the shaded net house and planted in July, 2011 which has been survived and plant stand is approximately 75% till on date. However, IISR-Shakthi couldn't be rescued and they have to be procured from IISR-Calicut and will be planted.

At Sirsi Black pepper variety IISR Shakti showed tolerance to *Phytophthora* foot rot by depicting least disease incidence (12.58%) and it was followed by IISR Thevam (15.17%). But, variety Panniyur-1 was highly susceptible (19.24%) to the disease. The disease incidence was least (11.10%) in vines irrespective of varieties wherein the vines were sprayed (2 l/vine) and drenched (3 l/vine) with consortium of bacteria (for growth, nematode and *Phytophthora* suppression (IISR 6 and IISR 859) and soil application with *Trichoderma harzianum* (MTCC 5179) @ 50 g per vine with one kg of neem cake to the root zone during pre monsoon (June 2011) and post monsoon (Aug 2011). This treatment was statistically on par with other two treatments wherein vines were treated with potassium phosphonate (@ 0.3 per cent) as spraying and drenching with incorporation of *Trichoderma harzianum* (MTCC 5179) @ 50 g per vine with one kg of neem cake to the root zone during pre monsoon

(June 2011) and post monsoon (Aug 2011) also exhibited less disease incidence (11.72 %) and vines were protected with consortium of bacteria (for growth, nematode and *Phytophthora* suppression (IISR 6 and IISR 859) as spraying and drenching also rendered less disease (12.95 %).

Black pepper variety IISR Thevam recorded maximum height (1.90 m height) as compared to IISR Shakthi (1.59 m) and Panniyur -1 (1.53 m) and were on par with each other at panniyur centre. The height of the vines were less (1.19 m) in the case of unprotected treatment as check irrespective of varieties viz., IISR Thevam (1.57 m height), IISR Shakti (1.03 m) and Panniyur -1 (0.98 m).

The experiment was restarted during June 2010 at Pampadumpara. All the three varieties of black pepper such as Panniyur – 1, IISR-Shakthi, and IISR Thevam were planted for evolving a management strategy for foot rot of black pepper.

PEP/CP/5.4 Effectiveness of new molecules of fungitoxicants against *Phytophthora* foot rot of blackpeppr in existing plantation

(Sirsi, Chinthapalli)

At Sirsi Black pepper vines applied with new molecules of fungi toxicant @ 0.1 % Fenamidon (10%) + Mancozeb (50 %) (Sectin) alone and Fenamidon (10%) + Mancozeb (50 %) (Sectin) as spraying (@ 2 l/vine) and drenching (3 l/vine) along with bioagent *Trichoderma harzianum* (MTCC 5179) 50 g with one kg of neem cake as soil application separately during first week of June 2011 and third week August 2011 resulted in effective reduction of leaf infection (6.69% and 8.67%), yellowing of vines (7.34 PDI and 10.00 PDI), defoliation (5.34 PDI and 6.67 PDI), death of vines (4.00 % and 5.35 %) and maximum yield (3.12 and 2.80 kg/vine (Table 6).

Table 6. Effect of new molecules of fungitoxicants against *Phytophthora* foot rot of blackpeppr in existing plantation at Chinthapalli

Treatments	Yellowing (%)	Defoliation (%)	Death of Vines (%)	Yield / Vine (kg)
T1 Spraying and drenching with 0.1 % of Fenamidone (10 %) + Mancozeb (50 %) (Sectin)	15.52	22.93	13.11	2.41
T2 Spraying and drenching with 0.1 % of Fenamidon (10 %) + Mancozeb (50 %) (Sectin) + Soil application of <i>T.harzianum</i> (MTCC-5179) 50 g/vine with 1 kg neem cake	11.57	18.98	9.68	3.01
T3 Spraying and drenching with 0.2% kocide + after 10 days soil application of <i>T. harzianum</i> (MTCC 5179) 50g/vine with 1 kg neem cake.	18.27	16.94	15.23	2.38
T4 Potassium phosphonate (0.3%) + <i>Trichoderma harzianum</i> (MTCC-5179)	10.80	13.39	10.54	2.92
T5 Control	22.48	33.06	22.11	1.53
SEM ±	1.21	1.94	1.25	0.12
CV %	15.37	18.54	17.78	10.15
CD (P=0.05)	3.76	6.07	3.91	0.38

The experiment was initiated during 2011-12 at Horticultural Research Station, Chintapalli. Application of Potassium phosphonate (0.3%) + *Trichoderma harzianum* (MTCC-5179) recorded less yellowing and defoliation that was on par with spraying and drenching with 0.1 % of Fenamidon (10 %) + Mancozeb (50 %) (Sectin) + Soil application of *T.harzianum* (MTCC-5179) 50 g/vine with 1 kg neem cake and yield recorded was 2.92 kg/vine and 3 kg vine respectively.

PEP/CP/6 Pest management Trial

PEP/CP/6.2 Management of *Erythrina* gall wasp, a popular standard of black pepper

(Mudigere, Pampadumpara)

The investigation was undertaken during 2011-12, in both black-pepper and betel vine growing areas of Karnataka at Mudigere. The incidence of pest was recorded on two species of *Erythrina*, viz., *Erythrina indica*, *Erythrina fusca* in all the places except on

Erythrina subumbrans which was almost free from gall wasp. Further, that species was screened against this pest intensively both under field and poly house conditions and there was no incidence recorded and it was free from gall wasp, later same has been sent for identification to Botanist with different parts of plant for proper identification.

At Pamadumpara survey has been conducted to ascertain the severity of gallwasp infestation in *Erythrina* a popular standard of black pepper in different panchayats of Idukki District. Three types of *Erythrina* black thorned, white thorned and thornless have been identified to be used as standard of pepper vines. The infestation was found severe in black thorned forms followed by white thorned types. Thornless *Erythrina* were found to be more resistant to infestation. Treatments were applied on *Erythrina* standards at farmer's pepper field. But it was observed that the natural infestation come down below 25 % during August – September and continues till now.



CARDAMOM

CAR/CI/1 Genetic resources



CAR/CI/1.1 Germplasm collection, Characterization, evaluation and conservation

(Pampadumpara, Mudigere)

This program was started in 1986 at CRS, Pampadumpara. Survey was continued attempting to collect superior genotypes with special characters viz., high yield, tolerance to biotic and abiotic stress conditions and good quality capsules (possessing boldness, parrot green colour, superior aroma as well as flavour). A total of 163 cardamom accessions are presently conserved in the gene bank (Table 7). Among them 73 cardamom accessions (CRSP 1-73) got IC numbers (547920 to 547992) from National Bureau of Plant Genetic Resources, New Delhi.

At Mudigere Germplasm collection lines (132) have been replanted during the 2010 as the cardamom plantation (trial) was very old. The observations on different growth and yield parameters will be recorded from the third year after planting.

Table 7. Cardamom germplasm collections of AICRPS centers

Center	Indigenous		Total
	Cultivated	Wild and related sp.	
Mudigere	141	-	141
Pampadumpara	162	1	163
Total	303	1	304

CAR/CI/2 Hybridization

CAR/CI/2.2 Hybridization and selection in cardamom

(Mudigere)

A crossing block involving elite clones of M-1, M-2, HS-1, Njallani Gold, SKP-14 and CL-726 was established at a closer spacing of 6' x 3' in order to generate all possible cross combinations through both random open pollination and hand pollination. All the clones were good general combiners and belong to Malabar type, while Njallani green gold is a Vazhuka type. Thirty six new F₁ combinations were produced by crossing six different improved/ elite genotypes in all possible combinations and seedling will be raised and evaluated to identify the high yielding genotypes in coming years.

CAR/CI/3 Coordinated varietal trial

CAR/CI/3.5 CVT 2005-series

(Pampadumpara, Mudigere)

A total of seven accessions namely MCC 73, MCC 309, MCC 246, MHC 26 (ICRI, Myladumpara), CL 722 (RARS, Mudigere), PS 27 (CRS, Pampadumpara) and *Green Gold* (check) are being evaluated for adaptability to high ranges of Idukki district at Pampadumpara. Vegetative and yield characteristics of these accessions were evaluated. Maximum Fresh weight (2805 g) and dry weight (597

g) of capsules per plant was recorded in the accession PS 27. MHC 26, MCC 26, MCC 246, GG (Njallani) and MCC 309 were the next better performers. The 100 capsule weight and volume of PS 27, MHC 26, MCC 246 and GG (Njallani) did not vary significantly. Trial comprising of eight clones from different research center was initiated in 2005-06 in RCBD with 3 replications at Mudigere (Table 8). MCC-309

recorded highest dry capsule yield of 290.17 kg/ha followed by PS-27 (280.15 kg/ha) and CL-722 (275.50 kg/ha) than the best check M1 (Ch) (254.67 kg/ha). Over the years, genotype CL-722 (301.16 kg/ha) recorded maximum yield followed by PS-27 (280.06 kg/ha) than the best check M1 (218.45 kg/ha).

Table 8. Performance of CVT 2005 Cardamom at Mudigere

Entries	No. of suckers/ plant.	No. of Bearing suckers/ plant.	No. of panicles/ plant.	Panicle length (cm)	No. of capsules/ panicle	No. of inter nodes/ panicle	100 capsule - green wt (g)	Dry capsule (yield kg/ ha)
CL-722	20.89	11.00	58.85	50.08	18.55	19.11	51.0	275.50
PS -27	19.89	13.78	53.19	41.72	17.45	18.67	40.72	280.15
MCC-309	19.42	12.44	60.11	46.82	16.25	16.44	45.67	290.17
MCC-246	19.44	13.00	65.33	52.33	20.44	18.77	44.20	274.00
M2 (Ch.)	18.65	9.92	48.59	41.43	15.81	16.33	41.20	199.85
M1(Ch.)	18.44	9.55	41.33	35.36	14.85	15.33	43.60	254.67
Expt.Mean	18.97	11.31	53.78	43.17	17.21	16.25		257.96
CD (0.05)	2.08	2.93	5.17	2.37	2.49	2.31	5.39	46.89
CV %	10.22	20.56	8.97	13.33	13.49	13.30	7.71	25.88

CAR/CI/3.6 CVT 2007/2009-series VI

(Mudigere, Pampadumpara, Myladumpara, Sakleshpur, Appangala)

The trial has been laid out during the year 2009 at Mudigere. Entry CL-726 (282.20 cm) was found to be tallest followed by IC-34987 (254.90 cm) and the entry IC-34987 (18.10) recorded more number of suckers/plant followed by IC-547185 (18.0) and the yield parameters will be recorded from third year onwards.

A total of 13 accessions viz IC 349545, IC 349651, IC 547167, IC 547185, CL 726, CL 691, PL NO 14 (CRSP 158), CR 6 (CRSP -19), MCC 346, SKP 104, SKP 164, PV 2 and Green gold (local check) are being evaluated for adaptability to high ranges of Idukki district at Pampadumpara. The number of tillers per clump did not vary significantly between varieties. Results showed that all the genotypes varied each other

with respect to all the parameters studied at Myladumpara. Among the entries, PL-14 (RRS, Pampadumpara) was found to be superior with respect to yield contributing characters. The variety ICRI-2 (check) recorded more number of tillers per clump compared to other entries tested for performance.

At Sakleshpur significantly more panicles (40.4), racemes/panicles (22.9) were observed in IC 34987 followed by SKP 164 (39.2 and 22.1 respectively). Significantly more capsules (4.0) were found in MCC 260 followed by SKP 164 (3.9). Maximum per plant yield recorded by IC 34987(958.7g) followed by SKP164 (948.8g). Maximum percentage (62.5 %) of bold capsules (capsules retained in 8 mm sieve) was found in MCC 346 followed by SKP 164 (61.2 %).

At Appangala IC 349651 recorded the highest yield (1764 kg/ha) followed by IC 547185 (1449 kg/ha). All the Appangala entries along with Pl. No.14 recorded more than 1000 kg dry yield per ha .



CAR/CI/4 Varietal Evaluation Trial (VET)

CAR/CI/4.1 Initial Evaluation Trial-I

(Mudigere)

Trial was initiated during 2009 at Mudigere. Among the growth parameters, plant height was maximum in 12-7-D11 (252.80 cm) and total suckers /plant was maximum recorded by the entry 7-12-D11 (11.93) followed by 7- 24-D11 (11.53).

CAR/CI/4.2 Initial evaluation trial -II

(Mudigere)

This experiment was initiated in the year 2009 at Mudigere. The selection 800 recorded maximum height (275.20 cm) followed by Valley No.1 (270.40 cm). Maximum number of suckers/plant was recorded by CL-720 (14.83) followed by Valley No.1 (13.73) than the best check M2 (11.07).

CAR/CM/5 Nutrient management Trial

CAR/CM/5.1 Effect of different irrigation schedule and fertilizers on yield of cardamom

(Mudigere)

Application of irrigation water 9 liter/clump/day along with 100% recommended dose of fertilizer through drips recorded the highest capsule yield (180.15 kg/ha) that was on par with irrigation 9 liter/clump/day with 75% Recommended fertilizer dose (179.78 kg/ha).

CAR/CM/5.2 Effect of fertigation on yield of cardamom through drips

(Pampadumpara)

The experiment was started during 2011 at Pampadumpara in the variety PV 2 and the treatments are being given as per schedule.

CAR/CM/5.3 Organic farming in Cardamom

(Mudigere, pampadumpara)

Application of organics with bio-fertilizers recorded

significantly higher yield than only organics at Mudigere. The maximum dry capsule yield (230.66 kg/ha) was obtained with recommended package which is superior over all other treatments.

At Pampadumpara the treatments were given as per schedule to study the effect of different organic amendments on growth and yield of cardamom variety PV 2.

CAR/CM/5.4: Liming in Cardamom

(Pampadumpara)

At Pampadumpara the experiment is laid out to study the effect of different liming materials on growth and yield of cardamom variety PV 2.

CAR/CP/6 Pest and disease management Trial

CAR/CP/6.4 Management of cardamom root grub through entomopathogenic nematodes

(Pampadumpara)

Experiment was conducted at CRS, Pampadumpara to evaluate the efficacy of two isolates of *Heterorhabditis* sp at two different concentrations and in combination with imidacloprid (0.006%) against cardamom root grub. Results of the experiments conducted during the period 2006-07 and 2010-11 proved that the native isolate *H. indica* alone or in combination with Imidacloprid (0.006%) effectively reduced the grub population.

CAR/CP/6.7 Evaluation of new insecticides/ biopesticides in cardamom against thrips and shoot and capsule borer

(Mudigere, Pampadumpara)

At Mudigere the treatments significantly influenced the total healthy capsules compared to untreated control. All the harvests indicated maximum damage with thrips compared to borers. Application of Methomyl @ 1.5 gm per lit of water and Acetamiprid @ 0.5gm and Imidacloprid @ 0.5 ml found to be effective and superior over standard check (Mudigere practices).

At Pampadumpara the experiment was restarted in September 2011 as per the proceedings of XXII workshop of AICRP on spices.

CAR/CP/6.8 Comparison of effect of chemical treatments as well as bio-control agents against pseudostem rots of cardamom

(Pampadumpara)

At Pampadumpara the treatments effective against

pseudostem rot are T1 (Bavistin 0.2%), T4 (*Trichoderma harzianum* 50 g + 1 kg neem cake as basal application + consortium of bacteria as spray) and T5 (*Trichoderma harzianum* 50 g + 1 kg neem cake as basal application and *Pseudomonas fluorescens* 10⁸ (cfu/g) as spray). The effect of these treatments were significantly higher than the application of *Pseudomonas fluorescens* alone, consortium of bacteria alone and that of control.

LARGE CARDAMOM

LCA/CI Genetic Resources

LCA/CI/ Germplasm of Large cardamom

(Gangtok)

Survey was conducted at large cardamom growing area of Sikkim and Darjeeling district of West Bengal to collect germplasm (Table 9). Nineteen accessions were collected and conserved at germplasm conservatory of Kabi (N. Sikkim) of which 5 accessions (SCC 227-231) were collected during 2011-12. Of this 9 accessions were selected based on high yield and other specific desirable characters and 10 accessions were based



on diseases escape. Received IC number for 13 collections during 2009-11 from germplasm division NBPGR New Delhi.

Table 9. Large cardamom collections maintained at ICRI Regional Research station, Gangtok

Center	Indigenous		Exotic		Total	
	Cultivated	Wild & related species	Existing	Addition (April 2011. to March 2012)		
	Existing	Addition (April 2011. to March 2012)	Existing	Addition (April 2011. to March 2012)		
ICRI,RRS, GANGTOK	215	05	11	NIL	NIL	231



LCA/CP/1.1. Evolving disease and pest tolerant lines in large cardamom

(Gangtok)

Forteen disease (blight caused by *Colletotrichum gleosporioides*) escapes were collected from Sikkim and Darjeeling hills of West Bengal. Six units of each accession were planted in ICRI research farm at Kabi for further multiplication and evaluation.

LCA/CP/1.2 Integrated pest and disease management in large cardamom

ICRI regional research station (Gangtok)

Monitored trial plot at singhik and phytosanitation was maintained. Data recorded as per the programme.

ICAR Research Complex, Gangtok

(Gangtok)

A survey on disease incidence of Large Cardamom had shown that minimum blight disease in Varlangey

and Seremna cultivars whereas maximum in the selection ICRISKM-1. Among several insect pollinators, Bumble bee, *Bombus harmorrhoidalis* was identified as main pollinator of Large Cardamom. Studies on disease occurrence and standardization of management practices, Bavistin + Mancozeb @ 3g/lit was found to be effective for management of leaf blight of Large Cardamom. Neem formulations like Nimbicidine @ 3ml/l and *Bacillus thuringiensis* @ 2g/l were found to be effective against leaf eating caterpillar, shootfly and stem borer of Large Cardamom at Gangtok.

In a study on efficacy of organic manure on production, growth and yield of Large Cardamom the combination of vermicompost and neem cake (T6) found to be effective for better growth and spike /clump in comparison to other treatments. Cultivation of Varlangey variety in 75% shade resulted in maximum growth and yield (253 kg/ha).

GINGER

GIN/CI/ Genetic Resources

GIN/CI/1.1 Germplasm collection, characterization, evaluation and conservation

(Dholi, Kumarganj, Solan, Pundibari, Pottangi, Raigarh)

The ginger germplasm maintained at various AICRPS centres are given in Table 10. At Dholi, out of forty seven accessions of ginger collected, only seven accessions namely RG-16, RG-18, RG-20, RG-29, RG-26, RG-21 and RG-3 recorded the maximum yield ranging from (7.30 kg to 10.90 kg/7.2 m²) compared

to check variety Nadia (6.50 kg/m²). Among seven promising accessions, RG-3 registered maximum yield (10.90 kg/7m²) followed by RG-21 i.e., (9.05 kg/7 m²).



Table 10. Ginger germplasm collection of AICRPS centres

Centre	Indigenous	Exotic	Total
Dholi	47	-	47
Kumarganj	61	-	61
Pottangi	175	-	175
Pundibari	58	-	58
Raigarh	44	-	44
Solan	236	-	236
Total	621		621

Out of 61 germplasm evaluated at Kumarganj, NDG-55 produced 34.24 t/ha fresh rhizomes of ginger followed by NDG-28 (14.60 t/ha).

At Solan, two hundred and thirty six ginger collections

were evaluated for rhizome yield and other horticultural traits. The yield of 21 best genotypes varied from 11.98 t/ha (SG-865) to 22.67 t/ha (SG-707). Yield of four lines viz., SG-707 (22.67 t/ha), SG-Path 4 (22.40 t/ha), SG-857 (21.75 t/ha) and SG-12/04 (21.47 t/ha) excelled the check Himgiri which yielded 21.35 t/ha. The rhizome rot disease incidence varied from 10.00-27.71% with 13.13% and 11.04% in SG-707 and Himgiri, respectively.

Out of fifty six germplasm of ginger were evaluated at Pundibari, maximum disease incidence was noticed in the accession GCP-26 (87.5%) whereas lowest disease incidence was shown by GCP-08 and GCP-54 (5.00%). Highest rhizome yield/plant was exhibited by GCP-14 (443.33 g) whereas lowest rhizome yield /

Table 11. Performance of genotypes in Coordinated Varietal Trial in ginger at Pottangi from 2007-2011

Entries	Fresh rhizome yield(kg/3m ²)						Projected yield (q/ha)	% Increase over check	Dry recovery (%)	E. oil %	Oleoresin (%)	Rot (%)	Wilt (%)
	2007	2008	2009	2010	2011	Average Yield							
IG-1	8.2	6.6	5.2	6.4	7.1	6.7	147.0		20.1	1.3	4.7	24.3	14.6
IG-2	7.6	7.1	6.4	6.2	6.3	6.7	148.0		17.2	1.2	4.2	22.6	20.1
IG-3	6.4	6.5	5.0	5.4	7.1	6.0	134.0		18.1	1.1	5.3	21.2	18.3
SG-646	9.1	8.1	6.2	8.4	8.0	8.0	175.0		21.3	1.3	6.4	18.4	13.4
V ₂ E ₅ -2	12.3	8.7	7.6	9.7	9.8	9.6	216.0	20.3	21.2	1.2	6.6	11.2	8.4
Acc-35	10.4	7.2	6.4	8.6	8.3	8.2	180.0		20.2	1.2	6.4	12.4	10.6
Singjhara	11.2	7.7	7.1	9.2	8.2	8.7	191.0		21.3	1.1	5.4	11.4	17.4
S-692	11.1	7.8	6.0	8.6	8.4	8.3	182.0		21.4	1.4	5.2	21.4	18.6
Acc-117	10.7	7.4	6.1	8.3	7.8	8.0	177.0		21.2	1.2	5.4	13.2	19.0
V ₃ S ₁ -8	10.4	8.2	7.4	9.2	10.2	9.1	200.0		21.4	1.3	6.1	12.4	14.3
V ₁ S ₁ -2	11.2	8.1	8.0	10.1	8.4	9.1	201.0	13.8	20.7	1.3	6.1	11.6	13.7
V ₁ S ₁ -8	11.3	8.3	7.3	10.4	7.6	8.9	197.0		22.1	1.3	6.2	12.2	10.6
V ₁ E ₄ -5	12.7	8.6	8.4	10.4	9.8	9.9	220.0	24.8	22.3	1.2	5.7	10.4	11.2
V ₁ C-8	11.6	8.2	7.2	7.1	7.2	8.2	181.0		20.2	1.2	5.3	17.2	14.6
Suprabha	9.6	7.4	6.6	8.3	8.2	8.0	176.0		21.2	1.3	5.4	16.4	13.3
CD (0.05)	2.1	1.2	1.3	NS	NS	1.47	3.23		1.2	NS	0.06	1.4	2.1



plant were recorded by GCP-43 (46.00 g).

At Pottangi out of 145 germplasm studied, 27 accessions recorded more than 5 kg/3m² fresh rhizome yield, ranged from 2.10 kg to 10.4 kg/3 m². The highest fresh rhizome yield was recorded by V₁E₄-5 (10.4 kg/3 m²) followed by PFLR (9.6 kg/3 m²) and KG-47(9.4 kg/3 m²).

GIN/CI/2 Coordinated Varietal Trial

GIN/CI/2.3 CVT 2006 – Series VII

(Pottangi, Pundibari, Kumarganj)

At Pottangi analysis of data pooled over 5 years indicated that out of 15 entries tested, it was found that the entry V₁E₄-5 (22.0 t/ha) was the top yielder with the yield increase of 24.8 % than the check variety Suprabha (17.6 t/ha) followed by V₂E₅-2 (21.6 t/ha) and V₁S₁-2 (20.1 t/ha) (Table 11).

At Pundibari NDG-1 registered the highest projected yield (17.07 ton/ha) and V₂E₅-2 recorded the projected yield (7.80 ton/ha). Highest disease incidence was noticed in GCP-5 whereas lowest was in the case of NDG-5 (1.67%).

At Kumarganj among seven genotypes evaluated, maximum fresh rhizome yield of 14.47 t/ha was recorded by V₂E₅-2 followed by 14.1t/ha in NDG 5.

GIN/CI/3 Varietal Evaluation Trial

GIN/CI/3.1 Initial evaluation trial 2010

(Dholi)

Nine promising genotypes along with check variety Nadia were tested under initial evaluation trial at Dholi. Among the entries and check, six entries namely RG-9, RG-13, RG-24, RG-30, RG-32 and RG-38 recorded significantly maximum yield (14.75, 13.20, 15.65, 12.40, 17.20 and 15.20 t/ha respectively) as compared to the check variety Nadia (9.55 t/ha).

GIN/CI/3.2 Initial evaluation trial 2011

(Solan)

This trial was started during the year 2011 at Solan.

Average yield varied from 21.35 t/ha to 27.8 t/ha. The genotype SG-26/04 recorded maximum yield (27.8 t/ha) followed by SG-908 (27.67 t/ha) and SG-08/04 (26.78 t/ha) whereas the check Himgiri yielded 21.37 t/ha. The rhizome rot disease incidence varied from 10.00 -13.12% with minimum in SG-26/04 and SG-908.

GIN/CI/3.4 Comparative yield trial

(Pottangi)

Out of the average performance of six entries tested in seven years, the V₁S₁-2 (23.5 t/ha) was the top yielder with the yield advantages of 23.5% over the check Suprabha (17.8 t/ha), followed by V₂E₅-2 (21.6t/ha) and ZO-2(21.4 t/ha).

GIN/CI/3.5 Genotype X Environment interaction on quality of ginger

(Solan, Pottangi, Chintapalli, Mizoram, Barapani, Pundibari, Kanke, Pasighat, Kalyani, Appangala.)

At Solan average yield varied from 14.32 t/ha to 21.67 t/ha and local check SG-827 recorded maximum yield 21.67 t/ha followed by Himgiri 21.35 t/ha. The rhizome rot disease incidence varied from 11.04 to 14.17% with minimum in SG-827 and Himgiri.

At Pottangi it was revealed from the analyzed data of 11 clones in three years that the clone V₁E₈-2 (21.6 t/ha) was the highest yielder among all the entries with rhizome yield advantage of 23.4 % over the check Suprabha (17.5 t/ha).

At Chinthapalli out of the ten varieties allotted in this programme only 6 varieties were received from different centers and maximum fresh rhizome yield was registered by Variety Varada (22.24 t/ha) followed by variety Suprabha (16.05 t/ha) and lowest yield was recorded by Himgiri (13.01 t/ha). All the genotypes were susceptible for ginger rhizome rot disease and the symptoms appeared from the month of August (Table 12).

Table 12. Morphological and Yield traits of ginger under GXE interaction at Chintapalli

Treatments	Plant Stand (No./40)	Plant height (cm)	No. of tillers/plant	Rhizome yield/plant (grams)	Rhizome yield/plot (kg.)	Fresh rhizome yield (t/ha)
Himgiri	18.33	35.3	12.3	251.2	5.07	13.01
Suravi	23.33	24.3	9.7	251.4	5.50	14.13
Suprabha	29.76	38.0	17.0	301.8	6.25	16.05
Rejatha	22.00	39.6	12.7	294.7	5.38	13.83
Mahima	24.33	39.0	13.6	286.3	5.67	14.57
Varada	30.76	44.0	20.6	514.3	8.66	22.24
Narsipatnam	17.33	41.0	16.0	262.3	4.69	12.04
SEM ±	1.160	0.53	0.43	5.63	0.179	-
CD 5%	3.615	1.65	1.35	17.56	0.557	-
CV %	8.493	2.46	5.15	3.16	5.25	-

At Mizoram leaf area was highest for Nadia (44.0 cm) that was on par with Himgiri (40.13cm) and Nisapui-Local (39.5 cm²). The maximum yield was recorded by Himgiri (18.1t/ha) followed by Nadia (15.5t/ha), Varada (14.1t/ha) and Mahima (13.0 t/ha).

Planting was done in relatively low lying area and the growth was not up to the mark at Barapani. Maximum yield was registered by Mahima (5.22 t/ha) followed by Nadia (4.44 t/ha). Maximum crude fibre was recorded by Khasi Local (7.80%) followed by Mahima (7.28%) whereas, Rejatha recorded highest dry matter content (22.90%) followed by Himgiri (22.63%).

Maximum oleoresin was observed in Khasi Local (10.51%) whereas lowest was found in Suprabha (3.70%).

At Pundibari the genotype GCP-5 (local check) showed the highest projected yield (11.70 t/ha.), followed by surabhi (7.36 t/ha). The quality analysis data from Solan centre revealed that Suprabha contained highest dry matter (18.26%) and oleoresin (6.8%). Surabhi had highest essential oil (1.8%) and Mahima had highest crude fibre of 5.2 % (Table 13.)

Table 13. Quality parameter under GXE interaction in ginger at Pundibari

Genotype/ variety	Dry matter(%)	Oleoresin (%)	Essential oil (%)	Crude Fibre(%)
Varada	16.75	5.8	1.7	4.4
Surabhi	17.23	6.2	1.8	4.8
Suprabha	18.26	6.8	1.52	5.1
Mahima	17.95	6.3	1.76	5.2

Pooled data of three years (2009-10) to (2011-12) at Kanke revealed that highest yield per ha was observed in suprabha (28.38t) followed by Suruchi (24.13 t) and lowest by Rejatha (16.33t/ha). Highest dry recovery was noticed in Suruchi (20.88%) followed by Surabhi (21.50%) at Kanke (Ranchi) condition.

Growth, yield and quality parameters were studied among the nine varieties of ginger at Pasighat, Arunachal Pradesh. Variety Surabhi recorded maximum

yield (24.17 t/ha of fresh rhizome) followed by Nadia (23.25 t/ha) and Varada (21.64 t/ha) whereas lowest yield was recorded by variety Rejatha (18.32 t/ha).

At Kalyani out of 10 varieties, maximum yield /plant recorded by the genotype Gorubathan with projected yield (25.18 t/ha) followed by Surabhi (22.51 t), Suprabha (0.244 kg and 22.48 t), and Suruchi (0.228 kg and 21.00 t) and the lowest yield was recorded by Varada (9.35t/ha) (Table 14).



Table 14. Morphological and yield of Ginger under GXE at Kalyan

Genotypes	Plant height (cm)	No. of tillers/clump	Leaf area (cm ²)	Average yield/plant (kg)	Projected yield (t/ha)
Suprabha	66.43	22.03	33.18	0.244	22.48
Suruchi	65.40	17.50	27.38	0.228	21.00
Surabhi	56.80	15.77	23.68	0.245	22.51
V ₃ S ₁ -8	61.63	16.70	30.53	0.198	18.18
Himgiri	58.47	13.93	36.75	0.181	16.62
Varada	64.37	15.40	29.67	0.102	9.35
Mahima	52.33	10.07	26.50	0.108	9.84
Rejatha	57.43	12.73	24.57	0.092	8.46
Gorubathan (local cv.)	77.13	13.80	21.27	0.274	25.18
Sambuk (local cv.)	60.00	12.80	29.23	0.115	10.55
SEm (±)	1.45	0.43	0.52	0.01	0.72
C D (0.05)	4.30	1.27	1.55	0.02	0.25

At Appangala plant height was found to be the maximum in Mahima (35.36 cm) followed by Himgiri (29.9 cm) whereas minimum height was recorded by Suprbha (21.99 cm). Mahima recorded the maximum yield (15.76 t/ha) followed by Varada (15.59 t/ha).

GIN/CI/4.1 Evaluation of germplasm from other centers for quality

(Solan)

Forty best performing collections were analyzed at Solan. The dry matter content (%) and crude fibre (%) ranged between 16.00 (Suprabha) to 23.73 (SG-1083) and 4.23 (SG-823) to 5.30 (SG-969), respectively. Essential oil (%) and oleoresin contents (%) varied from 0.63 (SG-08/04) to 1.97 (SG-707) and 2.77 (SG-08/04) to 5.29 (SG-1032) respectively. High yielding collections SG-26/04 and SG-908 were found superior/ comparable for dry matter content,

essential oil, oleoresin and crude fibre contents to the check Himgiri

GIN/CM/5 Nutrient Management Trial

GIN/CM/5.2 Organic farming in ginger – 2006

(Pundibari, Pottangi, Kumarganj, Raigarh)

Analysis of data pooled over 5 years indicated that application of organic nutrients in ginger at Pundibari (T₁) produced maximum yield (4.28 kg per plot) followed by application of fully integrated nutrients with plot yield 3.22 kg/plot.

At Pottangi there was significant difference among the three treatments for fresh rhizome yield of Ginger (Table 15). Application of recommended inorganic inputs produced the maximum fresh rhizome yield (18.2 t/ha). The lowest rhizome yield of 14.30 t/ha was recorded by T₁ (fully organic) with 21.2 % yield disadvantages over T₃ (fully inorganic).

Table 15. Effect of organics in ginger cultivation in the Suprabha at Pottangi from 2006-2011

Treatments	Fresh rhizome yield(kg/ 3m ²)							Projected yield (q/ha)	(% Decrease over T ₃)	Rot (%)	Wilt (%)	Leaf spot (%)	Dry recovery (%)	E. oil (%)	Oleoresin (%)	C:B ratio
	2006	2007	2008	2009	2010	2011	Avg. Yield									
T ₁	6.4	6.8	6.1	6.2	6.6	6.7	6.5	143.0	21.2	16.8	18.2	15.7	22.1	1.4	8.9	1:1.68
T ₂	7.2	7.8	6.6	6.7	7.3	7.4	7.2	158.0	13.2	13.7	13.6	12.2	21.2	1.3	7.7	1:1.71
T ₃	8.4	9.2	7.2	7.1	9.1	8.7	8.3	182.0	-	11.6	10.7	11.2	21.7	1.3	8.2	1:1.82
CD(0.05)	NS	1.6	1.2	NS	0.8	1.1	1.18	2.6		2.2	3.1	1.1	NS	NS	NS	-

At Kumarganj, maximum yield (52.34 q/ha) was recorded by the application of 50 % recommended dose of fertilizer (60:40:40 kg NPK/ha) + 50% FYM (10 t/ha) + *Azospirillum* (5 kg /ha) + seed treatment and soil application of *Pseudomonas fluorescens* + *Trichoderma* (50g/ m²).

At Raigarh the trial has been failed due to heavy rains during germination and development stage. However pooled data for the year (2008-09 to 2010-11) showed maximum yield (9.7 t/ha) when integrated nutrient management was followed.

GIN/CM/5.3 Nutrient supplementation through organic manures for growth and yield of ginger

(Dholi, Kumarganj)

At Dholi integrated nutrient management or INM (T₇) recorded maximum number of tillers (36.67), number of leaves (27.36), yield per plot (5.95 kg/3m²) & projected yield (1.70 t ha⁻¹) and increased yield (57.26%) over absolute control (T₈) followed by T₁ i.e., number of tillers per plant (30.90), number of leaves (23.73), yield per plot (5.05 kg/ 3 m²) & projected yield (15.15t ha⁻¹) and increased yield (33.48%) over absolute control i.e., yield per plot (3.78 kg/3m²) and projected yield (11.25t ha⁻¹).

At Kumarganj recommended dose of fertilizer alone recorded the maximum fresh rhizome yield (13.78 t/ha) followed by recommended INM package (12.11 t/ha).

GIN/CP/6 Disease Management Trial

GIN/CP/6.1 Disease surveillance and etiology of rhizome rot in ginger

(Dholi)

Diseased rhizomes of ginger collected from Samastipur districts of state were found to be associated with Bacterial wilt and Soft rot disease at Dholi. Bacterial wilt incidence of ginger ranged from 11.11 to 45.56% with mean disease incidence of 19.33% where as soft rot disease ranged from 5 to 14.44% with mean disease incidence of 5.78%. The crop was also found to be infected with leaf spot disease in the range of 4.44 to 15% with mean disease incidence of 8.11%.

GIN/CP/6.6 Management of soft rot of ginger (Biofumigation using mustard)

(Solan, Chintapalli, Pundibari, Kumarganj, Raigarh)

At Solan highest germination (96.37%) and minimum incidence of soft rot (3.51%), leaf spot (9.67%) and maximum yield (2.88 kg/bed) were obtained in rhizome treatment by Metalaxyl Mancozeb followed by mustard biofumigation, though statistically different from each other. However, minimum incidence of bacterial wilt was obtained in mustard biofumigation (3.10%).

Ginger seed material treated with Metalaxyl Mancozeb 72 % WP (1.25 g/l) recorded highest germination (37.50), maximum yield and lowest soft rot incidence followed by biofumigation using cabbage that recorded average germination count of 36.25 out of 40 at Chintapalli.



At Pundibari biofumigation using mustard (T_1) was the best treatment to control soft rot disease of ginger (7.16% disease) and recorded maximum yield (15.18

t/ha) (Table 16) followed by rhizome treatment by Metalaxyl Mancozeb (T_2) with a projected yield (13.81 t/ha) and 8.77% soft rot disease incidence

Table 16. Effect of different treatments on soft rot disease of ginger at Pundibari

Treatments	Germination (%)	Soft rot (%)	Bacterial wilt (%)	Leaf spot (PDI)	Mustard biomass (kg/plot)	Plot yield (kg)	Projected yield (t/ha)
T_1	88.75	7.16 (15.52)	10.45 (18.86)	12.36 (20.58)	4.62	7.53	15.18
T_2	87.81	8.77 (17.23)	15.75 (23.38)	11.60 (19.91)	-	6.85	13.81
T_3	87.09	11.22 (19.57)	13.30 (21.39)	15.77 (23.40)	-	6.66	13.43
T_4	84.06	11.23 (19.58)	21.75 (21.87)	13.73 (21.75)	-	6.63	13.37
T_5	88.23	22.93 (28.61)	21.70 (27.35)	13.67 (21.70)	-	4.62	9.31
SEm \pm	1.761	1.158	0.341	0.484	-	0.207	-
CD (0.05)	5.426	3.567	1.052	1.490	-	0.638	-

(Figures in parenthesis are angular transformed value)

The field was sown with mustard as per treatments. The field is left for biofumigation. The ginger will be sown in forthcoming season at Kumarganj.

At Raigarh among all the treatments T_2 (Rhizome treated by fungicides Metalaxyl + Mancozeb (72 % WP) 1.25 g/ liter and T_1 (soil treatment by bio fumigation using mustard crop) found effective against the disease and incidence was lowest 19.03 and 21.15 percent as compared to control (48.88) and these treatments recorded yield 7.7 and 6.5 t/ha respectively.

GIN/CP/6.7 Management of soft rot of ginger (Biofumigation using cabbage)

(Pundibari, Solan, Chintapalli, Ambalavayal, Raigarh, Kumarganj, Pampadumpara)

At Pundibari biofumigation using cabbage was the best treatment which produced lowest soft rot and bacterial wilt disease incidence of 7.21% and 11.25% respectively and recorded maximum yield (5.88 kg / plot). Leaf spot disease incidence was found lowest in T_2 (16.75 PDI) and highest in T_1 (21.00 PDI).

Cabbage biofumigation registered highest germination (98.27%), yield (8.500 kg/plot) and minimum incidence of bacterial wilt at Solan. However, rhizome treatment by Metalaxyl Mancozeb resulted in lowest incidence of soft rot (2.76%) and leaf spot (14.50)

Rhizome treatment with Metalaxyl Mancozeb 72 % WP (1.25 g/l) recorded lowest soft rot disease incidence (13.12 %) followed by Rhizome treatment with endophytic bacterial antagonist (20.62 %) while the control plots received maximum incidence of softrot disease (38.75%) at Chintapalli . Highest yield per bed was recorded when rhizomes were treated with Metalaxyl, Mancozeb 72 % WP (1.25 g/l) which recorded 3.13 kg / bed followed by rhizome treatment with Rhizobacterial antagonist which recorded 2.66 kg / bed while the control plots recorded an average yield of 1.48 kg/ bed.

At Ambalavayal germination was maximum when rhizomes were treated with Metalaxyl Mancozeb (75%). Soft rot, shoot borer and leaf spot incidence were noticed only in the control plots (3.6%, 3.55%

and 0.55% respectively). Rhizome yield was higher in plots where the soil was bio-fumigated using cabbage (18.50 t/ha).

On the basis of four year's result (2008-09 to 11-12) at Raigarh bio fumigation using cabbage crop and rhizome treatment by fungicides (Metalaxyl Mancozeb (72 % WP) (1.25 g/l) were effective against the disease and lowest incidence was 17.73 % and 15.46 %, respectively as compared to control (37.01 %). The respective projected yield of these treatments were 7.2 and 6.2 t/ha respectively

At Kumarganj the field was sown with cabbage as per treatment for biofumigation. The ginger will be sown in forthcoming season.

In this experiment at Pampadumpara minimum soft rot

incidence was recorded by treatments T1 (soil fumigation using cabbage,) T2 (Rhizome treatment by Metalaxyl Mancozeb 75% wettable powder) and T3 (Rhizome treatment by antagonist GRB). Germination percent was highest in treatment T4 (IISR GEB) where as maximum yield was recorded by T1 (soil fumigation using cabbage) followed by T4 (IISR GEB)

GIN/CP/6.8 Management of bacterial wilt of ginger (Biofumigation using mustard)

(Solan, Pundibari, Ambalavayal)

At Solan mustard biofumigation resulted in highest germination per cent (95.44%), yield (8.256 kg/plot) minimum incidence of bacterial wilt (3.97%), whereas lowest incidence of soft rot (5.66%) was noticed after rhizobacterial antagonist treatment (Table 17).

Table 17. Management of bacterial wilt of ginger (Biofumigation using mustard) at Solan

Treatment	Germination (%)	Soft rot (%)	Bacterial wilt (%)	Yield (kg/3m ²)
T ₁	95.44 (8.25)	5.90 (1.56)	3.97 (2.10)	8.256
T ₂	89.00 (7.90)	5.78 (1.97)	4.58 (2.28)	7.333
T ₃	86.40 (7.20)	6.50 (1.90)	4.67 (2.36)	7.500
T ₄	93.56 (8.12)	5.66 (1.50)	5.45 (2.50)	7.778
T ₅	89.54 (7.98)	7.96 (2.66)	5.60 (2.67)	7.985
T ₆	83.27 (7.10)	15.87 (3.40)	8.50 (3.06)	4.500
CD (0.05)	(0.34)	(0.25)	(0.17)	0.97

Biofumigation using mustard (T₁) recorded lowest bacterial wilt (5.58%) lowest soft rot (9.53%) and projected maximum yield (6.20 kg/plot) at Pundibari. T₁ produced maximum yield of 6.20 Kg/plot. Lowest leaf spot disease was found in T₃ (14.25 PDI) and highest leaf spot was found in T₅ (19.00 PDI).

Bacterial wilt incidence was higher in the control plots (3.30%) at Ambalavayal and in the rhizome treatment by heat (0.25%). Shoot borer and leaf spot incidence

was only shown in the control treatment (2.75% and 1.30 % respectively).

GIN/CP/6.9 Management of bacterial wilt of ginger (Biofumigation using cabbage)

(Solan, Pundibari, Raigarh, Ambalavayal, Pottangi, Pampadumpara)

At Solan maximum germination, yield, minimum incidence of wilt was noticed in cabbage biofumigation followed by rhizobacterial antagonist. Biofumigation



using cabbage (T_1) was the best treatment in reducing bacterial wilt disease of ginger (6.02% disease) that was on par with soil treatment by bleaching powder (T_2) which recorded 8.24% bacterial wilt disease incidence at Pundibari (Table 18). T_1 produced highest

yield of 8.09 Kg/plot followed by T_2 which recorded 7.39 Kg/plot yield. Regarding leaf disease, minimum PDI of 12.54 and maximum PDI of 16.95 was recorded by T_1 and T_2 respectively. No shoot borer incidence was noticed during the experiment.

Table 18. Effects of different treatments on bacterial wilt disease of ginger at Pundibari (Pooled mean)

Treatments	Germination (%)	Soft rot (%)	Bacterial wilt (%)	Leaf spot (PDI)	Cabbage biomass (kg./plot)	Plot yield (kg)	Projected yield (t/ha)
T_1	90.42	10.05 (18.48)	6.02 (14.20)	12.54 (20.74)	6.34	8.09	16.31
T_2	84.38	12.79 (20.95)	8.24 (16.68)	16.95 (24.31)	-	7.39	14.90
T_3	90.00	12.95 (21.09)	9.57 (18.02)	13.49 (21.55)	-	7.05	14.21
T_4	85.34	11.84 (20.13)	8.38 (16.83)	12.59 (20.78)	-	6.79	13.69
T_5	84.79	12.07 (20.33)	10.65 (19.05)	15.70 (23.34)	-	6.73	13.57
T_6	82.71	18.87 (25.75)	21.73 (27.78)	16.30 (23.81)	-	4.42	8.91
SEm \pm	3.985	0.317	1.106	0.572	-	0.263	-
CD (0.05)	12.556	0.997	3.202	1.802	-	0.830	-

At Raigarh among all the treatments T_1 (soil treatment by bio fumigation using cabbage crop) and T_2 (Rhizome treated by fungicides Metalaxyl Mancozeb (72 % WP) (1.25 g/ l) found effective against the disease and incidence was lowest 19.65 % and 23.79 %, respectively as compared to control (49.81 %). The respective projected yield of these treatments were 7.2 and 6.2 t/ha respectively .

Germination percentage was higher in the treatment where rhizomes were treated with rhizobacterial antagonist IISR GB 51 and minimum in the control at Ambalavayal. There was no shoot borer incidence but the control recorded leaf spot and bacterial wilt incidence (2.20 and 3.30 % respectively). Rhizome

yield was higher in the treatment where rhizomes were treated with endophytic bacterial antagonist IISR 18 (20.94 t/ha) and lower in the control (15 t/ha).

At Pottangi the treatment T_3 or four hour rhizome treatment by heat , yielded recorded maximum (17.2 t/ha) followed by T_1 (16.7 t/ha).

At Pampadumpara minimum soft rot incidence was recorded by the treatments T_1 (soil fumigation using cabbage,) T_2 (Rhizome treatment by Metalaxyl-Mancozeb 75% wettable powder) and T_3 (Rhizome treatment by antagonist GRB). Germination percent was highest in treatment T_4 (IISR GEB) where as highest yield was recorded by T_1 (soil fumigation using cabbage) followed by T_4 (IISR GEB).

TURMERIC

TUR/CI/1 Genetic Resources

TUR/CI/1.1 Germplasm collection, characterization, evaluation and conservation

(Coimbatore, Dholi, Kumarganj, Pottangi, Pundibari, Kammarapalli, Raigarh, Pasighat)

The turmeric germ plasm maintained at various AICRP centres are given in Table 19. At Coimbatore the rhizome yield per plot ranged from 10.00 kg to 28.60 kg/plot. The mean yield recorded by the accessions was 17.23 kg/plot. Three checks were involved in the evaluation viz., CL 189 (CO1), CL 1 (BSR 1) and CL 2 (BSR 2). The yield /plot recorded by the checks were 20.60 kg, 18.00 kg and 24.00 kg respectively.



Among the 275 lines evaluated, 23 lines recorded higher yield than check 1 (CL 189), 75 genotypes recorded higher yield than check 2 (CL 1) and 5 genotypes recorded higher yield than Check 3 (CL 2). Out of 275 lines evaluated 129 lines recorded a higher yield than the mean yield of all the genotypes.

Table 19. Turmeric germplasm collections in AICRPS centers

Centre	Indigenous		Total
	Cultivated	Wild and related sp.	
Coimbatore	284	2	286
Dholi	98	2	100
Jagtial	273	-	273
Kumarganj	147	-	147
Pantnagar	16	-	16
Pasighat	55	2	57
Pottangi	199	-	147
Pundibari	168	22	190
Raigarh	42	3	45
Solan	136	-	136
Total	1392	27	1343

Ninety eight accessions of turmeric were collected and evaluated for promising line with respect to yield at Dholi. Only thirteen accession namely- RH-412, RH-16, RH-426, RH-405, RH-6, RH-22, RH-416, RH-2/80, RH-413, RH-81, RH-406, RH-415 and RH-24 recorded the yield varying from (30.50 kg to 38.50 kg/7.2 m²) as compared to local check RH-5 (28.50 kg/7.2 m²) and Rajendra Sonia (25.0 kg/7.2 m²). Among thirteen promising accessions, RH-24 recorded

the maximum yield (38.50 kg/7.2 m²) followed by RH-415 i.e., (36.00 kg/7.2 m²).

At Kumarganj 147 germplasm were planted in the field and evaluated. Out of 30 early maturing germplasm NDH-74 recorded highest yield (35.10 t/ha) followed by NDH-79 (35.05 t/ha). Evaluation of 80 medium maturing germplasm, NDH-98 registered maximum fresh rhizome yield of 42.40 t/ha followed by NDH-14 yielding 35.24 t/ha of fresh rhizomes. Among 36



late maturing varieties NDH-8 exhibited maximum fresh yield (35.28 t/ha).

Out of total 197 turmeric accessions, 175 were evaluated in two replications at Pottangi. Among 173 accessions evaluated 157 were *Curcuma longa*, 20 were *Curcuma aromatica* and 4 were *Curcuma amada*. Out of 157 *Curcuma longa* accessions 22 entries registered more than (10 kg/3 m²) fresh rhizome yields. The range in fresh rhizome yield / 3 m² in *C. longa* varied from 4.2 kg/3 m² to 11.7 kg/3m². High yielders were Tu No-6 (11.7 kg/3m²), PTS-62 (10.4 kg/3m²) and PTS-32 (10.0 kg/3m²). In *Curcuma aromatica* the range in fresh rhizome yield varied from (4.2 kg/3 m²) to (8.6 kg/3 m²). Among 20 accessions in *Curcuma aromatica*, 6 entries registered more than 7 kg/3m² fresh rhizome yields. High yielders were CAS-56(8.6 kg/3m²), Chayapusupu-II (8.2 kg/3m²) and Phulbani wild (7.6 kg/3m²).

At Pundibari 163 cultures were maintained, 5 new collections were added during 2011 – 2012. Out of this, 146 cultures of turmeric were screened for suitable characterization systematically under genetic resource programme. Rhizome yield of individual plant (clump weight) was maximum in TCP-33 (950.00 g). Regarding plot yield and projected yield, TCP-90 (52.82 tons/ha), TCP-133 (52.42 t/ha), TCP-33 (50.40 t/ha) and TCP-165 (48.79 tons/ha) recorded significantly higher rhizome yield. A total of 30 genotypes out yielded the local check TCP-2 (32.26 t/ha).

Two hundred and ninety eight (189+84+25) genotypes/germplasm collections are being maintained at Jagtial (Kammarpally). Genotypes are grouped into long (8-9 Months), medium (7-8 Months), short (6-7 Months) based on duration. Lot of variability was observed for growth and yield characters, diseases like rhizome rot, *Colletotrichum* and *Taphrina* leaf blotch. During the year 2011-12, Duggirala Red recorded maximum rhizome yield (13.5 kg/3 m²) followed by CLI-316 (12.9 5 kg/3 m²).

Forty two entries of turmeric were evaluated at Raigarh station for yield and its attributing characters along with

the check Prabha during 2011-12 crop seasons. Among the entries, IT-13 (14.51 t/ha) and IT-16 (13.88 t/ha) were found significantly superior over the check Prabha (11.54 t/ha) in respect to yield.

Thirty eight (35 old + 3 new) diverse genotypes of turmeric were collected from entire NE region and evaluated in Randomized Block Design with three replications along with check variety Megha Turmeric-1 during 2011-12 at Pasighat. The genotypes CHFT-8 (30.41 t/ha), CHFT-32 (29.42 t/ha), CHFT-12 (29.60 t/ha) recorded significantly higher fresh rhizome yield as compared to check variety Megha Turmeric-1 (25.80 t/ha) however check variety Megha Turmeric-1 had highest curcumin content (7.40%) followed by CHFT-17 (6.87%) and CHFT-24 (6.41%). These genotypes would be further evaluated in replicated yield trial in future.

TUR/CI/2 Coordinated Varietal Trial

TUR/CI/2.4 Coordinated Varietal Trial – 2009

(Chintapalli, Coimbatore, Dholi, Kammarpalli, Pottangi, Pundibari, Raigarh, Kumarganj, Pasighat, Pantnagar, Navasari)

At Chintapalli among the 7 varieties evaluated during the year 2011-12, maximum rhizome yield per plant was recorded by RH-13/90 (366.7 grams/plant) followed by RH-9/90 (357.3 g/plant) and lowest values recorded by TCP-129 (184.7g/plant).

Six genotypes (RH-9/90, RH-13/90, RH-80, RH-50 from Dholi and TCP-129, and TCP-17 from Pundibari) along with two local checks (BSR 2 and CL 101) were evaluated for the second year at Coimbatore. The yield varied from 7.01 kg/plot to 14.41 kg/plot. The highest yield was recorded by RH 80 (14.41 kg/plot) followed by TCP-17 (13.66 kg/plot).

Among all the entries and check, none of the entries were found significantly superior over check variety RH-5 regarding yield at Dholi.

At Kammarpally during the year 2011-12, out of seven genotypes tested, RH-9/90 recorded maximum fresh rhizome yield (31.0 t/ha) followed by RH-13/90 (30.6

t/ha) in comparison to Duggirala red check variety (40.0 t/ha).

Fresh rhizome yield of PTS-3(19.50 t/ha) was the highest with the yield advantages of 10.8 % than the check Roma (17.60 t/ha) followed by PTS-47 (19.00 t/ha) and PTS-53 (17.90 t/ha) at Pottangi.

At Pundibari among 10 genotypes only 7 were tested and seed material of PTS-4 were tested and seed materials, of PTS-47, PTS 3 and National check was not received. In respect of plot yield and the projected yield, TCP-70 recorded the highest mean value (7.07 kg and 14.25 t/ha, respectively) and the lowest plot yield was recorded by 3.70 kg (7.45t/ha). Only one genotype TCP-70 out yielded TCP-2, the local check.

At Raigarh out of six entries the entry TCP-70 was found the best which produced 16.32 t/ha yield that was on par to the check TCP-2(Suranjana)(15.57t/ha).

At Kumarganj out of eight entries maximum yield of 312.21q/ha was recorded by RH-80. Among the eight samples analyzed, maximum curcumin content was observed in RH9/90 (4.7 %), oleoresin in Pratibha (12.74 %) and essential oil in RH-50 (6.8 %).

Six genotypes of turmeric namely RH-9/90, RH-13/90, RH-80, RH-50, TCP-129 and TCP-70 were received from different coordinating centres and evaluated along with Local Check Megha Turmeric-1 during 2011-12 at Pasighat, Arunachal Pradesh. The

genotype only RH-9/90 (9.73 kg/3m² and 32.41 t/ha) recorded significantly higher yield as compared with local check variety Megha Turmeric-1(7.73 kg/3 m² and 25.75 t/ha). In terms of quality parameters, the genotype RH-50 recorded the highest dry recovery (21.63%) while genotype RH-80 produced maximum oleoresins (10.53%). Megha Turmeric-1 recorded maximum curcumin (7.40%) and essential oil (6.47%).

The significant differences were observed for all the characters except number of tillers per plant at Pantnagar. Maximum fresh rhizome yield (24.39 t/ha) was recorded by RH-9/90, followed by RH-13/90 (23.16 t/ha).

Eight genotypes of turmeric including GNT-1 as local check and Kesar as national check were evaluated at Navasari and no significant difference was observed in yield among all tested eight entries.

TUR/CI/3 Varietal Evaluation Trial

TUR/CI/3.2 Initial Evaluation Trial 2006

(Kumarganj, Pottangi, Pundibari, Dholi)

At Kumarganj in three years of observation NDH-8 recorded maximum yield of 33 t/ha of fresh rhizomes ,16.10 % increase in the yield over Prabha 29.t/ha national check (Table 20). Maximum oleoresin content was recorded by NDH-7 (10.90 %), essential oil by NDH-88 (7.2 %), and maximum curcumin (4.5 %) by NDH-68.

Table 20. Yield observation in IET on Turmeric at Kumarganj (Pooled mean)

Entries	2009-10 q/ha	2010-11 q/ha	2011-12 q/ha	Mean q/ha
NDH-7	316.66	317.77	340.00	324.81
NDH-8	314.44	333.33	342.88	330.21
NDH-45	293.39	307.77	309.99	303.71
NDH-68	289.99	316.66	347.00	317.88
NDH-79	307.77	326.66	336.66	323.69
NDH-86	317.77	281.11	285.55	294.81
NDH-116	337.77	289.99	288.88	305.54
NDH-116	314.44	312.21	326.66	317.77
Narendra Haldi-1(ch)	325.53	319.99	300.10	315.17
Prabha (N Ch)	306.66	305.44	298.88	303.66
SEM ±	12.0	3.98	4.24	
CD (0.05)	35.96	11.83	12.59	
CV (%)	6.73	2.22	2.35	



At Pottangi fresh rhizome yield of PTS-47 (22.8 t/ha) was the highest with the yield advantages of 13.4 % than the check Roma (20.1 t/ha) followed by PTS-52 (22.7 t/ha) and PTS-3 (22.1t/ha). The dry recovery per cent of PTS-47(21.1%), PTS-52(22.2%) and PTS-3(22.4%) was less than Roma (24.4%).

Pooled Analysis of the data over 5 years (2007-08 to 2011-12) at Pundibari showed that the genotype TCP-64 registered the maximum rhizome yield (20.70 t/ha), followed by TCP-129 (15.36 t/ha) and TCP-70 (15.02 t/ha).

At Dholi among the promising entries and two checks, none of the promising entries were found significantly over check variety RH-5 and Rajendra Sonia regarding yield and yield attributing characters.

TUR/CI/3.3 Initial Evaluation Trial 2009

(Dholi)

At Dholi out of sixteen genotypes, RH-406 registered maximum yield per plot (23.37 kg/3 m²) & projected yield (70.10 t ha⁻¹) and 26.31% increase in the yield over check variety RH-5 was observed.

TUR/CI/3.4 Initial Evaluation Trial 2010)

(Pantnagar)

The significant differences were observed for all the growth parameters at Pantnagar. Maximum fresh rhizome yield (35.83 t/ha) was recorded by PT-5

followed by PT-6 (29.80 t/ha).

TUR/CM/3.4 Genotype x Environmental interaction on quality

(Chintapalli, Kumarganj, Kammarapalli, Pundibari, Pottangi, Mizoram, Kalyani, Coimbatore, Raigarh)

At Chintapalli among the 12 varieties maximum fresh rhizome yield was recorded by Roma (32.23 t/ha) followed by Suranjana (29.94 t/ha) and lowest yield was recorded by Alleppey Supreme (11.81 t/ha). Among the varieties, maximum dry recovery was observed in IISR-Pratibha (28.09 %) followed by Megha turmeric, Kedaram, Alleppy Supreme, Roma and Rasmi (26-27 %). Very low recovery % observed in BSR-2 (11.76 %). Maximum dry yield observed in Roma (8.6 t/ha) followed by Rasmi (5.3 t/ha).

At Kumarganj maximum fresh rhizome yield of 29.11 t /ha was recorded by NDH- 18 (Narendra Haldi-1) followed by BSR-2 (28.78 t/ha) and none of the entry was superior over the check. On the basis of the samples analysis report from Solan centre, among the eleven samples analyzed, IISR Alleppy showed maximum curcumin, oleoresin and essential oil 4.7, 13.54, and 6.5% respectively under Faizabad conditions (Table 21).

Table 21. Quality parameters of turmeric entries in G X E at Kumarganj

Genotype/ variety	Curcumin (%)	Oleoresin(%)	Essential oil (%)
Megha Turmeric-1	2.7	10.28	5.5
Rashmi	2.8	11.34	6.3
Surendra (Tel-2)	3.1	11.96	6.0
Rajendra Sonia	3.8	12.53	6.4
BSR-2	4.2	11.75	6.5
IISR-Alleppey	4.7	13.54	6.5
IISR-Kedaram	4.5	12.10	6.3
Roma	4.3	11.03	6.0
NDH-1	4.0	12.94	5.7
CL-317	3.9	10.94	6.4
IISR-Prathibha	4.4	12.25	6.3

At Kammarapally during the year 2011-12, among the eleven genotypes tested, Duggirala Red recorded the maximum fresh rhizome yield (41.0 t/ha) followed by Suranjana (26.6 t/ha), and lowest yield was registered by IISR Kedaram (20.7 t/ha) followed by BSR-2 (18.26 t/ha) and Narendra Haldi-1 (16.36 t/ha) (Table 22).

At Pundibari highest rhizome yield per plot and projected yield was recorded by IISR Kedaram (19 t/ha) and the lowest value was recorded by Rajendra Sonia (6.17 Kg). Regarding quality analysis data from

Solan, Megha Turmeric recorded highest curcumin of 4.5%. Highest oleoresin was found in TCP 2 (11.90%) from Pundibari centre and Roma registered highest essential oil (8.8%). Analysis of mean data pooled over 4 years (2008-09 to 2011-12) for the different growth and yield parameters are presented in (Table 23). As per the analysed data genotype TCP-2 showed the highest rhizome yield (11.68 kg/3 m²), followed by Narendra Haldi - 1 (11.27 kg/3 m²). Considering the clump weight TCP-2 exhibited highest mean value (354.01 g) followed by IISR Kedaram (334.94 g).

Table 22. Morphological and yield parameters of turmeric (GXE) at Kammarapally.

Genotypes	Plant height (cm)	No. of tillers	Leaf length (cm)	Leaf width (cm)	Rhizome yield/plot (kg/3 m ²)	Fresh rhizome yield (t/ha)
Megha Turmeric	69.2	2.5	37.3	11.5	6.9	23.0
Kedaram	64.9	2.4	34.7	12.1	6.2	20.7
Duggirala Red	78.3	3.0	42.5	14.0	12.3	41.0
BSR-2	65.4	2.3	34.5	11.4	7.0	23.3
Suranjana	67.2	2.5	28.9	10.3	8.0	26.6
Rajendra sonia	60.0	2.1	31.8	10.8	7.1	23.6
Roma	61.7	2.5	38.2	10.8	6.7	22.3
Rasmi	66.6	2.6	38.0	10.7	6.5	21.6
NH-1	71.2	2.5	31.4	11.3	6.4	21.3
Prathibha	73.9	2.6	38.3	11.5	6.9	22.8
Alleppey supreme	65.3	2.4	32.1	11.0	6.8	22.6
SEm ±	2.35	0.13	1.06	0.7	0.34	
CD (0.05)	6.9	0.38	3.15	NS	1.02	

Table 23. Yield parameters of Turmeric varieties under G × E at Pundibari (2008-09 to 2011-12)

Entries	Clump weight / plant (gm)					Rhizome yield/plot (kg/3 m ²)				
	2008-09	2009-10	2010-11	2011-12	Mean	2008-09	2009-10	2010-11	2011-12	Mean
Megha Turmeric	293.27	317.07	245.11	195.78	262.81	8.667	10.5	8.43	6.40	8.50
IISR Alleppey Supreme	280.48	259.48	200.22	360.33	275.13	9.667	9.33	7.18	7.63	8.45
IISR Kedaram	294.88	354.67	397.22	293.00	334.94	8.5	8.5	6.61	9.47	8.27
IISR Pratibha	268.33	227.73	262.33	272.78	257.79	10.667	8.83	7.04	7.27	8.45
BSR-2	347.53	261.33	155.56	255.33	254.94	12.833	8.67	7.08	8.67	9.31
TCP-2	464.27	373.2	311.22	267.33	354.01	15.167	12	11.77	7.77	11.68
Rajendra Sonia	367.47	280.8	149.33	244.78	260.59	13.167	11.5	10.52	6.17	10.34
Roma	317.33	308.07	298.22	345.78	317.35	8.5	7.83	6.71	9.17	8.05
Rasmi	322.8	253.07	323.89	331.67	307.86	9.583	9	7.83	8.47	8.72
Duggirala Red	288.67	247.47	301.94	310.11	287.05	8.083	6	6.87	8.43	7.35
Narendra Haldi-1	335.53	308	246.56	287.67	294.44	11.917	13	10.94	9.23	11.27
SEm ±	24.21	33.25	52.27	75.70	37.74	0.88	1.69	0.68	1.16	1.06
CD (0.05)	50.49	69.35	109.04	157.91	17.08	1.84	3.53	1.42	2.42	2.17



At Pottangi top three highest fresh rhizome yielder were TCP 2 (20.9 t/ha), Roma (20.9 t/ha) and Pratibha (19.9 t/ha). The dry recovery per cent of above genotypes was 22.2%, 26.2% and 22.4%, respectively. The curcumin per cent ranged from 4.4% to 6.4 % of test entries.

At Mizoram maximum yield was recorded by RCT-1 (41 t/ha), followed by Duggirala (40 t/ha), IISR Pratibha (40 t/ha), Rajendra Sonia (38 t/ha) and Roma (37.1t/ha). Dry matter content was found to be highest in Rashmi (22.86%) followed by Roma (21.76%), and IISR Alleppey supreme (21.56). The incidence of leaf spot (*Colletotrichum curcumae* and *C. capsici*) was more acute than leaf blotch (*Taphrina maculans*). Disease incidence was observed in four genotypes Suranjana, Narendra Haldi, BSR-2 and Rajendra Sonia.

At Kalyani thirteen genotypes namely Roma, NH-1, Suranjana, Rajendra Sonia, IISR-Alleppey Supreme, IISR-Pratibha, CIL -317, Duggirala, BSR-2, Rashmi, Megha Turmeric and Krishnanagar (local cv.) were evaluated. Maximum yield was recorded by Rajendra Sonia (0.346 kg/plant) and projected yield was 31.86 t/ha.

A total of eleven turmeric genotypes obtained from different co-ordinating centres were evaluated during the year 2011-12 at Coimbatore. The rhizome yield per plot varied from 10.76 kg to 16.62 kg. The highest yield was recorded by the genotype Duggirala (415.44 g/plant) followed by Rajendra Sonia (409.00 g/plant).

The evaluation of genotypes for quality parameters is in progress.

Eleven entries were evaluated to observe the genotype x environment interaction on turmeric at Raigarh. Among the entries, Suranjana (TCP-2) recorded the highest yield (21.67 t/ha) followed by Narendra Haldi-1 (19.17 t/ha). Entry BSR-2 and Pratibha also recorded good yield of 16.51 and 16.28 t/ha, respectively.

TUR/CI/4 Quality Evaluation Trial

TUR/CI/4.1 Quality Evaluation of germplasm

(Coimbatore)

From the 275 germplasm collections maintained seven genotypes viz., CL 2, CL 7, CL 8, CL 23, CL 28, CL 101 and CL 187 recorded the highest plot yield of more than 22 kg /plot (3m²) at Coimbatore. The samples are being prepared for sending the same to the quality analysis to be done at Solan.

TUR/CM/5 Nutrient Management Trial

TUR/CM/5.2 Effect of organic farming in Turmeric

(Pundibari, Pottangi, Raigarh)

At Pundibari application of integrated nutrient management on turmeric (T₂) recorded highest clump weight (380.24 g), yield (8.76 kg / plot), curcumin (5.4%) and oleoresin (12.11%) followed by application of fully organic inputs in turmeric (T₁) which produced clump weight and plot yield of 313.13 g and 7.20 kg/ plot respectively.

Table 24. Effect of organics in yield of Turmeric Variety Roma at Pottangi (Pooled mean 2006-2011)

Treatments	Fresh rhizome yield (kg/3 m ²)							Projected yield (q/ha)	% Decrease over T ₃	Curcumin %	Dry recovery %	E. oil %	Oleoresin %	C:B ratio
	2006	2007	2008	2009	2010	2011	Avg. yield							
T ₁	8.4	8.2	7.1	7.6	9.1	8.0	9.7	212.0	22.1	5.8	26.7	4.4	11.2	1:1.2
T ₂	10.2	10.4	7.8	8.9	10.2	9.4	11.4	250.0	8.1	5.5	25.2	4.6	10.7	1:1.4
T ₃	11.6	12.2	8.6	10.0	9.1	10.3	12.4	272.0	-	5.7	25.1	4.8	11.4	1:1.52
C.D.	NS	1.2	1.26	NS	1.4	1.1	1.24	2.73	-	NS	NS	NS	NS	

At Pottangi results over the period of six years showed that there was significant difference among the three treatments for fresh rhizome yield. The highest rhizome yield of 27.2 t/ha obtained in T_3 (fully inorganic) with 22.1 % yield advantages over T_1 (fully organic) (Table 24).

At Raigarh maximum yield 19.68 t/ha was recorded by integrated nutrient management

TUR/CM/5.5 Standardization of water requirement for turmeric through drip irrigation

(Coimbatore, Kumarganj, Kammarpally)

A trial was laid out to standardize the irrigation requirement in turmeric with seven treatments with varying levels of irrigation during 2011-12 at Coimbatore. The plot yield of turmeric rhizome varied from 55.54 kg/plot to 59.82 kg/plot. The treatment T_4 -Drip once in a day at 60% PE recorded the highest yield per plot which is more than the control- Surface irrigation, 5cm, and 0.09 IW/CPE ratios.

Maximum yield of 33.00 kg/bed fresh rhizome yield at Kumarganj were recorded in surface irrigation (5 cm), 0.90 IW/CPE ratio followed by drip once in two days at 80 %PE.

At Kammarapally Drip irrigation once in a day at 80% PE recorded maximum rhizome yield (29.8 kg/plot) followed by Drip once in 2 days at 80 % PE (29.5 kg/plot) where as Drip once in 2 days at 40% PE recorded lowest rhizome yield (21.4 kg/plot).

TUR/CM/5.6 Standardization of fertigation in turmeric

(Coimbatore, Kammarapally)

The study in at Coimbatore from the pooled data of three years among the seven different treatments the treatment T_2 – 100 % RDF through drip – weekly once recorded the highest rhizome yield with high benefit cost ratio of 2.94 followed by T_3 -100% RDF (59.11 t/ha).

At Kammarapally also, 100% RDF through drip-weekly once recorded highest rhizome yield (42.62 t/

ha) followed by 100% RDF through drip- fortnightly once (41.29 t/ha) where as 50% RDF through drip-weekly once recorded lowest rhizome yield

TUR/CM/5.7 Effect of micronutrients on turmeric

(Dholi, Pundibari, Kumarganj)

At Dholi soil application of micro-nutrients @ 25 kg ha⁻¹ recorded the maximum number of plant per plot (40.00), dry matter production of plant (1.59 kg 3 m⁻²), yield per plot (16.90 kg 3 m⁻²) and projected yield (56.33 t ha⁻¹) followed by two foliar spray @ 0.5% at 60 and 90 days after sowing i.e., number of plant per plot (39.91), dry matter production of plant (1.58 kg/3m²), yield per plot (16.73 kg/3m²) and projected yield (55.75 t/ha).

At Pundibari based on mean data pooled over two years (2010-11 to 2011-12) foliar spray of zinc recorded maximum weight of mother clump (64.97 g), foliar spray of iron (T_7) registered maximum weight of primary fingers (131.59g), secondary fingers (131.59g). In respect of plot yield (kg/3m²) and the projected yield (t/ha), soil application of Boron (T_2) recorded the highest mean value of 10.25 kg and 20.67 t/ha, respectively.

Soil application of Zinc @ 25 kg/ha recorded maximum yield (30 t/ha) at Kumarganj followed by foliar spray of Iron (Fe_2SO_4) @ (0.5%) at 60 & 90 DAS (29.4 t/ha). Based on analysis report of 12 samples from Solan, maximum curcumin content(4.5%) was noticed in soil application of Boron (Borax) @ 25 kg/ha, maximum oleoresin content (11.31%) in soil application of Iron (Fe_2SO_4) @ 25 kg/ha and maximum essential oil content (6.71%) in Boron (Borax) during the year 2010-11.

TUR/CM/5.8 Studies on the effect of rhizome size and nursery on growth and yield of turmeric

(Coimbatore, Chintapalli)

At Coimbatore a trial to standardize the size of the planting material and to the study the effect of the seedling on growth and yield parameters was laid out



with nine different treatments for the first year. The treatment combination comprises of different size of the rhizome combined with the nature of the rhizome used as a planting material. The rhizome yield per plot varied from 38.93 kg per plot to 53.13 kg per plot. The treatment T₉ - Mother rhizome pieces (35-40 g) directly planting in the field (1 month) recorded significantly the highest yield (53.13 kg/plot) followed by T₇ - Primary full length rhizome (25-30 g) planting directly in the field 52.67 kg/plot.

At Chintapalli in terms of yield parameters, lesser per plant yield was recorded in direct sowing of cut pieces and transplanted treatments compared to complete seed treatments (T7, T8, and T9). However in all the cases compared to single node, two node cuttings, and mother rhizome cut pieces recorded maximum plant yields. Maximum fresh rhizome yield was recorded by T9 (30.78 t/ha) followed by T7 (26.89 t/ha). T1, T2, T3 treatments were on par with T4, T5 and T6.

TUR/CM/ 6.1 Standardisation of processing in turmeric

(IISR)

Experiments on curing of turmeric (variety Prathiba) was done during May 2012 by improved steam boiling and conventional water boiling method at IISR, Experimental Farm, Peruvannamuzhi. Cured turmeric was dried in cemented yard to reduce the moisture content of fresh rhizomes from 80.50% to less than 10%. Turmeric cured by traditional water boiling method for 40, 60, 90, min and those cured in improved steam boiler for 30, 45, 60 and 90 min took 10 days for drying. But in the case of rhizomes dipped in boiling water for 10 min and then dried, the drying time increased to 13 days. When the rhizomes were sliced and dried, the drying time reduced to 8 days. There was significant reduction in curcumin content from 4.66 to 4.44% when the curing time was increased from 30 min to 90 min in case of improved curing method.

TUR/CP/7 Disease Management Trial

TUR/CP/7.1 Survey and identification of disease causing organisms in turmeric and screening of turmeric germplasm against diseases

(Coimbatore, Pundibari, Dholi, Raigarh)

At Coimbatore center a disease survey was conducted in turmeric growing areas of different districts viz., Coimbatore, Erode, and Thirupur districts during the year 2011-2012. In Coimbatore district, the maximum leaf spot intensity was noticed at Ganesapuram (58.34 PDI) and the minimum intensity was observed at Sundarapuri (38.62 PDI). For the leaf blotch, the maximum intensity of 44.60 PDI was noticed at Boluvampatty and minimum at Sundarapuri (24.60 PDI). The rhizome rot incidence ranged from 8.00-16.00 % and maximum incidence at Mettupalayam and Sundarapuri and minimum incidence at Boluvampatty (8.00%). In Erode district, the maximum leaf spot intensity of 58.60 PDI was recorded at Poonachi and minimum at Chinthanaickanoor (44.20 PDI). The leaf blotch intensity was maximum (62.30 PDI) at poonachi and minimum at Thimmmu (32.30 PDI). The rhizome rot incidence ranged from 10.00 -16.00 %. In Tiruppur district, maximum leaf spot intensity of 52.62 PDI was observed at Kunnathur and minimum at Perumanallur (36.20 PDI). In the case of leaf blotch, the maximum intensity of 54.10 PDI was observed at Kunnathur and minimum at Perumanallur (38.42 PDI). The rhizome rot incidence ranged from 12.00 %-16.00 %.

Germplasm Screening

The leaf spot intensity of germplasm screened ranged from 14.00 PDI – 60.00 PDI. The accession number viz., CL 32 recorded the least leaf spot intensity of 14.00 PDI with maximum yield (60.67 t/ha) followed by CL 34 and CL 54 (16.00 PDI) with maximum yield of 56.13 t/ha and 57.47 t/ha respectively. The other accessions viz., CL 33, 52, and 80 recorded the least intensity of 18.00 PDI with the maximum yield of 56.13, 63.33 and 51.67 t/ha respectively. The highest leaf spot intensity of 60.00 PDI was recorded in CL.135 with



the lowest yield of 26 t/ha.

The leaf blotch intensity ranged from 14.00 PDI-68.00 PDI. The accessions CL.34 and 101 recorded the least intensity of 14.00 PDI with maximum yield of 56.13 t/ha and 62.13 t/ha respectively followed by CL32 and CL.101 which recorded the disease intensity of 16.00PDI with the maximum yield of 60.67 t/ha and 62.13t/ha respectively. The other accessions viz., CL.52 and CL 54 recorded the least intensity of 18.00 PDI with a maximum yield of 63.33t/ha and 61.33 t/ha respectively. The highest leaf blotch intensity of 68.00 PDI was recorded by CL 12 with the lowest yield of 29.67 t/ha.

At Pundibari center a survey was conducted in 2 blocks of Coochbehar (Coochbehar I and II) and some places of Dinhata of Coochbehar district to identify the diseases occurring in the area and to assess the severity of different diseases of turmeric in this area. Twelve well distributed locations within those places were selected for the survey. In each location the survey was done in at least 2 different places. Three major diseases of turmeric were found to be prevalent in this area, namely, leaf Blotch (*Taphrina spp.*), *Colletotrichum* leaf spot (*Colletotrichum spp.*) and *Helmintho-sporium* leaf spot (*Helminthosporium sp.*).

Most of the area is covered with local varieties which are highly susceptible to leaf blotch disease and some of the area is highly susceptible to Leaf Spot Disease too. In the survey it was found that leaf blotch disease severity was highest in Coochbehar I block (average 35.27%) followed by Dinhata (average 34.22%) and Coochbehar II block (average 33.83%). Regarding leaf spot of turmeric it was found that disease severity was highest in Dinhata (average 41.44%) followed by Coochbehar I block (average 39.13%) and Coochbehar II block (average 36.50%)

Germplasm Screening

The germplasm found to be resistant (PDI ranging from 1 – 10) against leaf blotch disease are TCP 5, 14, 28, 43, 48, 54, 74, 85, 95, 107, 129, 137, 149, 161, 202, etc. and moderately resistant germplasm (PDI

ranging from 11 – 20) are TCP 4, 21, 62, 79, 90, 104, 130, 168, 184, 187, 209, 217, etc. The germplasm found to be resistant (PDI ranging from 1 – 10) against leaf spot disease are TCP 14, 95, 120, 129, 153, 161, 163, 172 whereas moderately resistant germplasm (PDI ranging from 11 – 20) against this disease are TCP 5, 28, 85, 111, 136, 154, 168, 171, 190, 240, etc.

At Dholi, Turmeric crop cultivated by farmer were found to be affected by leaf spot caused by *Colletotrichum* and *Taphrina* leaf spot in Vaishali district of Bihar. *Colletotrichum* leaf spot incidence of turmeric was found in the range of 47.22 to 58.34% with mean disease incidence of 53.89%. *Taphrina* leaf spot incidence of turmeric ranged from 22.22 to 36.11% with mean disease incidence of 30%. Among 98 germplasm of turmeric screened against diseases, 53 & 41 no. of germplasm were found to be resistant & moderately resistant against *Taphrina* leaf spot whereas, 20 & 39 no. of germplasm were found to be resistant & moderately resistant against *Colletotrichum* leaf spot disease respectively. At Raigarh in the Mahapali developmental block found 54.32 percent disease intensity of *Colletotrichum* leaf spot and 38.56 percent disease intensity of *Taphrina* leaf blotch.

TUR/CP/7.2 Management of foliar diseases in turmeric

(Coimbatore, Kumarganj, Chintapalli, Pundibari, Raigarh, Pottangi)

A field trial was laid out with nine treatments in RBD during 2011-12 at Coimbatore (Table 25). The rhizomes were treated with fungicides as per the technical programme and the fungicidal spray was given on 45 and 90 days after sowing. In all the treatments more than 80% of germination was recorded. The highest germination percentage of 92.12% was recorded by T6 followed by T2 treatment (91.30 %). The pooled mean of three years data revealed that T6 (Foliar spray – Propiconazole (0.1%) on 45 and 90 days) was the best treatment in reducing the leaf spot



intensity to 19.33 PDI and leaf blotch intensity to 13.34 as compared to untreated control (61.56 PDI). This treatment was on par with T8 treatment (Foliar spray with Carbendazim + Mancozeb (0.1%) on 45 and 90 days). The T6 treatment also recorded the maximum yield of 38.92 t/ha with the highest C: B ratio of 1:4.60 followed by T8 treatment with yield of 34.44 t/ha and the BC ratio of 1:3.92 as compared to control (23.51 t/ha).

At Kumarganj maximum fresh rhizome yield of 34.67 t/ha was recorded by seed treatment and foliar spray with Hexaconazole (0.1%) on 45 and 90 days after

sowing (DAS) followed by seed treatment and foliar spray with Tricyclazole (0.1%) on 45 and 90 DAS that was on par with Tricyclazole treatment. The same treatment also revealed the minimum incidence of leaf blotch disease (19.08 %, PDI) followed by foliar spray of Carbendazim + Mancozeb (0.1%) on 45 and 90 DAS with leaf blotch incidence of 22.94 against the control (35.15 %). Minimum incidence of Leaf spot 14.08 % PDI was observed by rhizome treatment and foliar spray of Propiconazole (0.1%) at 45 & 90 DAS followed by rhizome treatment with Tricyclazole (0.1%) and foliar spray of Tricyclazole (0.1%) at 45 & 90

Table 25. Management of foliar Diseases in turmeric at Coimbatore (Pooled mean of 3 years -2008-2011)

Treatment	Germination (%)	Disease Intensity (PDI)				Plot yield (kg)	Yield (t/ha)	C:B ratio
		Leaf spot (PDI)	Percent reduction over control	Leaf blotch (PDI)	Percent reduction over control			
T1 - Rhizome treatment with Hexaconazole (0.1%)+ foliar spray- Hexaconazole (0.1%) on 45 and 90 days	75.00	31.77	48.39	29.11	32.65	13.05	26.11	1:2.82
T2 - Rhizome treatment with Propiconazole (0.1%) + foliar spray- Propiconazole (0.1%) on 45 and 90 days	75.67	30.67	50.18	24.88	42.43	15.11	30.22	1:3.20
T3 - Rhizome treatment with Tricyclozole (0.1%)+ foliar spray- Tricyclozole (0.1%) on 45 and 90 days	76.36	30.43	50.57	28.67	33.66	13.14	26.29	1:2.64
T4 - Rhizome treatment with Carbendazim+ Mancozeb (0.1%)+ Foliar spray- Carbendazim +Mancozeb (0.1%) on 45 and 90 days	77.50	26.32	57.24	18.66	56.83	16.78	33.56	1:3.70
T5 - Foliar spray – Hexaconazole (0.1%) on 45 and 90 days	73.57	30.22	50.91	23.78	44.98	13.74	27.49	1:3.23
T6- Foliar spray- Propiconazole (0.1%) on 45 and 90 days	82.62	19.33	68.60	13.34	69.13	19.01	38.92	1:4.60
T7 - Foliar spray- Tricyclozole (0.1%) on 45 and 90 days	73.69	31.78	48.38	25.78	40.35	12.91	25.49	1:2.72
T8 - Foliar spray- Carbendazim+ Mancozeb (0.1%) on 45 and 90 days	76.27	20.67	66.42	14.67	66.06	17.22	34.44	1:3.92
T9 – Control	72.50	61.56	-	43.22	-	11.76	23.51	-
SEm ±		1.85		1.70			1.34	
CD (0.05)		3.92		3.41			2.85	
CV%		6.75		6.20			5.61	

DAS against control values of 32.76 with 16.72 % leaf spot incidence. Rhizome treatment with Carbendazim + Mancozeb (0.1%) on 45 and 90 DAS was on par with Tricyclazole (0.1%) treatment.

On the basis of the samples analysis report from Solan centre for the year 2010-11, among the nine samples analysed, maximum curcumin content of 4.5 % in foliar spray with Carbendazim and Mancozeb (0.1%) on 45 and 90 DAS, maximum oleoresin content of 11.31 % in foliar spray with Hexaconazole (0.1%) on 45 and 90 DAS and essential oil content of 6.71 % in foliar spray with Tricyclazole (0.1%) on 45 and 90 DAS were recorded.

At Chintapalli rhizome treatment with Propiconazole (0.1%) + Foliar spray of Propiconazole (0.1%) on 45 and 90 DAS recorded a lowest incidence (19.66 %) of leaf spot followed by rhizome treatment with Carbendazim (0.1%) + Mancozeb (0.1%) + Foliar spray of Carbendazim + Mancozeb (0.1%) on 45 and 90 DAS (20.71%) while control plots received an incidence of 46.35 % infection of leaf spot.

Regarding Leaf Blotch, rhizome treatment with Carbendazim (0.1%) + Mancozeb (0.1%) + foliar spray of Carbendazim + Mancozeb (0.1 %) on 45 and 90 DAP recorded a lowest incidence (13.46 %) followed by foliar spray of Carbendazim + Mancozeb (0.1%) on 45 and 90 DAP (16.91%) . Rhizome treatment with Propiconazole (0.1%) + Foliar Spray of Propiconazole (0.1%) on 45 and 90 DAP also recorded a lower incidence of leaf blotch (20.81 %) compared to control (39.82 %).

In terms of yield, maximum fresh yield/bed was recorded in Rhizome treatment with Propiconazole (0.1 %) + Foliar Spray of Propiconazole (0.1 %) on 45 and 90 DAS (9.34 kg/ bed) followed by experimental plots that received the foliar Spray of Carbendazim + Mancozeb (0.1 %) on 45 and 90 DAS (7.75 kg/ bed) while the control plots received a meager yield of 7.13 kg/ bed.

In management of foliar diseases of turmeric trial at

Pundibari, it was found that rhizome treatment as well as foliar spray with Hexaconazole (0.1%) at 45 and 90 days after planting (T_1) was the best treatment in controlling both leaf blotch and leaf spot disease of turmeric. T_1 produced lowest percent disease index of 27.41 and 30.78 in the case of leaf blotch and leaf spot respectively and maximum yield (8.58 kg/plot (17.30 t/ha).

At Raigarh minimum disease intensity 8.7 percent and maximum yield 14.98 t/ha was found when rhizomes treated with Carbendazim + Mancozeb (1:1) and spray (0.1%) 45 and 90 DAS followed by rhizome treatment with Tricyclazole (0.1%) and spray (0.1%) 45 and 90 DAS with 12.00 disease intensity and 12.89 t/ha yield. On the basis of four years pooled result (2008-09 to 2011-12) minimum disease intensity 12.32 percent and maximum yield 13.34 t/ha was found when rhizomes treated with Carbendazim + Mancozeb (1:1) and its spray (0.1%) 45 and 90 DAS.

Minimum disease intensity 9.88 percent and maximum yield 12.40 t/ha was found when rhizome treated with Carbendazim + Mancozeb (1:1) and spray (0.1%) 45 and 90 DAS followed by rhizome treated with tricyclazole (0.1%) and spray (0.1%) 45 and 90 DAS with 15.45 percent disease intensity and yield (12.89 t/ha). On the basis of four years pooled result (2008-09 to 2011-12) minimum disease intensity 16.63 percent and maximum yield 13.34 t/ha was found when rhizome treated with Carbendazim + Mancozeb (1:1) and spray (0.1%) 45 and 90 DAS.

At Pottangi with respect to fresh rhizome yield the treatment T_4 or rhizome treatment with Carbendazim+ Mancozeb @ (0.1%) + Foliar spray – Carbendazim+ Mancozeb @ (0.1%) on 45 DAS and 90 DAS (19.4t/ha) was the best followed by T_1 or Rhizome treatment with Hexaconazole @ 0.1% + Foliar spray – Hexaconazole @ (0.1%) on 45 DAS and 90 DAS (18.3t/ha). However the cost: benefit ratio was high in the case of treatment T_5 (1:2.06) followed by T_2 (1:1.98).



TREE SPICES

TSP/C1/1 Genetic Resources

TSP/C1/1.1 Germplasm collection, characterization, evaluation and conservation of clove, nutmeg, and cinnamon

(Dapoli, Pechiparai)

Clove

The germplasm of tree spices are maintained at Dapoli, Pechiparai and Yercaud centres (Table 26). The germplasm of clove consisting of two accessions viz. IISR Calicut type and Kallar type have been maintained and are being evaluated for growth and yield performance at Dapoli. From the germplasm of clove planted during the year 1996-97, four promising genotypes DBSKKVSA1, 2, 3, 4 were selected. The plant height varied from 4.75 to 6.15 m., girth ranged from 29.00 to 32.00 cm and spread varied from 2.76 m to 4.20 m. Defoliation and die back of young shoots was observed and only 18 plants from genotype block recovered after the continuous spraying to the plants.

This trial was initiated at Pechiparai with an objective to collect, maintain, characterize and catalogue the germplasm of clove. In clove 24 accessions are being maintained. Two more collections were added in and around Kerala.

Among the 24 accessions, the accession SA-13 was significantly superior to other accessions and recorded tree height (8.22), stem girth (38.56 cm), leaf length (14.60 cm) and leaf breadth (5.55 cm). Dry bud yield was maximum in SA-13 (3.89 kg/tree), followed by SA-3 (2.95 kg/tree). The local check recorded a flower

Table 26. Tree spices germplasm collections at AICRPS centers

Crop/Centre	Indigenous/ cultivated
Clove	
Dapoli	2
Pechiparai	24
Yercaud	1
Total	27
Nutmeg	
Dapoli	87
Pechiparai	26
Yercaud	1
Total	114
Cinnamon	
Dapoli	11
Pechiparai	12
Yercaud	02
Total	25
Cassia	
Dapoli	06
Pechiparai	04
Total	10

yield of 2.65 kg/tree. The accession SA-13 recorded maximum clove bud oil (2.78%) and oleoresin content of 2.56%. whereas local check recorded clove bud oil content of 1.50% and oleoresin content of 1.50%. The comparative analysis was done between the high yielding accessions and local check and it was observed that there was 47% increase in dry bud yield in SA-13.

From the germplasm collections of nutmeg planted during the year 1996 -97 at Dapoli, fifteen promising genotypes (DBSKKVSA 16-30) have been identified

and average no. of fruit of four years ranged from 55 - 198. The genotype no. DBSKKVMF 28 (198), DBSKKVMF 21 (149), DBSKKVMF 22 (138), DBSKKVMF 16 (134), and DBSKKVMF 26 (131) Av. No. of fruits) showed higher average yield. These genotypes are further evaluated for yield and fruit characters. The genotype DBSKKVMF 29 recorded maximum dry nut yield (3025g) and dry mace yield (700g) during the year 2010 - 11 and also performed well during the period 2006 to 2011. The genotype DBSKKVMF 29 is promising considering its fruit wt., nut wt. and mace wt. as yield contributing characters in nutmeg.

In Nutmeg 24 accessions are maintained at Pechiparai among which the accession MF- 4 recorded maximum number of fruits (999 nos/tree) and the single fruit weight was also highest in MF-4 (73.45 g). The dry mace yield recorded per tree was 419 g. Local check recorded 672.60 numbers of fruits /tree and single fruit weight was 63.70 g. The mace yield was 221g. Comparative analysis showed that there was an increase in 48% in number of fruits, 88% increase in yield per tree in MF-4 over local check.

Cinnamon

In cinnamon, 12 accessions are being maintained at Pechiparai and during the year a high yielding selection

from Thadikarakonam was added to the germplasm. Among twelve accessions, CV-5 recorded the highest dry bark yield of 545g per tree whereas local check recorded dry bark yield of only 260 g per tree. Comparative analysis showed that there was an increase in percentage of 40.22 dry bark yield in CV-5 over local check.

At present total germplasm of cinnamon consisting of 11 accessions have been maintained and are being evaluated at Dapoli. Nine accessions planted during the year 1996-97 were evaluated for growth parameters. The data on growth parameters did not differ significantly in different genotypes. The plant height ranged from 3.68-4.74 m, the girth 21.22- 26.78 cm, the spread 3.39-4.57m and the regenerated shoots 4.53 -6.05.

TSP/CI/2 Coordinated varietal Trial

TSP/CI/2.1CVT 1992-clove

(Yercaud, Pechiparai)

Nine genotypes collected from IISR, Calicut is being maintained at Pechiparai and growth parameters are studied (Table 27). Among the types SA-3 was found to be promising in terms of yield characters (2.95 kg) of dry buds /tree.

Table 27. Performance of CVT Clove accessions at Pechiparai

Accession	Yield/kg/tree (dry)						Pooled mean	Yield (kg/ha) (dry)
	2006	2007	2008	2009	2010	2011		
SA- 3	1.59	1.70	2.50	3.00	3.33	2.95	2.46	681.42
SA -4	0.40	1.50	1.80	1.40	1.76	1.40	1.38	405.34
SA -5	1.26	1.50	2.00	1.10	1.00	1.92	1.46	404.42
SA -6	1.12	1.40	1.80	2.40	2.50	2.55	1.96	542.92
SA -7	1.05	1.40	2.40	2.30	2.30	2.60	2.22	614.94
SA -8	1.33	1.60	2.30	2.50	2.31	2.15	2.37	656.49
SA -9	0.60	1.20	1.90	1.50	1.30	2.14	1.66	459.82
SA -10	1.25	1.40	1.70	1.90	1.83	2.54	1.77	490.29
SA -11	0.46	1.20	1.80	1.90	1.90	2.57	1.64	452.28
SA -12	1.26	1.40	2.10	2.40	2.05	2.21	1.90	526.30
Local check.	1.22	1.30	1.45	1.80	1.95	2.65	1.72	476.44
SEm ±	0.01	0.02	0.01	0.05	0.14	0.16	0.12	0.70
CD(0.05)	0.03	0.03	0.03	0.11	0.29	0.26	0.06	1.41
CV (%)	1.66	1.31	0.88	3.10	8.73	6.06	1.51	0.18



TSP/CI/2.2CVT 2001 Nutmeg

(Pechiparai, Dapoli)

Six accessions were collected from IISR, Calicut and are being maintained at Pechiparai and evaluated along with a local check (Table 28). Among the accessions A9/150 has recorded the highest plant height of 1.98 m, stem girth of 11.81 cm and maximum number of shoots recorded was 20.00

At Dapoli out of eight accessions, planted during 2003-04 was evaluated for growth parameters. There was only significant difference in spread and other parameters viz. height, number of branches and girth did not showed significant differences among different genotypes. The plant height ranged from 0.55–1.47 m, the girth 8.17–17.50 cm, no of branches 5.17–15.50 and the spread 0.30–6.62 m. Few plants from Acc. no. A 9/4, A 9/20 and A 9/150 started bearing.

Table 28. Yield performance of Nutmeg accessions at Pechiparai

Accessions	Plant height (m.)	Stem girth (cm.)	Branches (No)
A9/4	1.32	9.70	5.88
A9/20	1.15	11.15	14.77
A9/25	1.06	8.45	13.80
A9/71	1.40	7.00	14.08
A9/150	1.98	11.81	20.00
M.L.	1.70	7.63	7.86
Local check	0.98	6.34	3.71
SEm ±	0.06	0.18	0.16
CD(0.05)	0.03	0.06	0.07
CV (%)	10.67	2.07	1.28

TSP/CI/2.3 CVT 2001-Cassia

(Pechiparai, Dapoli)

Four genotypes collected from IISR, Calicut along with local check is being evaluated at Pechiparai (Table 29). Among the four selections, D3 was found to be promising with plant height of 5.78 m, stem girth 40 cm, the leaf yield of 390g/tree, and bark yield of 226 g/tree.

At Dapoli out of 6 accessions evaluated significant difference was observed only in girth and plant height did not show significant difference among different genotypes. The genotype KKVCTSH1 recorded significantly higher girth (32.63 cm) followed by KKVCTSH2 (32.50 cm). The oil percentage in leaf varied from 6.14-7.34%. The genotype KKVCTSH1 and KKVCTSH2 recorded higher oil percentage 7.34% and 7.12% respectively than other genotype.

Table 29. Growth and Yield Performance of Cassia at Pechiparai

Accessions	Plant height(m.)	Stem girth(cm)	Leaf yield(g/tree)	Bark yield(g/tree)
C1	2.62	22.41	279.10	195.12
D1	2.56	23.20	313.67	215.00
D3	5.78	40.00	390.00	226.00
D5	2.68	30.17	352.00	200.45
Local check	2.22	19.50	278.64	190.60
SEm±	0.14	0.03	14.03	0.30
CD (0.05)	0.03	0.06	29.45	0.67
CV (%)	0.67	8.11	7.89	0.22

CORIANDER

COR/CI/I Genetic Resources

COR/CI/1.1 Germplasm collection, description, characterization, evaluation, conservation and screening against diseases

(Coimbatore, Dholi, Guntur, Hisar, Jagudan, Jobner, Kumarganj)

The coriander germplasm maintained at various centers of AICRPS are given in Table 30. Among the 275 coriander accessions evaluated at Coimbatore, the coriander grain yield ranged from 1.99 g per plant to 5.12g per plant. The average mean yield is 3.35 g per plant. Out of 275 collections evaluated, 109 genotypes recorded the yield higher than the mean yield. Three checks were involved in the evaluation (CS 111, CS 49 and CS 82). The grain yield of the check lines were 2.18g for CS111, 3.79 g for CS 82 and 4.89g for CS 49 respectively. In the evaluation of 275 germplasm lines during 2011-12 twelve lines recorded higher yield than Check CS 49 with lowest incidence of powdery mildew.

The incidence of powdery mildew disease was noticed



in all 275 accessions. The PDI ranged from 18.00 to 60.00. The accessions viz., CS 16, 18, 29, 37, 46, 58, 66, 70, 94, 105, 134, 216, 225 and 245 recorded the least disease intensity of 18.00-18.60 PDI with the highest yield of 865-900 kg /ha. The highest intensity of powdery mildew was recorded by CS 111 with the lowest yield of 383 kg /ha.

Table 30. Coriander germplasm collections at AICRPS centres

Centre	Indigenous		Total
	Cultivated	Wild and related sp.	
Coimbatore	275	-	275
Dholi	144	1	145
Guntur	309	-	309
Hisar	266	-	266
Jagudan	74	21 (Exotic)	95
Jobner	753	102	855
Kumarganj	160	-	160
Pantnagar	20	-	20
Solan	95	-	95
Total	2096	124	2220



At Dholi out of one hundred forty four accessions, only fourteen accessions namely- RD-392, RD-397, RD-410, RD-421, RD-422, RD-424, LCC-13, RD-425, RD-427, RD-385, RD-413, RD-415, and RD-418 recorded maximum yield ranging from (1.20 kg to 1.40 kg/5.4 m²) as compared to check variety Hisar Anand, Pant Haritima & Rajendra Swati (1.05 kg, 1.10 kg & 1.05 kg/5.4 m²) respectively. Among the promising accessions, RD-418 recorded maximum yield (1.40 kg/5.4 m²) followed by RD-385, RD-413 and RD-415 (1.30 kg/5.4 m²).

Among the sixty one germplasm entries evaluated at Guntur, in augmented Block Design, LCC-272 (6.48 g/plant), LCC-268 (6.38 g/plant), LCC-262 (6.02 g/plant), LCC-275 (5.3 g/plant) and LCC-276 (5.3 g/plant) were found significantly superior in yield over the best check Sudha (4.02 g/plant).

At Hisar One hundred eighty four accessions of coriander were evaluated using Hisar Anand, Hisar Sugandh and Hisar Bhumit as checks during 2011-2012. The mean seed yield of the germplasm material ranged from 17.2 g/plant (DH-226) to 87.4 g/plant (DH-318). The most promising lines for seed yield were DH-238, DH-244-1, DH-252, DH-254, DH-288, DH-289, DH-293, DH-294, DH-295, and DH-318.

During the year 95 entries were raised and evaluated with GCo 1 and GCo 2 as checks at Jagudan. Among them five entries was dwarf type, having less than 64 cm plant height. Six entries had more branches i.e. equal or more than 6.3 branches per plant. The higher umbels per plant were recorded by entry JCr 330. Eleven entries recorded equal or more than 7.0 umbellate per umbel. The entry Dhana 98 was promising for more seeds per umbellate > 10.7 seed per umbellate. The entry JCr 393 observed as early maturing (90 days). Fifteen entries found bold seeded has high test weight > 14.0 g. Ten entries isolated as high yielder recorded more than 1417 kg ha⁻¹ grain yield. During the reported year, total 97 (95+2) entries of Jagudan centre, were screened for the resistance against powdery mildew disease under natural condition. The incidence of

Powdery mildew was ranged from 35.00 to 82.75 per cent. None of the entry was found resistant against the disease.

At Jobner one hundred twenty six (126) germplasm accessions were evaluated along with nine checks namely RCr-20, RCr -41, RCr-435, RCr-480, RCr-728 and Local in Augmented design in one row plot of 3 x 0.3 sq.m size. Out of 230 accessions, 31 accessions were better than best check variety RCr-728. Some of the promising accessions identified on the basis of yield per 5 plants were UD-319, UD-646, UD-172, UD-263 Bold, UD-332, UD-365, UD-226, UD-399, UD-295, UD-373, UD-733, UD-364, UD-665, UD-239, UD-144, UD-657 and UD-179. At Kumarganj out of 160 germplasms evaluated, ND Cor-38 recorded maximum seed yield (17.60 q/ha) followed by NDCor-2.

Multilocation evaluation of coriander genotypes

(Jobner)

Ninety (90) germplasm accessions of different parts of country were evaluated along with four checks namely Hisar Sungandh, RCr-435, RCr-436 and Local at Jobner. Out of 90 accessions, 37 accessions were better than best check variety RCr-436. Some of the promising accessions identified on the basis of yield per 5 plants were DH-213, DH-226, UD-21, DH-214, DH-230, J.Cr.-394, DH-220, DH-222, UD-51, UD-7 J.Cr.-329, J.Cr.-388, J.Cr.-330, DH-208, UD-109, UD-31, UD-19 and UD-33

COR/CI/2 Coordinated Varietal Trial

COR/CI/2.4 Coordinated Varietal Trial – 2009 Series – VIII

(Jagudan, Kumarganj, Jobner, Hisar, Raigarh, Dholi, Guntur, Pantnagar, Jabalpur, Udaipur, Ajmer, Navasari)

At Jagudan the yield differences among the entries were significant. The entries COR 26 and COR 29 recorded the highest yield (2024 and 2004 kg ha⁻¹), which was 9.64 and 8.56 per cent higher over check GCr 2,

respectively (Table 31). The pooled over three years data shown that the entries COR 29, COR 30 and COR 27 recorded 2221, 2114 and 2052 kg ha⁻¹ yield,

which was 15.14, 9.59 and 6.38 per cent higher over check GCr 2, respectively.

Table 31. Yield performance of CVT coriander at Jagudan (Pooled mean)

Entry	Projected Yield (kg ha ⁻¹)			Mean	% IOC		
	2009-10	2010-11	2011-12		GCr-2	H.Anand	RCr-728
COR-25	2336	1077	1866	1760	-	18.04	29.32
COR-26	2355	1151	2024	1843	-	23.61	35.42
COR-27	2791	1725	1640	2052	6.38	37.63	50.77
COR-28	2112	972	734	1273	-	-	-
COR-29	2948	1710	2004	2221	15.14	48.96	63.19
COR-30	2718	1803	1820	2114	9.59	41.78	55.33
COR-31	2071	1611	701	1461	-	-	7.35
COR-32	3094	1880	826	1933	0.21	29.64	42.03
COR-33	1694	1550	1522	1589	-	6.57	16.75
COR-34	1765	1049	1227	1347	-	-	-
COR-35	1637	-	1062	1350	-	-	-
GCr-2 (Local check)	2324	1616	1846	1929	-	29.38	41.73
Hisar Anand (N. check)	-	1562	1419	1491	-	-	9.55
RCr-728 (N Check)	-	1502	1220	1361	-	-	-
SEm ±	180	94	131	-	-	-	-
CD (0.05)	530	274	382	-	-	-	-
C.V. %	13.49	11.89	16.01	-	-	-	-

At Kumarganj yield of K selection (Check) was maximum (16.52 q/ha) followed by Cor-29 and Cor-27 with a yield of 16.24 q/ha. The percent increase in yield was 11.92 % over check Hisar Anand. Among eleven entries and two check, all eleven entries were found non-significant regarding growth parameters and projected yield (t/ha) as compared to local check variety Rajendra Swati at Kumarganj. At Jobner the seed yield ranged from 937.50 to 1842.59 kg/ha. Of the fourteen entries evaluated, COR-27 recorded maximum seed yield 1842.59 kg/ha followed by COR-34 (1625.00 kg/ha), RCr-435 check (1562.50 kg/ha), COR-32 (1486.11 kg/ha), COR-29 (1453.70 kg/ha), Hisar Anand Check (1425.53 kg/ha), COR-33 (1381.94 kg/ha) and COR-26 (1351.58 kg/ha), whereas lowest seed yield of 937.50 kg/ha was

recorded by COR-35. At Raigarh among thirteen entries evaluated, COR-31 (846.88 kg/ha) was found significantly superior over all the checks ICS-1(LC), Hisar Anand and COR-728 with yield 607.29, 347.57 & 186.11 kg/ha, respectively followed by COR-32 (635.07 kg/ha).

Among the promising entries and check, all the entries were found non-significant regarding number of primary branches per plant, number of days to 50% flowering, number on umbellets per umbel and test weight of 1000-seed as compared to national check variety Hisar Anand at Dholi. At Guntur among the eleven coded entries evaluated, COR-29 (845.1 kg/ha) recorded significantly higher yield than all other entries including best check Sudha (694 kg/ha). statistical analysis



(pooled) indicated that the maximum seed yield was recorded by Cor-33 (2146.16 kg/ha), followed by Cor-31 (2139.52) at Pantnagar.

At Jabalpur among the twelve genotypes COR 33 recorded maximum height (116.62 cm), number of primary branches (9.00), and number of secondary branches (12.06), number of seed / umbel (38.13). However maximum seed yield was noticed in COR 31 (2.26 t/ha) that was on par with COR-33. The trial was conducted during Rabi including eleven test entries along with two checks in three replications at Udaipur. COR – 26 was found to be the best performing entry in terms of seed yield, (1840 kg/ha) followed by COR – 30 (1771 kg/ha) and COR 25 (1701 kg/ha).

Thirteen genotypes were tested against three checks namely Hisar Sonali and RMT-361 and AFG-1 (local check) at Ajmer. COR29 recorded maximum yield (910 kg/ha) that was on par with COR 29 (786 kg/ha) at Navasari. Based on the pooled data of coriander CVT trials COR-29 (929.17 kg/ha) was observed as a significantly superior over Hisar Anand for seed yield.

COR/CI/2.6 Coordinated varietal trial on coriander (Leaf type during off season) CVT – 2010

(Guntur, Coimbatore, Periyakulam)

During 2011-12 summer season, seven genotypes of coriander from different coordinating centers were tested with Sadhana and Local as checks in Randomized Block Design with three replications at Guntur. Among the entries evaluated, LCC-232 (2.59 t/ha) recorded highest green leaf yield followed by CS-38 (2.46 t/ha) and CS-11 (2.32 t/ha) which were on par with one another and significantly superior to checks Sadhana (1.68 t/ha) and local check (0.31 t/ha).

At Coimbatore the trial was conducted with leaf coriander genotypes from TNAU, Coimbatore and APHU, Guntur (three each) and one genotype from NRCSS, Ajmer with two checks. The leaf yield of the genotypes varied from 4.09 kg per plot (10 m²) to 4.91 kg per plot. The highest yield was recorded by

the genotypes LCC 234 followed by CS 1 (4.77 kg per plot) which were higher than both the checks.

At Periyakulam also LCC- 234 recorded the highest yield per plot (3.54 kg/plot) followed by LCC-242 (3.46 kg/plot) and CS-1 (3.39 kg/plot). The same trend was observed in estimated yield also. In the case of cost benefit ratio, the highest return was found in the genotype LCC-234 (4.00), followed by LCC-242 (3.86) and CS-1 (3.81). The genotypes like LCC-234, LCC-244 and CS-1 recorded the highest values in all the trials when compared to the rest of the treatments under Periyakulam conditions.

COR/CI/3 Varietal Evaluation trial

COR/CI/3.1 Initial evaluation trial 2010

(Jobner, Dholi, Jagudan).

At Jobner of the ten entries evaluated, UD-61 recorded maximum seed yield of 1754.17 kg/ha followed by UD-123 (1733.80 kg/ha), UD-411 (1452.78 kg/ha), RCr-436 check (142 by Local Check).

At Dholi among the promising entries and two checks, Pant Haritima and Rajendra Swati, RD-377 recorded significantly maximum yield per plot (15.3 kg/4.8m²) & projected yield (2.87t/ha) compared to check variety Rajendra Swati (1.30 kg/4.8m²) & projected yield (2.43 t/ha). The entries JCr 379 and JCr 380 recorded significantly maximum similar yield 1593 kg ha⁻¹, which was 11.24 per cent higher over check GCr 2. At Jagudan the pooled analysis over four years data shown non significant differences for yield but an entry JCr 404 and JCr 379 recorded maximum yield 1669 and 1611 kg/ha⁻¹, which was 8.24 and 4.47 per cent higher over check GCr 2, respectively.

COR/CI/3.2 Initial Evaluation Trial 2010 (Leaf purpose)

(Pantnagar)

The significant differences were obtained for all the parameters at Pantnagar. Maximum fresh leaf yield (6693.33 kg/ha) was recorded by PD (L)-51 followed by PD (L)-11 (4281.67 kg/ha).

COR/CI/3.3 Initial Evaluation Trial 2010 (Seed purpose)

(Hisar, Kumarganj, Guntur, Pantnagar)

The initial evaluation trial in coriander was conducted at Hisar with ten accessions along with Hisar Anand as check. The results indicated that DH-281 and DH-314 recorded significantly better yield over Hisar Anand (check) showing 20.0 and 19.8 % increase in yield, respectively. At Kumarganj in three years of study in IET, NDCor-38 registered significant increase in yield (17.70 q/ha) with 23.08 percent increase in yield over check followed by NDCor-10 (16.66 q/ha) over control of Hisar Anand (14.38 q/ha). At Guntur among the ten entries evaluated, LCC-219 recorded maximum yield (706.7 kg/ha) followed by LCC-212 (704.2 kg/ha) and LCC-225 (697.9 kg/ha) which were significantly superior to check Sudha (534.7 kg/ha). At Pantnagar maximum seed yield (3183.72 kg/ha) was recorded by PD(S)-21 followed by PD(S)-7 (2998.62 kg/ha) and PD(S)-2 (2924.58 kg/ha).

COR/CI/4 Quality Evaluation Trial

COR/CI/4.1 Quality evaluation in coriander

(Jobner)

Fourteen entries of coriander under CVT were analysed for volatile oil content during Rabi 2010-11 at Jobner (Table 32). The volatile oil content in the entries ranged from 0.27% to 0.40%. The maximum volatile oil of 0.40% was observed in COR-34, RCr-435, COR-27, COR-28, COR-29, COR-33 followed by 0.37% in COR-26, COR-30, and COR-31, while minimum of 0.27% was noticed in COR-35 and Hisar Anand (National check). The entry COR-27 ranked first in terms of volatile oil yield (7.37 l/ha) followed by COR-34 (6.50 l/ha), RCr-435 check (6.25 l/ha), and COR-29 (5.81 l/ha) while lowest volatile oil yield of 2.50 l/ha was noticed in COR-35.

On the basis of two years data (2009-10 and 2010-11), the highest mean volatile oil content of 0.44% was noticed in COR-34 followed by 0.42% in COR-27, COR-29, RCr-435 check, whereas minimum 0.29% was recorded by COR-35 and Hisar Anand (National Check). The maximum mean volatile oil yield in terms of litre per ha was observed in COR-27 (7.06 l/ha) followed by COR-34 (6.87 l/ha), & RCr-435 check (6.35 l/ha) and minimum in COR-35 (2.97 l/ha).

Table 32. Volatile oil content of entries of coriander CVT in 2010-11 at Jobner

Entry	Seed yield (kg/ha)	Volatile oil(%)	Volatile oil yield (l/ha)
COR-25	1120.37	0.30	3.36
COR-26	1351.85	0.37	4.96
COR-27	1842.59	0.40	7.37
COR-28	1275.46	0.40	5.10
COR-29	1453.70	0.40	5.81
COR-30	1041.67	0.37	3.82
COR-31	1344.91	0.37	4.93
COR-32	1486.11	0.30	4.46
COR-33	1381.94	0.40	5.53
COR-34	1625.00	0.40	6.50
COR-35	937.50	0.27	2.50
Hisar Anand NC	1425.93	0.27	3.80
RCr-435 Check	1562.50	0.40	6.25
Local Check	1300.93	0.30	3.90
CD (0.05)	272.65	0.06	
CV (%)	11.88	10.09	



IET

Ten entries of coriander under IET were analysed for volatile oil content during Rabi 2010-11. The volatile oil content in the entries ranged from 0.30% to 0.43%. The maximum volatile oil of 0.47% was observed in UD-565 and UD-663 followed by 0.40% in RCr-435, 0.37% in UD-563 and UD-737, while minimum of 0.30% was noticed in Local check. The entry UD-663 ranked first in terms of volatile oil yield (9.31 l/ha) followed by UD-565 (8.71 l/ha), RCr-435 check (7.38 l/ha), and UD-794 (6.76 l/ha) while lowest volatile oil yield of 4.33 l/ha was noticed in RCr-436 Check.

On the basis of three years data (2008-09, 2009-10 and 2010-11), the highest mean volatile oil content of 0.43% was observed in UD-565 and UD-663 followed by 0.42% in RCr-436 Check and 0.36% in UD-563, whereas minimum 0.30% was recorded in UD-737. The maximum mean volatile oil yield in terms of litre per ha was noticed in UD-663 (7.73 l/ha) followed by UD-565 (6.83 l/ha), RCr-435 check (6.78 l/ha), UD-794 (6.45 l/ha) and minimum in Local check (3.65 l/ha).

COR/CM/5 Nutrient Management Trial

COR/CM/5.3 Identification of drought/alkalinity tolerant source in coriander

(Jobner, Kumarganj)

The seed yield in coriander indicated significant differences between the genotypes in both irrigated and drought environments at Jobner. The mean yield in irrigated condition was 15.29 gm/plant while in drought conditions it was 14.20 gm/plant, thus the average yield over the environments did not vary much. The mean data ranged from a minimum 9.13 gm/plant in RCr 435 to a maximum of 21.83 in UD 476 in irrigated conditions while in drought conditions it ranged from minimum of 7.80 gm/plant (RCr 480) to 20.63 gm/plant (UD 476). Drought tolerance based on TOL, SSI and STI indicated that UD 10 was the best among the genotypes followed by UD 476 and UD 115. RCr 436 was most susceptible to drought among the

genotypes; it was also poor yielder among the genotypes.

Comparison of mean values over the years indicated that in irrigated trial, RCr 684, UD 476, UD 479 were stable yielders. In the drought trial, UD 115 had the highest mean yield over the years; this was followed by RCr 684 and UD 493. Comparison over the years indicated fluctuation of yield of genotypes. The genotypes which yielded lowest were the stable ones, while the highest yielders were generally least stable. Based on ranks, RCr 684 followed by UD 476 were relatively stable and high yielding in drought trial across the years.

The experiment was laid out in pots with ten genotypes of coriander at Kumarganj. Maximum 44.76/g plant mean seed and 35.67 g plant seed yield showing tolerance at 10, 20 and 30 ESP in NDCor-24.

COR/CM/5.4 Nutrient supplementation through organic manures for growth and yield of coriander

(Coimbatore, Kumarganj, Dholi, Hisar, Jobner, Guntur, Raigarh, Jagudan)

At Coimbatore a trial on nutrient supplementation through organic manures for growth and yield of coriander with the CO (CR) 4 variety was taken up during 2011-2012 with eight treatments. From the pooled data of three years among the eight different treatments tried the treatment T_7 - recommended INM package of the centre (FYM 5 t/ha + inorganic N 50% + *Azospirillum* 1.5 kg/ha (seed treatment) recorded the highest grain yield per ha (948.89 kg/ha) with high benefit cost ratio of 2.37.

Recommended dose of fertilizer (60:30:30 kg NPK / ha) recorded significantly higher yield of 17.18 q/ha followed by recommended integrated nutrient management practices (15.55 q/ha) against control (12.49 q/ha) at Kumarganj. Three years of pooled data recorded that RDF alone produced maximum yield of (17.20 q/ha) (Table 33)

Table 33. Effect of nutrient supplementation through organic manures on growth and yield of coriander at Kumarganj

Entries	2009-10 q/ha	2010-11 q/ha	2011-12 q/ha	Mean q/ha	Increase over control (%)
T ₁ FYM (100%) @ 10t/ha	15.13	15.62	15.10	15.28	20.69
T ₂ Vermi compost (100%) @ 5 t/ha	15.10	15.41	15.06	15.19	19.98
T ₃ FYM (50%) + Vermi Compost (50%)	14.09	13.95	13.47	13.83	9.24
T ₄ FYM (25%) + Vermi Compost (75%)	15.51	15.69	15.30	15.50	22.43
T ₅ FYM (75%) + Vermi Compost (25%)	14.54	14.31	14.09	14.31	13.03
T ₆ RDF alone chemical fertilizer	17.14	17.29	17.18	17.20	35.86
T ₇ Recommended INM package of the centre	16.17	15.97	15.55	15.89	25.51
T ₈ Absolute control	12.81	12.70	12.49	12.66	-
SEm±	0.30	0.22	0.21		
CD (0.05)	2.34	0.65	0.64		
CV %	2.16	2.47	2.51		

At Dholi among the treatments, (T₇) recommended dose of integrated nutrient management (FYM-15t ha⁻¹, N:P:K:50:40:30 kg⁻¹) had registered the maximum plant height (150.80 cm), number of primary branches per plant (10.53), number of secondary branches per plant (34.67), number of umbels per plant (91.33), number of grains per umbel (53.13), yield per plot (2.23 kg 6m⁻²) and projected yield (3.35 t ha⁻¹) and yield increase (63.41%) over control followed by (T₆) recommended dose of chemical fertilizer alone (N:P:K::50:40:30 kg ha⁻¹).

The significant differences were obtained for all the parameters at Hisar. Plant height ranged from 106.2 to 121.7, number of branches 7.9 to 8.8, umbels per plant 84.5 to 104.3, umbellate per umbel 34.1 to 39.6 and seeds per umbel 34.1 to 39.6. Maximum seed yield (2128.2 kg/ha) was recorded by the application of recommended INM followed by 100% nitrogen

supplemented with vemicompost (1924.3 kg/ha) and RDF (1862.4 kg/ha) respectively. At Guntur among the treatments evaluated, T₄ (FYM 25% + VC 75%) recorded maximum yield (642.4 kg/ha) followed by T₃ (FYM 50% + VC 50%) (576.4 kg/ha) and T₇ (INM) (572.7 kg/ha) which were significantly superior to control (451.4 kg/ha).

Maximum yield (10.1 q/ha) was recorded by the treatment recommended INM packages (FYM 10 t/ha + 80N: 60P: 40 K) at Raigarh.

COR/CM/5.5 Effect of micronutrients on yield of coriander

(Coimbatore, Dholi)

A Study on the effect of micronutrient on the yield of coriander CO (CR) 4 at Coimbatore revealed that the treatments differed significantly for growth and yield parameters under study. Among the twelve treatments



imposed the highest coriander seed yield was obtained in the treatment T₅ (0.5% foliar spray of ferrous sulphate 2 sprays-45 & 60 days of sowing) (649 kg/ha) followed by T₂ 0.5 % foliar spray of zinc sulphate (2 sprays-45 & 60 days of sowing) (636.33 kg/ha). From the pooled data of three years among the twelve different treatments 0.5 % foliar spray of zinc sulphate

(2 sprays 45 & 60 days of sowing) recorded the highest grain yield of 772.44 kg per ha with a benefit cost ratio of 2.10 followed by spraying of 0.5% foliar spray of copper sulphate (2 sprays 45 & 60 days of sowing) with a grain yield of 683.56 kg per ha with a benefit cost ratio 2.05 (Table 34).

Table 34. Effect of micronutrient on yield of coriander (2009 to 2012) at Coimbatore

Treat ment details	Plant height (cm)	No. of primary branches	No. of secondary branches	No. of umbels / plant	No. of umbellets/ umbel	No. of seeds / umbel	Seed yield / plot (g)(4 x 2.7 m ²)	B:C
T ₁	54.83	5.96	10.56	26.30	5.30	30.66	581.11	1.74
T ₂	59.02	5.37	10.52	28.22	5.41	33.04	772.44	2.10
T ₃	59.60	5.63	10.56	33.89	5.48	34.30	548.22	1.49
T ₄	61.07	5.70	11.56	32.93	6.19	35.93	644.66	1.93
T ₅	62.30	5.37	11.00	30.48	5.93	33.96	650.78	1.95
T ₆	60.15	5.89	10.67	34.37	6.15	36.19	528.00	1.58
T ₇	58.43	5.52	10.22	31.37	5.74	34.93	652.00	1.95
T ₈	64.91	6.00	10.26	30.78	5.56	32.67	683.56	2.05
T ₉	61.69	5.59	10.26	25.07	5.29	28.33	532.11	1.59
T ₁₀	57.01	6.19	10.89	31.93	5.96	30.59	654.22	1.96
T ₁₁	62.57	5.56	10.74	33.30	5.93	33.11	652.45	1.95
T ₁₂	57.64	5.82	11.04	30.07	5.89	29.04	563.55	1.69
SED	Mn - 0.118 MnL -0.102 Mn MnL- 0.204	Mn - 0.011 MnL -0.010 Mn MnL- 0.201	Mn - 0.016 MnL - 0.014 Mn MnL- 0.028	Mn -0.123 MnL -0.107 Mn MnL- 0.214	Mn -0.013 MnL -0.011 Mn MnL- 0.022	Mn-0.109 MnL -0.094 Mn MnL- 0.189	Mn -3.082 MnL -2.669 Mn MnL- 5.339	
CD (0.05)	Mn - 0.244 MnL -0.212 Mn MnL- 0.424	Mn - 0.024 MnL -0.021 Mn MnL- 0.042	Mn - 0.034 MnL -0.029 Mn MnL- 0.059	Mn -0.256 MnL -0.222 Mn MnL- 0.444	Mn-0.027 MnL -0.023 Mn MnL- 0.046	Mn - 0.227 MnL -0.196 Mn MnL- 0.393	Mn- 6.393 MnL -5.536 Mn MnL- 11.073	

At Dholi between soil application of micro-nutrients and foliar spray of micro-nutrient, soil application of micro-nutrients (zinc sulphate, ferrous sulphate, copper sulphate, manganese sulphate) @ 25 kg/ha recorded the more projected yield of 2.42 t/ha followed by foliar application of micro-nutrients @ 0.5% at 45 and 60 days after sowing projected yield (2.38 t/ha). Regarding benefit - cost ratio soil application of micro-nutrients @ 25kg/ha recorded maximum return of Rs.2.77 per unit cost followed by two foliar application of micro-nutrients @0.5% at 45 and 60 days after sowing i.e.,

Rs. 2.64 per unit cost.

COR/CM/5.6 Irrigation management for sustainable coriander production

(Guntur)

At Guntur among the different methods of irrigation, maximum number of umbels per plant was recorded in Sprinkler (21.9) which was significantly higher than Flooding (20.5) and Raingun (19.8). Number of umbellets per umbel, maximum was recorded in Sprinkler irrigation (5.9) that was on par with Raingun

(5.7) and significantly superior to the Flooding (5.4). Maximum number of fruits per umbel was recorded in Sprinkler (34.3) followed by Raingun (32.4) which were on par with each other and significantly superior to the Flooding (28.0). Among the methods of irrigation, irrigation with Flooding (946.4 kg/ha) (or) Raingun (942.7 kg/ha) was superior to Sprinkler (869.6 kg/ha) (Table 35).

Among irrigation schedules, all the irrigation schedules were found superior yield contributing characters. Irrigation at 30 and 60 DAS recorded highest yield

(1086.9 kg/ha) followed by irrigation at 45 and 60 DAS (1023.6 kg/ha) which were on par with each other and significantly superior to the control (664.7 kg/ha).

Among the interactions between methods and schedules, Raingun at 30 & 60 DAS (1142.7 kg/ha) recorded maximum yield followed by Flooding at 30 & 60 DAS (1102.0 kg/ha), irrigation with flooding at 45 DAS (1072.0 kg/ha) that were on par with one another and significantly superior to respective controls (635 kg/ha and 665 kg/ha respectively).

Table 35. Yield and yield attributes of coriander at Guntur with different methods of irrigation and schedules

Treatment	Plant height (cm)	No. of primary branches	No. of secondary branches	Umbels per plant	Umbellets per umbel	No. of days to 50% flowering	Days to maturity	Yield (kg/ha)
Irrigation Method								
Flooding (FL)	65.6	5.5	12.4	20.1	5.4	51.6	92.3	862.9
Sprinkler (SP)	62.8	5.7	13.0	21.9	5.7	52.5	92.1	824.9
Raingun (RG)	65.5	5.8	12.7	21.5	5.8	52.1	92.2	863.3
CD (0.05)	NS	NS	NS	1.5	NS	NS	NS	NS
Irrigation Schedule								
30 DAS	66.0	5.5	12.1	20.0	5.8	52.3	89.7	775.5
45 DAS	65.3	5.6	12.8	20.9	5.7	52.4	90.6	843.9
30 & 45 DAS	68.0	6.6	14.7	23.6	6.2	54.9	96.9	953.5
30 & 60 DAS	64.6	6.0	13.4	22.8	6.2	53.5	97.3	1041.0
Control	59.3	4.6	10.5	18.5	4.3	47.3	86.4	637.9
CD (0.05)	4.4	0.7	1.3	1.9	0.6	1.4	1.3	76.7
Interaction*								
RG at 30 DAS	68.1	5.3	12.1	18.3	5.6	51.8	90.7	768.0
RG at 45 DAS	68.9	5.7	13.4	22.0	5.3	52.1	90.3	892.1
RG at 30 & 45 DAS	67.9	6.3	14.2	22.8	6.1	54.3	96.7	955.3
RG at 30 & 60 DAS	64.5	6.0	12.9	20.8	6.0	52.9	98.0	1049.7
Control (RG)	58.7	4.0	9.5	16.5	4.1	47.3	85.9	649.5
SP at 30 DAS	65.8	5.5	12.3	21.1	5.8	52.0	88.9	745.1
SP at 45 DAS	63.6	5.4	12.5	20.9	5.8	53.1	91.0	801.3
SP at 30 & 45 DAS	61.1	6.8	15.5	23.0	6.2	55.2	97.0	935.0
SP at 30 & 60 DAS	65.0	5.9	13.5	25.6	6.3	54.9	96.7	1002.7
Control (SP)	58.2	5.0	10.9	19.1	4.5	47.5	86.8	640.3
FL at 30 DAS	64.1	5.6	11.8	20.5	5.8	53.1	89.7	813.3
FL at 45 DAS	63.4	5.6	12.6	19.8	6.0	52.1	90.3	838.4
FL at 30 & 45 DAS	74.9	6.6	14.4	25.0	6.4	55.3	97.0	970.1
FL at 30 & 60 DAS	64.4	6.2	13.9	22.0	6.4	52.9	97.3	1070.8
Control (FL)	60.9	4.8	10.9	20.0	4.3	47.0	86.5	623.8
CD (0.05)		7.7	1.2	2.2	3.3	1.0	2.4	2.3 132.8
CV (%)		10.3	18.8	15.2	13.5	16.0	4.0	2.2 13.6

*RG-Raingun, SP-Sprinkler, FL-Flooding



COR/CM/5.7 Nutrient management in off – season coriander leaf production

(Guntur, Coimbatore, Periyakulam, Ajmer)

At Guntur maximum yield was recorded by treatment T 8 (45:40:20 NPK + spraying with GA 10 ppm at 20 DAS) (2.51 t/ha) followed by T9 (45:40:20 NPK + spraying with GA 15 ppm at 20 DAS) (2.42 t/ha) which were on par with each other and significantly superior to control (1.43 t/ha).

Significant variation was noticed for the leaf yield and varied from 3.42 kg per plot (10 m²) to 5.28 kg per

plot at Coimbatore. The maximum yield (5.28 kg per plot) was recorded by the treatment T₃- 45:40:20 NPK followed by the treatment T₆-30:40:20 NPK + GA 15ppm at 20 DAS (4.68 kg per plot).

At Periyakulam the treatment T9 i.e., 45:40:20 NPK + Spraying with GA 15 ppm at 20 DAS recorded the highest values for the traits like plant height (31.27 cm), no. of compound leaves per plant (6.90), yield per plot (3.93 kg/plot) and estimated yield (3916.66 kg/ha) (Table 36). The highest cost benefit ratio was recorded by the treatment T9 (4.48).

Table 36. Effect of nutrient on off season coriander leaf production at Periyakulam

Treatments	Days taken for germination (days)	Plant height (cm) 40 DAS	No. of compound leaves per plant	Plant weight (g) 40 DAS	Yield per plot (10m ² area) (kg/plot)	Estimated yield (kg/ha)	B:C ratio
T1	10.33	22.27	5.10	6.79	3.06	3056.66	3.27
T2	10.00	25.23	5.53	7.35	3.18	3176.66	3.44
T3	10.00	26.87	5.83	7.63	3.32	3316.67	3.63
T4	10.00	28.43	6.17	7.60	3.48	3480.00	3.86
T5	10.00	28.73	6.37	7.90	3.59	3593.33	4.02
T6	10.00	29.50	6.53	8.63	3.72	3716.66	4.19
T7	10.00	27.53	6.13	8.00	3.60	3598.33	4.03
T8	10.00	29.83	6.67	8.77	3.74	3743.33	4.24
T9	10.00	31.27	6.90	9.03	3.93	3916.66	4.48
SEd ±	0.1571	0.3169	0.0664	0.0912	0.0466	46.044	
CD (0.05)	0.3331	0.6718	0.1408	0.1964	0.0988	97.610	

COR/CP/6 Disease Management Trial

COR/CP/6.2 Survey to identify the disease incidence, collection and identification of causal organism.

(Dholi)

Out of 144 germplasm, 110 and 7 germplasm were found highly resistant against stem gall disease under natural condition at Dholi. Survey conducted at cultivated Coriander field at Samastipur and Muzaffarpur districts of state were found to be infested with stem gall disease caused by *Protomyces macrospores*.

COR/CP/6.3. Management of stem gall disease of coriander

(Coimbatore, Kumarganj, Raigarh, Pantnagar, Jabalpu)

At Coimbatore all the treatments were found to have statistically significant effect on disease severity, reduction of stem gall incidence and increasing yield over control. Highest yield (2.22t/ha) with lowest PDI (5.00%) was recorded by treatment (T₆) where seeds were treated with Propiconazole (@ 0.20%) prior to sowing and also the crop was sprayed at 45, 60 and 75 DAP (@0.20%).

At Kumarganj significant decrease in the incidence of stem gall disease and yield was observed in all the treatments. Minimum stem gall disease of 29.16 (PDI) was recorded in seed treatment with Hexaconazole @ 0.2 % and foliar spray of Hexaconazole (0.2%) at 45, 60 and 90 DAP followed by 48.33 % stem gall disease by treatment of seeds with Propiconazole @0.2% with foliar spray at 45, 60 and 90 DAP against the control of 32.5% of stem gall disease. Maximum seed yield of 15.32 q/ha was recorded in Seed Treatment with Propiconazole (@ 0.20 %) + spray at 40, 60 & 75 DAP (@ 0.20 %) followed by 13.36 q/ha in seed treatment with Hexaconazole (@ 0.20 %) + spray at 40, 60 & 75 DAP (@ 0.20 %).

Minimum disease incidence (6.4%) was recorded when seeds were treated with Hexaconazole (@ 0.20%) + spray at 45, 60 & 75 DAP which were on par with seed treated with Propiconazole (@ 0.20%) + spray at 45, 60 & 75 DAP (@ 0.20%) (7.20%) at Raigarh. The respective maximum yield were 7.7 q/ha and 7.5 q/ha.

At Pantnagar the highest seed yield and no incidence of stem gall disease was observed by the treatment seed treatment with Propiconazole @ 0.2% + spray at 45, 60 & 75 DAP (0.2%). At Jabalpur no incidence of stem gall disease was observed during the period.

COR/CM/6.5 Evaluation of PGPR bioformulation of coriander

(Coimbatore, Guntur, Hisar, Raigarh, Ajmer, Jagudan)

Among the four treatments, the treatment FK 14 + FL 18 seed treatment recorded the highest seed yield of 766.33 kg/ha followed by FK 14 seed treatment (683.0 kg/ha) at Coimbatore.

At Guntur among the treatments evaluated, T-2 (Seed treatment with FL 18) recorded maximum yield (1102.8 kg/ha) followed by T-1 (Seed treatment with FK14) (828.9 kg/ha) which were significantly superior to control (without PGPR treatment) (750 kg/ha) and Sudha (559 kg/ha).

The maximum seed yield (1968 kg/ha) was recorded by the treatment Bioformulation of FK 14 followed by Bioformulation of FK 14 + FL 18 (1922 kg/ha) at Hisar.

At Raigarh maximum seed yield of 9.30 and 9.20 q/ha and maximum plant height (63.55 and 62.20 cm) were found when seeds were treated with Rhizobacteria FK₁₄ and FL₁₈ respectively and both the treatments were statistically on par.

At Ajmer it was observed that the PGPR coated treatments germinated early than the control treatments. However there was no significant difference of yield among the various treatments.

The effect of different PGPR bioformulations on growth and yield attributing characters, yield and volatile oil content of coriander seed at Jagudan was not significant.



CUMIN

CUM/CI/ Genetic Resources

CUM/CI/1.1 Germplasm collection, characterization, evaluation, conservation and screening against diseases

(Jagudan, jobner)

The germplasm maintained at cumin center are given in (Table 37) during 2011-2012, 214, genotypes of cumin were sown for evaluation for their yield and yield attributes, but no data could be recorded due to high incidence of wilt disease at Jagudan (Table 37).

Screening

One hundred and four (102+2) entries were screened for the resistance against blight disease caused by *Alternaria burnsii* and found that forty two entries were free from blight disease. The disease incidence ranged from 0.00 to 20.50 per cent and categorized as moderate. The minimum incidence was noticed in GC-2000-62 (2.75%) followed by JC-99-36, JC-2000-66, JC-2002-7 and JC-200-64.

One hundred four (102+2) entries were screened for the resistance against powdery mildew disease caused by *Erysiphe polygoni* under natural condition and no disease incidence was reported. All entries were screened against wilt caused by *Fusarium oxysporum* f.sp. *cumini* under sick plot condition. The entry GC 4 recorded minimum wilt incidence (39.00%) followed by Hairy Cumin (60.20%). The wilt disease incidence ranged between 39.00 to 100.00 per cent.

Germplasm accessions (303) maintained at Jobner centre along with 6 checks were evaluated at Jobner and seed yield ranged from 1.04 gm / five plants to 17.5 gm/ five plants. Checks on the other hand yielded between 5.8 gm (RZ 223) to 8.8 gm (Local) per five



plants. Fifty accessions outyielded the checks. Best accessions which yield higher over the checks were UC 340, UC 341, UC 346, UC 333, UC 348, and JC-95-126.

Multilocation evaluation of cumin germplasm

(Jobner)

Out of 91 accessions, 14 accessions were better than best check variety GC-4 at Jobner. Some of the promising accessions identified on the basis of yield per 5 plants were JC-95-1, C-08-33, UC-255, C-08-42, UC-271, JC-9, UC-245, JC-61, JC-188, UC-342, UC-334, UC-306, JC-10 and C-08-9.

CUM/CI/2 Coordinated Varietal Trial

CUM/CI/2.3 Coordinated Varietal Trial – 2009

(Jobner, Ajmer, Jabalpur, Jagudan)

Mean performance of the entries evaluated in CVT at Jobner over 2009-10 and 2010-11 revealed superior performance of CUM-13 yielding 677.61 kg/ha followed by CUM-12 (595.14 kg/ha), RZ-223 check (582.99 kg/ha), CUM-9 (573.61 kg/ha) and RZ-345 check (565.63 kg/ha), while lowest seed yield of 459.90 kg/ha was noticed in CUM-11. At Ajmer CUM-9 recorded maximum yield followed by

Table 37. Cumin germplasm collection maintained at AICRPS centres farming at Panniyur

Center	Indigenous	Exotic	Total
Jagudan	207	7	214
Jobner	370	6	376
Total	577	13	590

GC4. The crop was totally damaged due to winter rains at Jabalpur in the month of January 2012 and no observations could be recorded. At Jagudan, none of the entries registered the higher yield over checks GC 4.

CUM/CI/3 Varietal Evaluation Trial

CUM/CI/3.3 Initial evaluation trial 2009

(Jobner, Jagudan)

At Jobner mean performance of the entries evaluated in IET over 2009-10 and 2010-11 revealed superior performance of UC-339 yielding 726.74 kg/ha followed by UC-336 (671.88 kg/ha), Wt-5 (620.32 kg/ha), UC-293 (610.94 kg/ha), UC-267 (610.59 kg/ha) and UC-292 (584.20 kg/ha), while lowest seed yield of 412.68 kg/ha was recorded by local check. The pooled over two year's data of IET in Cumin shown non significant differences for yield at Jagudan.

CUM/CI/4 Quality Evaluation Trial

CUM/CI/4.1 Quality evaluation in cumin

(Jobner)

On the basis of two years data (2009-10 and 2010-11), the highest mean volatile oil content of 3.69% was recorded in RZ-345 check followed by 3.54% in CUM-10, 3.53 in GC-4 NC, 3.28% in CUM-13 and 3.27% in RZ-223 check, whereas minimum 2.79% was recorded in RZ-209 check. The maximum mean volatile oil yield was observed in CUM-13 (22.23 l/ha) followed by RZ-345 check (20.87 l/ha), GC-4 NC (19.50 l/ha) & RZ-223 check (19.03 l/ha) where as minimum in CUM-11 (13.75 l/ha).

CUM/CM/5 Nutrient management trial

CUM/CM/5.1 Identification of drought tolerance

(Jobner)

At Jobner based on the different drought indices namely TOI, SSI and STI, CUM 2 was the best tolerant genotype followed by UC 299 and Local at Jobner.

UC 334 was found to be least drought tolerant among the genotypes evaluated. Based on average performance, UC 331 was the highest yielder followed by UC 274 and UC 225 respectively in the irrigated conditions. While in limited moisture conditions, UC 239 followed by UC 274 and UC 225 were the best genotypes.

CUM/CP/6 Disease Management Trial

CUM/CP/6.1 Management of wilt and blight disease in cumin

(Jobner, Jagudan)

At Jobner out of thirteen treatments, minimum wilt incidence (1.78 %) and maximum seed yield 579 kg/ha was recorded by the treatment application of *Trichoderma harziunum* @ 10 kg/ha + FYM @ 3 t/ha that was on par with application of *Trichoderma harziunum* @ 10 kg/ha + FYM 6 t/ha with seed yield of 556 kg/ha and wilt incidence of 2.31%. The control recorded maximum wilt incidence (18.35%) and minimum seed yield (352 kg/ha).

At Jagudan significantly higher yield (431.11 kgha⁻¹) and minimum incidence of blight was found in the treatment Spray of Mancozeb @ 0.25% at 40, 50, 60 & 70 DAS (T₁₁) (20.64%) followed by the treatment Soil Solarization + Soil Application of *Trichoderma harzianum* + Spray Mancozeb @ 0.25% at 60 DAS (T₁) (24.18). Significantly minimum incidence of wilt disease was noticed in the treatment soil solarization + Soil application of *Trichoderma harzianum* + Spray of Mancozeb @ 0.25% at 60 DAS (T₁) (18.37%) followed by FYM + soil application of *T. harzianum* + Spray Mancozeb @ 0.25% at 60 DAS (T₂) (21.19 %).

CUM/CP/6.2 Survey for yellowing causing organism in cumin

(Jagudan, Jobner)

Survey was conducted in different cumin growing areas (five to eight villages of five districts of North Gujarat) by Jagudan and observed that yellowing ranges from 2.0 – 15.0. None of the biotic cause was isolated from



infected plant samples. Soil samples of diseased plant plots showed low level of organic carbon and high level of P_2O_5 as compared to healthy plant soil samples collected from different villages of North Gujarat. A filler trial was conducted at Jagudan during 2011-12 with twelve different treatments and three replications. Three sprays were given @ 10 days interval after 30 days after sowing. Minimum yellowing per cent was observed in Zinc sulphate spray @ 100 ppm + Imidacloprid 17.8 SL @ 0.005% while, 17.8 SL @ 0.005%.

Survey was conducted in different cumin growing areas of Rajasthan by Jobner center. Soil and plant samples were collected and analysed for nutrient status. None

of the biotic cause was isolated from infected plant samples. Soil samples of diseased plant plots showed low level of organic carbon and high level of P_2O_5 as compared to healthy plant soil samples.

CUM/CM/6.4 Evaluation of PGPR bioformulation on Cumin

(Jagudan, Ajmer)

Growth and yield attributes, yield as well as quality of cumin seed were not influenced significantly due to various inoculants at Jagudan. At Ajmer, it was observed that the PGPR coated treatments germinated early than the control treatments. However there was no significant difference of yield among the various treatments.

FENNEL

FNL/CI/1 Genetic Resources

FNL/CI/1.1 Germplasm collection, characterization, evaluation, conservation and screening against diseases

(Dholi, Jagudan, Hisar, Jobner & Kumarganj)

The germplasm of fennel is maintained at Dholi, Jagudan, Hisar, Jobner and Kumarganj of AICRPS (Table 38). One hundred thirty eight accessions of fennel were evaluated in respect of yield at Dholi using GF-2 and HF-33 as checks. The mean seed yield of the germplasm ranged from 40 g/plant (HF-183) to 99.6 g/plant (HF-112). The most promising lines were



HF-112, HF-147, HF-157, HF-163, HF-176, HF-180, HF-195, HF-223, HF-225, HF-228, and HF-229.

Table 38. Fennel germplasm collections maintained at various AICRPS centers

Center	Indigenous	Exotic	Total
Dholi	56	-	56
Guntur	2	-	2
Hisar	131	-	131
Jagudan	129	2	131
Jobner	259	-	259
Kumarganj	133	-	133
Total	709	2	711

At Jagudan during the *kharif* & *rabi* season, the 124 & 16 indigenous and 2 & 1 exotic entries of fennel were evaluated for different yield attributes with four checks i.e. GF 1, GF 2, GF 11 and GF 12, respectively. Among the ten entries observed dwarf type, eleven entries had more than 10 branches per plant. 5 entries had more than 40 umbels per plant, eight entries recorded more than 54 umbellates per umbel, and six entries had 40 seed per umbellate, eight entries had more or less early maturity (< 134 days), ten entries had high test weight > 10 g. Eleven entries isolated as high yielder recorded more than 3200 kg ha⁻¹ grain yield.

Among 143 genotypes evaluated for their yield and yield attributes at Jagudan, 11 genotypes were identified as high yielding (> 3200 kg ha⁻¹) and some of the promising lines were screened for various diseases. Total ninety three (90+3) entries were screened against *Ramularia* blight diseases (*Ramularia foeniculi*) during Kharif and no disease was observed. Total twenty entries (17+3) were screened against *Ramularia* blight diseases during Rabi season. All screened entries were free from disease during ensuing crop season.

One hundred thirty eight accessions of fennel were evaluated during 2011-2012 using GF-2 and HF-33

as checks at Hisar. The mean seed yield ranged from 40 g/plant (HF-183) to 99.6 g/plant (HF-112). The most promising lines were HF-112, HF-147, HF-157, HF-163, HF-176, HF-180, HF-195, HF-223, HF-225, HF-228, and HF-229.

At Jobner out of 253 accessions, evaluated along with six checks namely RF-101, RF-125, RF-143, RF-145, RF-205 and local, 40 accessions were better than best check variety RF-205. Some of the promising accessions identified on the basis of yield per 5 plants were UF-166, UF-8, UF-92, UF-147, UF-215, UF-266, UF-186, UF-116, UF-202, UF-210, UF-253 and UF-112.

Out of 130 germplasm NDF-46 recorded maximum seed yield of 13.80 q/ha followed by NDF-5 (13.50 q/ha) at Kumarganj.

FNL/CI/2 Coordinated Varietal Trial

FNL/CI/2.4 Coordinated Varietal Trial -2009 Series VII

(Hisar, Kumarganj, Jagudan, Jobner, Dholi, Jabalpur, Udaipur, Raigarh, Pantnagar)

One hundred thirty eight accessions of fennel were evaluated during 2011-2012 using GF-2 and HF-33 as checks at Hisar and the mean seed yield ranged

Table 39. Yield in CVT of fennel at Kumarganj 2009-10 to 2011-12 (Pooled mean)

Entries	2009-10 (t/ha)	2010-11 (t/ha)	2011-12 (t/ha)	Mean (t/ha)	% increase over control
FNL-37	6.52	13.08	13.61	11.07	-
FNL-38	7.01	13.12	13.74	11.29	-
FNL-39	6.59	12.32	12.77	10.56	-
FNL-40	8.88	13.81	14.23	12.30	0.90
FNL-41	7.42	14.61	15.06	12.36	1.39
FNL-42	7.49	12.42	12.84	10.91	-
FNL-43	7.84	14.65	14.99	12.49	2.46
FNL-44	8.19	14.85	15.20	12.74	4.51
FNL-45	6.45	-	14.58	-	-
FNL-46	7.46	-	13.50	-	-
GF-11 (Ch)	7.98	14.09	14.51	12.19	-
RF-101 (Ch)	-	13.50	13.95	-	-
RF-205	-	13.71	14.16	-	-
NDF-5 (Ch)	-	15.62	15.96	-	-
NDF-30	8.12	-	-	-	-
SEM ±	0.17	0.34	0.33	-	-
CD (0.05)	0.50	1.00	0.96	-	-
CV %	4.00	4.29	4.05	-	-



from 40 g/plant (HF-183) to 99.6 g/plant (HF-112). The most promising lines were HF-112, HF-147, HF-157, HF-163, HF-176, HF-180, HF-195, HF-223, HF-225, HF-228, and HF-229.

At Kumarganj as per three years pooled mean FNL-44 recorded (1274 kg/ha) maximum yield whereas FNL 40 registered maximum yield at Jagudan (1474kg/ha) compared to all the checks (Table 39).

Mean performance of the entries evaluated in CVT over 2009-10 and 2010-11 at Jobner revealed superior performance of FNL-43 yielding 1904.22 kg/ha followed by FNL-46 (1901.33 kg/ha), FNL-38 (1860.45 kg/ha), FNL-44 (1818.00 kg/ha), RF-143 check (1781.12 kg/ha), FNL-41 (1767.56 kg/ha) and RF-125 check (1748.89 kg/ha), while lowest mean seed yield of 1492.89 kg/ha was recorded by Local check. Similarly FNL-43 recorded maximum yield (1945.22 kg/ha) at Dholi and Jabalpur.

Among the entries, entry FNL-40 with yield 905.31 kg/ha was found significantly superior over the checks i.e. RF-101 (605.40 kg/ha), RF-205 (247.01 kg/ha) and GF-11 (360.13 kg/ha) at Raigarh and Jagudan. At Udaipur FNL – 42 found to be the highest yielding entry (1932.29 kg / ha) followed by GF – 11 (NC) (1770.83 kg / ha) and FNL – 43 (1661.455 kg / ha). However non significant yield differences were observed among entries at Pantnagar.

FNL/CI/3 Varietal Evaluation Trial

FNL/CI/3.1 Initial Evaluation Trial

(Jagudan, Hisar and Kumarganj)

The pooled analysis over three year's data indicated significant differences for yield at Jagudan. The entries JF-671-1, JF-674-1 and JF-671-2 recorded 1273, 1272 and 1265 kg ha⁻¹ yield, which was 8.80, 8.72 and 8.12 per cent higher over check GF 11 respectively.

At Hisar in IET, maximum seed yield was noticed in HF-151 (2182 kg /ha) followed by HF-212 (2016 kg/ha) showing an increase of 30.9 and 19.8 % over HF-33 (check), from both years mean respectively.

Significant differences were observed in the yield of genotypes at Kumarganj. Based on mean of three years data NDF-46 (1278 kg/ha) recorded the maximum seed yield and 27.40 % increase in yield followed by NDF-45 (1145kg/ha) over the control GF-2 (1003 kg/ha).

FNL/CI/3.3 Initial Evaluation Trial - 2011

(Jobner)

Of the ten entries evaluated at Jobner , entry UF-168 recorded maximum seed yield of 2306.67 kg/ha followed by UF-135 (2155.56 kg/ha), UF-149 (1922.22 kg/ha), RF-205 check (1797.78 kg/ha), UF-236 (1706.67 kg/ha) and UF-191 (1595.56 kg/ha), while lowest seed yield of 1448.89 kg/ha was noticed in Local check.

FNL/CI/4.1 Quality Evaluation in fennel

(Jobner)

Fourteen entries of fennel under CVT were tested for volatile oil content at Jobner. On the basis of two years data (2009-10 and 2010-11), the highest mean volatile oil content of 2.89 % was noticed in FNL-39 followed by 2.60% in FNL-46, 2.58 in RF-125 check, 2.47% in FNL-43, whereas minimum 2.20% was observed in Local Check. The maximum mean volatile oil was noticed in FNL-46 (49.43 l/a) followed by FNL-43 (46.94 l/a), RF-125 check (45.12 l/ha), FNL-44 (43.63 l/ha), FNL-38 (43.44 l/ha) and RF-143 check (42.75 l/ha) where as minimum in FNL-40 (33.37 l/ha).

Ten entries of fennel under IET were tested for volatile oil content at Jobner and ranged from 1.77% to 2.23%. On the basis of three years data (2008-09, 2009-10 and 2010-11), the highest mean volatile oil content of 2.27% was recorded by RF-101 Check followed by 2.24% in UF-114, 2.23% in UF-278, 2.20% in UF-270, RF-143 check and Local check, whereas minimum 2.06% was recorded by UF-235. The maximum mean volatile oil yield in terms of litre per ha was recorded by UF-278 (47.74 l/ha) followed by

UF-157 (46.51 l/ha), RF-143 Check (42.25 l/ha) and minimum in Local check (32.68 l/ha).

Nutrient Management Trial

FNL/CM/5.2 Identification of drought/alkalinity sources in fennel

(Kumarganj)

At Kumarganj NDF-22 showed maximum alkalinity tolerance at 10, 20 and 30 ESP among 10 entries tested showing maximum mean seed values of 41.91 g/plant. Pooled mean values for alkalinity tolerance suggests that NDF-22 bear maximum tolerance to alkalinity at 10, 20 ESP levels at Kumarganj.

FNL/CM/6.3 Evaluation of PGPR bioformulation on Fennel

(Hisar, Raigarh, Ajmer, Jagudan)

At Hisar, the maximum seed yield (1968 kg/ha) was recorded by treatment T1 - Bioformulation of FK 14 followed by T3 - Bioformulation of FK 14 + FL 18 (1922 kg/ha). Maximum seed yield of 9.30 and 9.1 q/ha and maximum plant height (155.46 and 151.56 cm) were found in the treatment when seeds were

treated with rhizobacteria FK 14 and FL 18 respectively at Raigarh. At Ajmer there was no significant difference in yield among the various treatments. At Jagudan the effect was not significant due to seed pelleting of both the PGPR bioformulations (FK-14 & FL-18) individually as well as in combination

FNL/CP/6 Disease Management Trial

FNL/CP/6.2 Field evaluation of different insecticides/botanicals against seed midge *Systole albipennis walker* fennel

(Jagudan)

At Jagudan application of Thiamethoxam 25WG @ 0.0084% recorded maximum yield (1973 kg ha⁻¹) and the least seed wasp damage (8.73%) at three and seven days after the spray and the second best treatment identified was application of Acetamiprid 20SP @ 0.004% which recorded seed wasp damage 11.72% at three and (12.97%) seven days after the spray. At harvest, the damage caused by seed wasp was also the least (9.50%) due to the application of Thiamethoxam 25WG @ 0.0084%.

FENUGREEK

FGK/CI/1 Genetic Resources

FGK/CI/1.1

Germplasm collection, characterization, evaluation conservation and screening against diseases

(Dholi, Hisar, Guntur, Jagudan, Jobner, Kumarganj)

The germplasm of fenugreek conserved at various centers is given in (Table 40). One hundred sixty three collection of fenugreek germplasm were tested for promising line with respect to yield and yield attributing characters at Dholi of which only twelve registered the maximum yield ranging from 1.15 kg to 1.70 kg/



5.4 m² as compared to check variety Hisar Sonali & Rajendra Kanti (100 kg/5.4m²). Among the promising accessions IC-590113 (RM-27) recorded the maximum yield (1.70 kg/5.4m²) followed by IC-590122 (RM-16) i.e., (1.40 kg/5.4 m²).



Table 40. Fenugreek germplasm collections under AICRPS centers

Centre	Indigenous	Exotic	Total
Dholi	176	-	176
Guntur	124	-	124
Hisar	192	-	192
Jagudan	75	-	75
Jobner	348	-	348
Kumarganj	162	-	162
Coimbatore	50	-	50
Total	1127	-	1127

At Hisar out of one hundred ninety two accessions of fenugreek were evaluated along with Hisar Sonali, Hisar Suvarna and Hisar Mukta as checks, the seed yield of the germplasm material ranged from 7.5 g/plant (HM-478) to 23.6 g/plant (HM-392). The most promising lines for seed yield were HM-381, HM-392, HM-396, HM-401, HM-411, HM-424, HM-425, HM-443, HM-452, HM-456, HM-460, HM-466, HM-483 and HM-490.

During the year 2011-12, one hundred and twenty four germplasm lines along with five checks were evaluated at Guntur. The first five promising entries for yield i.e. LFC-105 (4.8 g/plant), LFC-116 (4.8 g/plant), LFC-103 (3.8 g/plant), LFC-113 (3.8) and LFC-18 (3.7 g/plant) were significantly superior to the check APHU Methi-1 (2.95 g/plant).

At Jagudan 75 entries including GM-2 as check were evaluated for different characters. Among them 8 entries were found dwarf, six entries had recorded more or equal 6.0 branches per plant. Five entries were found equal or more than 34 pods per plant. Long pod length ≥ 9.3 cm was recorded by entry JFg-225. More seed per pod ≥ 19.0 was found in 8 entries. The four entries were matured before 90 days. Seven entries were found bold seeded having equal or more test weight ≥ 12.80 . Eleven entries found promising for yield i.e. more than 3250 kg ha⁻¹. None of the screened entries (77) were found free from the incidence of powdery mildew. The minimum incidence was noticed in JFg-

209 (7.25%) followed by JFg-184 (7.40%). The incidence ranged between 7.25 to 90.65 %.

At Jobner wide range of variability was found for all the characters studied in 348 germplasm accessions, of which 106 accessions were better than best check variety RMt-303. Some of the promising accessions identified on the basis of yield per 5 plants were UM-28, UM-36, UM-54, UM-71, UM-72, UM-75, UM-91, UM-129 and UM-172.

During the year 2011-12, hundred and twenty four germplasm lines along with five checks were evaluated in Augmented Block Design at Guntur. The first five promising entries for yield LFC-105 (4.8 g/plant), LFC-116 (4.8 g/plant), LFC-103 (3.8 g/plant), LFC-113 (3.8) and LFC-18 (3.7 g/plant) were significantly superior to the check APHU Methi-1 (2.95 g/plant).

Out of 165 germplasm of Fenugreek, maximum seed yield of 2360 kg/ha was recorded by NDM-19 followed by NDM -69(2070 kg/ha) at Kumarganj.

FGK/CI/2 Coordinated Varietal Trial

FGK/CI/2.1 Coordinated Variety Trial - 2009 Series VII

(Coimbatore, Guntur, Hisar, Jagudan, Jobner, Jabalpur, Raigarh, Kumarganj, Pantnagar, Ajmer, Udaipur)

Among the thirteen fenugreek genotypes along with two checks evaluated at Coimbatore , the CVT line

FGK 29 recorded the highest grain yield of 741.67 kg/ha followed by FGK 35 (700.33 kg/ha). From the pooled data of three years of evaluation of fifteen fenugreek genotypes, FGK 33 registered the highest grain yield per ha (467.22 kg/ha).

At Guntur among the thirteen genotypes evaluated, FGK-28 (525 kg/ha), FGK-30 (505.8 kg/ha), FGK-37 (468 kg/ha), FGK-34 (424 kg/ha) and FGK-31 (412 kg/ha) recorded significantly higher yield than check LS-1 (257.8 kg/ha).

At Hisar, out of 16 entries evaluated in coordinated varietal trial in fenugreek, the maximum seed yield (2303 kg/ha) was recorded by FGK-32 followed by FGK-31 (2292 kg/ha) and FGK-29 (2094 kg/ha).

Significant yield differences were observed among the entries at Jagudan. But none of the entries recorded significantly higher yield over checks RMT 361, Hisar Sonali and GM 2.

At Jobner the seed yield ranged from 1712.96 to

2800.93 kg/ha. Mean performance of the entries evaluated in CVT over 2009-10 and 2010-11 revealed superior performance of FGK-37 yielding 2410.65 kg/ha followed by FGK-36 (2202.55 kg/ha), FGK-31 (2182.87 kg/ha), FGK-30 (2172.46 kg/ha), RMT-361 check (2096.99 kg/ha), FGK-33 (2023.38 kg/ha), FGK-34 (2023.15 kg/ha) and FGK-28 (2010.65 kg/ha), while lowest seed yield of 1563.66 kg/ha was recorded by Local check.

Out of Fifteen genotypes of Fenugreek were tested at Jabalpur, FGK 34 registered maximum plant height (90.27 cm), number of primary branches (7.89), number days to early maturity (129 days), pod / plant (62.93), seeds /pod (16.24) & yield (3.39/plant & 1.63 t/ha).

Out of sixteen entries were evaluated, the entry FGK-27 (532.98 kg/ha) recorded maximum yield and among the checks RMT-361 (451.04 kg/ha) recorded the highest yield at Raigarh (Table 41)

Table 41. Yield and yield related attributes of CVT entries of fenugreek at Raigarh

Entry	Plant Height (cm)	No. branches /plant	Pods/ plant	Yield (kg/plot)	Yield (kg/ha)	Powdery mildew	Root rot
FGK-26	67.46	5.45	20.63	0.427	444.792	MR	S
FGK-27	68.38	6.36	18.47	0.512	532.986	MR	MR
FGK-28	58.47	8.87	26.94	0.304	317.014	MR	MR
FGK-29	55.46	6.35	16.46	0.311	323.958	MR	S
FGK-30	58.32	7.37	24.75	0.342	356.597	S	MR
FGK-31	62.52	6.49	22.65	0.269	280.556	S	MR
FGK-32	63.23	7.33	21.78	0.163	170.139	MR	MR
FGK-33	57.46	5.38	13.37	0.174	180.903	MR	MR
FGK-34	56.54	7.49	24.28	0.189	197.222	S	S
FGK-35	58.64	5.98	17.96	0.304	316.319	MR	S
FGK-36	43.76	6.48	22.46	0.354	368.750	MR	MR
FGK-37	51.38	5.39	14.86	0.367	382.639	MR	MR
FGK-38	53.67	6.98	21.78	0.341	355.556	S	S
Hisar Sonali (check)	66.76	5.73	13.57	0.362	376.736	MR	MR
RMT-361 (check)	71.64	6.38	21.48	0.433	451.042	MR	MR
Local methi (check)	54.67	5.73	12.75	0.182	189.410	MR	MR
CV% CD (0.05)					13.57 43.67		



In CV T at Kumarganj, NDM-25 (check) recorded maximum seed yield (16.87 q/ha) followed by check FGK-37 (16.24 q /ha) showing 1.5 % increases in yield over check Hisar Sonali.

At Pantnagar maximum seed yield (3180.56 kg/ha) was recorded by FGK-27, followed by FGK-37 (3138.89 kg/ha), Hisar Sonali and National Check (3138.89 kg/ha).

At Ajmer among the test entries FGK-32 registered maximum seed yield i.e. 22.84 q/ha that was on par with FGK-27. Of the sixteen entries evaluated in CVT at Udaipur, entry FGK 28 recorded maximum yield of 2789 kg/ha followed by FGK -27 (2595 kg/ha) and FGK 29 (2494 kg/ha), while lowest yield of 1761 kg/ha was noticed in Local check.

FGK/CI/3 Varietal Evaluation Trial

FGK/CI/3.2 Initial Evaluation Trial 2009

(Guntur)

Among the twelve entries tested, at Guntur, LFC-98 recorded significantly highest yield of 562 kg/ha followed by LFC-120 with 520.8 kg/ha and LFC-93 with 461.8 kg/ha which were superior over check LS-1 (301.9 kg/ha) and PEB (416.6 kg/ha).

FGK/CI/3.3 Initial Evaluation Trial 2009

(Jobner, pantnagar)

At Jobner mean performance of the entries evaluated in IET over 2009-10 to 2011-12 revealed superior performance of UM-126 yielding 2373.92 kg/ha followed by UM-124 (2192.28 kg/ha), UM-100 (22125.15 kg/ha), UM-222 (2112.81 kg/ha), UM-137 (2037.81 kg/ha), UM-136 (1965.74 kg/ha) and RMt-1 check (1927.16 kg/ha), while lowest mean seed yield of 1507.25 kg/ha was recorded by Local check.

The significant differences were observed for all the characters except pod length at Pantnagar. Maximum seed yield (2981.48 kg/ha) was registered by PM (C)-1, followed by Pant Ragani as local check (2518.52 kg/ha).

FGK/CI/3.4 Initial Evaluation Trial 2010

(Jobner, Dholi, Hisar)

In an IET at Jobner fourteen entries were evaluated and the seed yield ranged from 1879.63 to 3027.78 kg/ha (Table 42). Mean performance of the entries evaluated in IET over 2009-10 and 2010-11 revealed superior performance of UM-126 yielding 2595.61 kg/ha followed by UM-222 (2419.22 kg/ha), UM-124 (2378.71 kg/ha), UM-100 (2250.23 kg/ha), UM-137 (2193.29 kg/ha), RMt-361 check (2138.43 kg/ha), UM-325 (2128.48 kg/ha), UM-228 (2121.53 kg/ha) and UM-136 (2052.78 kg/ha), while lowest seed yield of 1671.99 kg/ha was noticed in Local check.

Table 42. Initial Evaluation Trial of fenugreek (Rabi 2009 to 2011) at Jobner

Name of Entry	Seed Yield (kg/ha)			Mean
	2009-10	2010-11	Total	
UM-100	1528.24	2972.22	4500.46	2250.23
UM-124	1873.15	2884.26	4757.41	2378.71
UM-126	2163.43	3027.78	5191.21	2595.61
UM-136	1661.11	2444.44	4105.55	2052.78
UM-137	1770.83	2615.74	4386.57	2193.29
UM-140	1640.28	2194.44	3834.72	1917.36
UM-193	1795.83	2240.74	4036.57	2018.29
UM-222	2088.43	2750.00	4838.43	2419.22
UM-228	1766.20	2476.85	4243.05	2121.53
UM-325	1872.69	2384.26	4256.95	2128.48



At Dholi among five out yielded entries, RM-188 recorded the maximum yield per plot (1.17 kg/4.8m²) and projected yield (2.19 t/ha) and increased yield (71.09%) over check variety Rajendra Kanti followed by RM-194 (1.08 kg/4.8m²) with (2.03 t/ha) projected yield and (58.59%) increased yield over check.

At Hisar the initial evaluation trial (IET) in fenugreek was conducted with nine accessions along with Hisar Sonali as check and maximum mean seed yield was recorded by HM-425 (3090 kg/ha) followed by HM-257 (2947 kg/ha) showing an increase of 30.1 and 24.1% over Hisar Sonali (check), respectively.

FGK/CI/3.5 Initial Evaluation Trial 2011

(Pantnagar & Jagudan)

The significant differences were observed for all the characters except pod length at Pantnagar. Maximum seed yield (2981.48 kg/ha) was recorded by PM (C)-1, followed by Pant Ragani as local check (2518.52 kg/ha). The yield differences were found non significant among entries during the year at Jagudan.

FGK/CM/4 Nutrient Management Trial

FGK/CM/4.2 Identification of drought/tolerance source in fenugreek

(Jobner)

At Jobner among the genotypes evaluated, UM 24 had the highest mean yield in the irrigated conditions followed by UM 29 and RMt 1. In drought conditions, UM 36 followed by UM 26 and RMt 1 were the top yielders. Thus RMt 1 was the best genotype for both types of environments. Based on drought tolerance indices namely, TOL, SSI and STI, UM 11 followed by UM 24 were found to be most drought tolerant,

UM 5 was the least tolerant among the genotypes tested.

Based on the average yield over the three years, RMt 1 followed by UM 29, UM 13 were the top yielders in irrigated conditions. Similarly in drought conditions, UM 36, followed by UM 26, UM 10 were the top yielders. UM 10, UM 8, UM 13, UM 26 and RMt 1 were the stable genotypes over the years and environments.

FGK/CM/4.5 Evaluation of PGPR bioformulations on seed spices

(Jobner, Guntur, Kumarganj, Hisar, Jagudan)

At Jobner the results indicated that seed treatment with bioformulation FK 14 + FL 18 recorded significantly higher number of pods per plant, number of seeds per pod and seed yield over the control. The control and all other treatments were also significantly superior over local control.

Among the three treatment combinations evaluated, highest yield was obtained for the treatment, FL 18 (595.1 Kg/ha) followed by FK14 (590.5 kg/ha) and FK14+ FK18 (590.5 kg/ha) which were on par and significantly superior to control (524.1 kg/ha) at Guntur.

At Kumarganj maximum seed yield of 1661 kg/ha was recorded by bioformulation of FI-18 + FK14 (Table 43). At Hisar the maximum seed yield (2082 kg/ha) was recorded by treatment T3 - Bioformulation of FK 14+ FL 18 followed by treatment T1 - Bioformulation of FK 14 (2054 kg/ha). At Jagudan growth and yield attributes as well as yield of fenugreek crop were not influenced significantly due to different strains of Rhizobacteria.



Table 43. Effect of *Rhizobacteria* bioformulations (PGPR) on growth and seed yield of fenugreek at Kumarganj (2011-12)

Treatments	Plant height (cm)	Branches / plant	Pods / plant	Pod length (cm)	Seeds / pod	Seed yield (kg/ha)
Rhizobacteria FK 14	109.2	6.3	102	8.5	17.5	2054
Rhizobacteria FL 18	114.2	6.4	107	8.6	16.8	2050
Rhizobacteria FK 14+ FL 18	113.7	7.0	111	8.8	17.5	2082
Control	105.4	6.1	106	8.3	15.9	1855
Local variety	102.7	6.4	107	8.6	16.4	1946
C D (0.05)	8.6	0.4	5.0	0.3	0.4	88.3

TECHNOLOGIES DEMONSTRATED UNDER AICRPS COORDINATING CENTERS (2011-2012)

Centres /Technologies demonstrated

I Panniyur - (Kerala Agricultural University)

1. Management of Phytophthora foot rot disease of black pepper

II Coimbatore – (Tamil Nadu Agril. Univeristy)

2. Integrated nutrient management in Turmeric

III Guntur - (Acharya N.G. Ranga Horticultural University)

3. Demonstrations of the improved high yielding coriander variety for rainfed conditions (Sudha –LCC 128)
4. Use of growth regulators for enhancing seed set and yield in coriander

IV Jobner - (Rajasthan Agricultural University)

5. Demonstrations of the improved high yielding varieties of coriander(RCr 480)
6. Demonstrations of the improved high yielding varieties of cumin (RZ 223)
7. Demonstrations of the improved high yielding varieties of fennel (RF 143)

V Jagudan - (SD Agricultural University)

8. Demonstration of wilt resistant variety of cumin (GC -4)
9. Demonstration of the high yielding variety of fennel (GF -11)
10. Demonstration of the high yielding variety of fenugreek (Guj. Methi -2.)

VI Hisar - (Chaudharay Charan Singh Haryana Agril. University)

11. Demonstration of the of the leafy coriander variety (Hisar Bhoomit)
12. Response of coriander to micronutrients

VII Dholi - (Rajendra Agril. University)

13. Response of ginger to micronutrients



VIII Pundibari - (Uttara Banga Krishi Vishwa Vidyalaya North Bengal Campus)

14. Efficacy of biofertiliser using *Azospirillum* on ginger

IX Sirsi -(University of Agricultural Sciences-Dharward)

15. Management of *Phytophthora* foot rot of black pepper under arecanut based cropping system

X Chinthapalli ((Acharya N.G. Ranga Horticultural University)

16. Management of *Phytophthora* foot rot and slow decline of black pepper

XI Pampadumpara - (Kerala Agricultural University)

17. Demonstration of cardomom variety(Pv -2)

XII Yercaud - (Tamil Nadu Agricultural University)

18. Management of *Phytophthora* foot rot of black pepper

XIII Raigarh - (Indira Gandhi Krishi Vishwa Vidyalaya)

19. Integrated disease management in ginger

XIV Dapoli - (Konkan Krishi Vidyapeeth)

20. High yielding nutmeg variety(Konkan Swad)

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LIST OF RESEARCH PROJECTS

PROJECT CODE	TITLE	CENTERS
BLACK PEPPER		
PEP/CI/1	Genetic Resources	
PEP/CI/1.1	Germplasm collection, characterization, evaluation and conservation	Chintapalli, Dapoli, Panniyur, Pundibari, Sirsi, Ambalavayal & Yercaud
PEP/CI/2	Hybridization Trial	
PEP/CI/2.1	Intervarietal hybridization to evolve high yielding varieties	Panniyur
PEP/CI/3	Coordinated Varietal Trial (CVT)	
PEP/CI/3.2	CVT 2000 – Series V	Chintapalli, Pampadumpara, Panniyur, Sirsi & Ambalavayal
PEP/CI/3.3	CVT 2006 – Series VI	Chintapalli, Dapoli, Pampadumpara, Sirsi & Yercaud
PEP/CI/3.4	Evaluation of grafts, orthotropic and runner shoots in black pepper	Ambalavayal, Panniyur, Sirsi Yercaud & Thadiyankudasai*
PEP/CM/4	Nutrient Management Trial	
PEP/CM/4.4	Development of organic package for spices based cropping system – Observational trial	Chintapalli, Sirsi, Panniyur, & Dapoli
PEP/CM/4.5	Organic farming in black pepper – 2006	Panniyur, Dapoli, Pechiparai, Sirsi & Yercaud
PEP/CP/5	Disease Management Trial	
PEP/CP/5.1	Adaptive trial on management of <i>Phytophthora</i> foot rot of black pepper in farmers field	Ambalavayal
PEP/CP/5.3	Trial on management of <i>Phytophthora</i> foot rot of black pepper in new plantation	Chintapalli, Dapoli, Panniyur, Pampadumpara, Sirsi
PEP/CP/5.4	Effectiveness of new molecules of fungi toxicants against <i>Phytophthora</i> foot rot of black pepper in existing plantation	Sirsi, & Chintapalli
* Testing Centre		
PEP/CP/6	Pest Management Trial	
PEP/CP/6.2	Management of <i>Erythrina</i> gall wasp, a popular standard of black pepper	Mudigere & Pampadumpara
CARDAMOM		

PROJECT CODE	TITLE	CENTERS
CAR/CI/1	Genetic Resources	
CAR/CI/1.1	Germplasm collection, characterization, evaluation and conservation	Mudigere & Pampadumpara
CAR/CI/2	Hybridization	
CAR/CI/2.2	Hybridization & selection in cardamom	Mudigere
CAR/CI/3	Coordinated Varietal Trial	
CAR/CI/3.5	CVT 2005-Series V	Pampadumpara, Mudigere & Myladumpara
CAR/CI/4	Varietal Evaluation Trial (VET)	
CAR/CI/4.1	Initial evaluation trial – I	Mudigere
CAR/CI/4.2	Initial evaluation trial – II	Mudigere
CAR/CM/5	Nutrient Management Trial	
CAR/CM/5.1	Effect of different irrigation schedule and fertilizers on yield of cardamom	Mudigere
CAR/CM/5.2	Effect of fertigation on yield of cardamom through drips	Pampadumpara
CAR/CM/5.3	Organic farming in cardamom	Mudigere & Pampadumpara
CAR/CM/5.4	Liming in Cardamom	Pampadumpara
CAR/CP/6	Pest and Disease Management Trial	
CAR/CP/6.4	Management of Cardamom root grub through entomopathogenic nematodes	Pampadumpara
CAR/CP/6.7	Evaluation of new insecticides/biopesticide in cardamom against thrips and shoot and capsule borer	Mudigere & Pampadumpara
CAR/CP/6.8	Comparison of effect of chemical treatments as well as biocontrol agents against pseudostems rot of cardamom	Pampadumpara

LARGE CARDAMOM

LCA/CI/1	Germplasm collection and evaluation of large Cardamom	Gangtok
LCA/CP/1.1	Evolving disease & pest tolerant lines in large Cardamom	Gangtok
LCA/CP/1.2	Integrated pest and disease management in large cardamom	Gangtok



PROJECT CODE	TITLE	CENTERS
GINGER		
GIN/CI/1	Genetic Resources	
GIN/CI/1.1	Germplasm collection, characterization, evaluation and conservation	Dholi, Kumarganj, Pottangi, Pundibari & Solan
GIN/CI/2	Coordinated Varietal Trial	
GIN/CI/2.3	CVT 2006 – Series VII	Pottangi & Pundibari
GIN/CP/6.6	Management of soft rot of ginger (Biofumigation using Mustard)	Solan, Chintapalli, Pundibari, Kumarganj & Raigarh
GIN/CP/6.7	Management of soft rot of ginger (Biofumigation using cabbage)	Solan, Chintapalli, Kumarganj, Ambalavayal, Raigarh & Pundibari
GIN/CP/6.8	Management of bacterial wilt of ginger (Biofumigation using mustard)	Solan , Ambalavayal& Pundibari
GIN/CP/6.9	Management of bacterial wilt of ginger (Biofumigation using cabbage)	Dholi, Solan, Ambalavayal, Pottangi, Pampadumpara & Pundibari
GIN/CP/6.10	Efficiency of different fungicide against leaf spot disease of ginger including new molecules	Pundibari
TURMERIC		
TUR/CI/1	Genetic Resources	
TUR/CI/1.1	Germplasm collection, characterization, evaluation and conservation	Coimbatore, Dholi, Pasighat, Kammarapalli, Kumarganj, Pottangi & Raigarh
TUR/CI/2	Coordinated varietal trial	
TUR/C1/2.4	Coordinated Varietal Trial - 2009	Chintapalli, Kammarapalli, Dholi,Coimbatore, Kumarganj, Pottangi, Pundibari, Pasighat, Pantnagar, Raigarh & Navasari
TUR/CI/3	Varietal evaluation trial	
TUR/CI/3.2	Initial Evaluation Trial 2006	Kumarganj, Pottangi, Dholi & Pundibari
TUR/CI/3.3	Initial Evaluation Trial 2010	Pantnagar
TUR/C1/3.4	Initial Evaluation Trial 2009	Dholi
TUR/CI/3.5	Genotype x Environmental interaction on quality	Chintapalli, Kammarapalli, Pottangi, Kumarganj, Pundibari, Coimbatore, Mizoram & Kalyani

PROJECT CODE	TITLE	CENTERS
TUR/CI/4	Quality Evaluation	
TUR/CI/4.1	Quality evaluation of germplasm	Coimbatore
TUR/CM/5	Nutrient Management Trial	
TUR/CM/5.2	Effect of organic farming in turmeric	Pottangi, Raigarh, Pundibari
TUR/CM/5.4	Efficacy of biocontrol agents for control of rhizome rot of turmeric	Pottangi
TUR/CM/5.5	Standardization of water requirement for turmeric through drip irrigation	Coimbatore, Jagtial, Kumarganj, & Kammarapalli
TUR/CM/5.6	Standardization of fertigation in turmeric	Coimbatore & Kammarapalli
TUR/CM/5.7	Effect of micronutrients on turmeric	Dholi, Kumarganj & Pundibari
TUR/CM/5.8	Studies on the effect of rhizome size and nursery on growth and yield of turmeric	Chintapalli, Coimbatore
TUR/CM/6	Post Harvest Technology	
TUR/CM/6.1	Standardization of processing in Turmeric	Calicut
TUR/CP/7	Disease Management Trial	
TUR/CP/7.1	Survey and identification of disease causing organisms in turmeric and screening of turmeric germplasm against diseases	Coimbatore, Pundibari, Raigarh & Dholi
TUR/CP/7.2	Management of foliar disease of turmeric	Chintapalli, Pottangi, Kumarganj, Pundibari, Kammarapalli, Raigarh & Coimbatore
TREE SPICES		
TSP/CI/1	Genetic Resources	
TSP/CI/1.1	Germplasm collection, characterization, evaluation and conservation of clove, nutmeg and cinnamon	Dapoli & Pechiparai
TSP/CI/2	Coordinated Varietal Trial	
TSP/CI/2.1	CVT 1992 – Clove	Pechiparai
TSP/CI/2.2	CVT 2001- Nutmeg	Dapoli & Pechiparai
TSP/CI/2.3	CVT 2001 – Cassia	Pechiparai & Dapoli
CORIANDER		CORIANDER
COR/CI/1	Genetic Resources	



PROJECT CODE	TITLE	CENTERS
COR/CI/1.1	Germplasm collection, description, characterization, evaluation, conservation and screening against diseases	Dholi, Guntur, Hisar, Jagudan, Jobner & Kumarganj
COR/CI/1.2	Multilocation Evaluation of germplasm	Jobner
COR/CI/2	Coordinated Varietal Trial	
COR/CI/2.4	Coordinated Varietal Trial 2009 – Series – VIII	Ajmer, Dholi, Guntur, Hisar, Jabalpur, Jagudan, Jobner, Kumarganj, Navasari, Pantnagar, Periyakulam, Raigarh, Udaipur & Coimbatore
COR/CI/2.6	Coordinated varietal trial on coriander (Leafy type during off season) CVT 2010	Guntur, Ajmer, Coimbatore & Periyakulam**
**Testing centre		
COR/CI/3	Varietal Evaluation Trial	
COR/CI/3.1	Initial evaluation trial 2010	Dholi, Jobner & Jagudan
COR/CI/3.2	Initial evaluation trial 2010 (Leaf purpose)	Pantnagar
COR/CI/3.3	Initial Evaluation Trial 2010 (Seed purpose)	Pantnagar, Kumarganj, Guntur & Hisar
COR/CI/3.4	Initial Evaluation Trial 2011	Jobner, Kota (Udaipur) & Jagudan
COR/CI/3.5	Production of leafy type of coriander in off season	Kumarganj
COR/CI/4	Quality Evaluation Trial	
COR/CI/4.1	Quality evaluation in coriander	Jobner
COR/CM/5	Nutrient Management Trial	
COR/CM/5.3	Identification of drought/ alkalinity tolerant source in coriander	Kumarganj & Jobner
COR/CM/5.4	Nutrient supplementation through organic manures for growth and yield of coriander	Coimbatore, Dholi, Hisar, Jagudan, Jobner, Kumarganj & Raigarh
COR/CM/5.5	Effect of micronutrients on yield of coriander	Coimbatore & Dholi
COR/CM/5.6	Irrigation management for sustainable coriander production	Guntur
COR/CM/5.7	Nutrient management in off season coriander leaf production	Periyakulam*, Guntur, Ajmer & Coimbatore
* Testing centre		
COR/CP/6	Disease Management Trial	



PROJECT CODE	TITLE	CENTERS
COR/CP/6.2	Survey to identify the disease incidence collection and identification of causal organism	Dholi
COR/CM/6.3	Management of stem gall disease of coriander	Pantnagar, Jabalpur, Coimbatore, Kumarganj & Raigarh
COR/CM/6.5	Evaluation of PGPR bioformulation of coriander	Coimbatore, Guntur, Hisar, Jagudan ,Ajmer & Raigarh

CUMIN

CUM/CI/1 Genetic Resources

CUM/CI/1.1	Germplasm collection, characterization, evaluation conservation and screening against diseases	Jagudan & Jobner
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CUM/CI/1.2	Multilocation Evaluation of germplasm	Jobner
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CUM/CI/2 Coordinated Varietal Trial

CUM/CI/2.3	Coordinated Varietal Trial – 2009	Jobner, Jagudan, Ajmer & Jabalpur
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CUM/CI/3 Varietal Evaluation Trial

CUM/CI/3.3	Initial evaluation trial -2009	Jobner, Jagudan
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CUM/CI/4 Quality evaluation trial -2008

CUM/CI/4.1	Quality evaluation in cumin	Jobner
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* Testing centre

CUM/CM/5 Nutrient Management trial

CUM/CM/5.1	Identification of drought tolerance	Jobner
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CUM/CP/6 Disease Management Trial

CUM/CP/6.1	Management of wilt and blight diseases in cumin	Jobner & Jagudan
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CUM/CP/6.2	Survey for identification of yellowing causing organisms in cumin	Jobner, Jagudan & Ajmer
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CUM/CM/6.4	Evaluation of PGPR bioformulation on cumin	Jagudan & Jobner
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FENNEL

FNL/CI/1 Genetic Resources



PROJECT CODE	TITLE	CENTERS
FNL/CI/1.1	Germplasm collection, characterization, evaluation, conservation and screening against diseases	Dholi, Hisar, Jagudan, Jobner & Kumarganj
FNL/CI/2	Coordinated Varietal Trial	
FNL/CI/2.4	Co-ordinated Varietal Trial - 2009-Series VII	Dholi, Hisar, Jabalpur, Jagudan, Jobner, Kumarganj, Pantnagar, Udaipur & Raigarh
FNL/CI/3	Varietal Evaluation Trial	
FNL/CI/3.1	Initial evaluation trial	Hisar, Kumarganj & Jagudan
FNL/CI/3.3	Initial evaluation trial 2011	Jobner
FNL/CI/4	Quality Evaluation Trial	
FNL/CI/4.1	Quality evaluation in fennel	Jobner
FNL/CM/5	Nutrient Management Trial	
FNL/CM/5.2	Identification of drought/alkalinity tolerance source in fennel	Kumarganj
FNL/CP/6	Disease Management Trial	
FNL/CP/6.1	Survey, identification of disease causing organisms and survey of germplasm against disease	Dholi
FNL/CP/6.2	Field evaluation of different insecticides/ botanicals against seed midge <i>Systole albipennis</i> walker fennel	Jagudan,
FNL/CM/6.3	Evaluation of PGPR bioformulation on fennel	Hisar, Jagudan, Ajmer & Raigarh

FENUGREEK

FGK/CI/1	Genetic Resources	
FGK/CI/1.1	Germplasm collection, characterization, evaluation, conservation and screening against diseases	Dholi, Hisar, Jagudan, Jobner, Kumarganj & Guntur
FGK/CI/2	Coordinated Varietal Trial	
FGK/CI/2.1	Coordinated Variety Trial 2009 series - VII	Ajmer, Coimbatore, Dholi, Guntur, Hisar, Jabalpur, Jagudan, Jobner, Kumarganj, Pantnagar, Raigarh & Udaipur
FGK/CI/3	Varietal Evaluation Trial	
FGK/CI/3.2	Initial evaluation trial 2009	Jabalpur & Guntur

PROJECT CODE	TITLE	CENTERS
FGK/CI/3.3	Initial evaluation trial 2009	Jobner & Kumarganj
FGK/CI/3.4	Initial evaluation trial 2010	Dholi, Jobner & Hisar
FGK/CI/3.5	Initial evaluation trial 2011	Pantnagar & Jagudan
FGK/CM/4	Nutrient Management Trial	
FGK/CM/4.2	Identification of drought/tolerance source in fenugreek	Jobner
FGK/CM/4.5	Evaluation of PGPR bioformulation on fenugreek	Jagudan, Jobner, Guntur, Hisar & Kumarganj



STAFF POSITION

PROJECT COORDINATOR'S OFFICE

1. Project Coordinator: Dr M Anandaraj
2. Principal Scientist (Hort.): Dr J Rema
3. Technical Information Officer: Dr Johny A Kallapurackal
4. Personal Assistant: Ms Alice Thomas
5. Supporting staff: Vacant

COORDINATING CENTRES

1. Cardamom Research Station, KAU, Pampadumpara

1. Breeder (Asst. Professor): Dr S Bijul
2. Agronomist (Hort.): Dr (Mrs.) T Maya
3. Jr. Entomologist: Dr R Narayana
4. Farm Assistant (Sel. Gr.): Mr C G Pradeep
5. Lab Assistant (Grade II): Mr Anil Kumar
6. Peon: Mr Shinoj Antony

2. Pepper Research Station, KAU, Panniyur

1. Pathologist (Asst. Professor): Dr Lulu Das
2. Jr. Breeder (Asst. Professor): Dr P M Ajith
3. Jr. Pathologist: Dr G Heera
4. Jr. Horticulturist (Agronomy): Smt T V Anupama
5. Farm Supervisor (Gr. II): Mr K Lakshmanan
6. Farm Supervisor (Sr. Gr.): Mr P P Muralidharan
7. Farm Supervisor (Gr. I): Mr P Krishnan
8. Lab Assistant (Gr. III): Ms Nirmala Chellath
9. Peon (Sel. Gr.): K Rajeev

3. Horticultural Research Station, UHS, Mudigere

1. Pathologist: Dr S D Rangaswamy
2. Agronomist (Hort.): Dr K M Devaraju
3. Breeder: Vacant
4. Jr. Entomologist: Dr D Jemla Naik
5. Technical Assistant: Mr Mahadevappa
6. Technical Assistant: Smt H R Manjula
7. Messenger: Ms Savithri

4. Horticultural Research Station, UHS, Sirsi

1. Jr. Pathologist: Dr M S Lokesh
2. Jr. Horticulturist: Mr Nagesh Naik
3. Technical Assistant: Mr B B Doddamani

5. Horticultural Research Station, TNAU, Yercaud

1. Agronomist (Hort.): Dr R Arulmozhiyan
2. Jr. Breeder (Hort.): Dr J Prem Joshua (Posted at HRS, Pechiparai)
3. Lab Assistant: Mr P Pappu

6. Department of Spices & Plantation Crops, TNAU, Coimbatore

1. Breeder (Horticulturist): Dr (Mrs) N. Shoba
2. Jr. Pathologist: Dr P Muthulakshmi
3. Agricultural Assistant: Mr R Swaminathan

7. Horticultural Research Station, Dr.YSR Horticultuyural University, Chintapalli

1. Horticulturist: Sri K Ravindra Kumar
2. Junior Pathologist: Sri K Sessa Kiran
3. Technical Assistant: Post filled on contract basis

8. Regional Agricultural Research Station, Dr.YSR Horticultural University, Kammarpally (Jagtial)

1. Jr. Pathologist: Sri Narasimha Rao
2. Jr. Horticulturist: Mrs K Uma Maheswari
3. Technical Assistant: Sri K Venkanna

9. Horticultural Research Station, Dr.YSR Horticultuyural University, Guntur

1. Horticulturist: Smt A Rajani
2. Jr. Breeder (Hort.): Sri K Giridhar
3. Sub Assistant: Sri Shaik Jilani Bhasha

10. Department of Vegetable Crops, Dr YSPUHF, Solan

1. Breeder (Olericulturist): Dr Happy Dev Sharma
2. Jr. Pathologist: Dr Meenu Gupta
3. Jr. Biochemist: Dr Vipin Sharma
4. Field Assistant: Mr Chunni Lal



11. High Altitude Research Station, OUAT, Pottangi

1. Breeder: Vacant
2. Jr. Breeder: Mr D K Dash
3. Technical Assistant: Mr L K Mishra
4. Technical Assistant: Vacant

12. Department of Genetics and Plant Breeding, SKN College of Agriculture, RAJAU, Jobner

1. Sr. Breeder: Dr E V D Sastry
2. Breeder: Dr Dhirendra Singh
3. Jr. Agronomist: Dr A C Shivran
4. Jr. Pathologist: Dr K S Shekhawat
5. Jr. Biochemist: Vacant
6. Technical Assistant: Dr S S Rajput
7. Technical Assistant: Mr S R Kumawat

13. Main Spices Research Station, SDAU, Jagudan

1. Pathologist: Dr K D Patel
2. Jr. Breeder: Mr D G Patel
3. Technical Assistant: Mr S R Chaudhari

14. Department of Vegetable Crops, CCS HAU, Hisar

1. Assistant Scientist (VC) : Dr Suresh Tehlan
2. Horticulturist/Oleoculturist : Dr T P Malik

15. Department of Horticulture, Tirhut College of Agriculture, RAU, Dholi

1. Horticulturist: Dr S P Singh
2. Jr. Pathologist: Dr A K Mishra
3. Technical Assistant: Dr A N Mishra

16. Department of Vegetable Science, NDUAT, Kumarganj

1. Horticulturist: Vacant (from 17th May 2010)
2. Jr. Pathologist: Dr R P Saxena
3. Jr. Breeder: Dr V P Pandey
4. Technical Assistant: Mr R K Gupta
5. Technical Assistant: Mr VK Singh

17. Department of Horticulture, UBKVV, Pundibari

1. Horticulturist: Vacant (Dr J C Jana, in-charge)
2. Jr. Breeder: Dr N Bhowmik (Study leave) Dr B C Saha, in-charge
3. Jr. Pathologist : Mr S Bandyopadhyay
4. Technical Assistant : Mr B Dutta
5. Technical Assistant : Ms Anupama Das

18. Department of Horticulture, KKV, Dapoli

1. Horticulturist: Dr R G Khandekar
2. Jr. Pathologist: Prof U A Gadre
3. Jr. Breeder: Prof U B Pethe
4. Technical Assistant: Mr D D Bhandari
5. Technical Assistant: Mr G D Bandre

19. Regional Agricultural Research Station, IGAU, Raigarh

1. Horticulturist: Vacant (from 11-3-2008)
2. Jr. Breeder: Smt. Roshni Bhagat
3. Jr. Pathologist: Dr A K Singh
4. Technical Assistant: Mr D S Kshatri
5. Technical Assistant: Vacant (From commencement of the project)

AICRPS - BUDGET PROVISION
ALL INDIA COORDINATED RESEARCH PROJECT ON SPICES
CENTREWISE AND HEADWISE RE 2011-12 (Final)

(Rs. In lakhs)

Name of the centre	Pay and Allowances		TA		RC		Tech. A (ICAR)	Total RC (ICAR)		Total		Grand	
	Total	ICAR	Total	ICAR	Total	ICAR		Total	ICAR	ICAR Share	State Share	Total	State Share
	1	2	3	4	5	6	7	8	9	10	11		
Pampadumpara (KAU)	21.733	16.300	0.600	0.450	2.40	1.800	0.05	1.850	18.600	6.200	24.800		
Panniyur (KAU)	59.413	44.560	0.800	0.600	3.20	2.400	0.05	2.450	47.610	15.870	63.480		
Mudigere (UHS)	61.866	46.400	0.800	0.600	3.20	2.400		2.400	49.400	16.466	65.866		
Sirsi (UHS)	60.666	45.500	0.400	0.300	1.60	1.200	0.05	1.250	47.050	15.683	62.733		
Yercaud (TNAU)	30.200	22.650	0.400	0.300	1.60	1.200	0.05	1.250	24.200	8.067	32.267		
Coimbatore (TNAU)	33.573	25.180	0.400	0.300	6.93	5.850	0.05	5.900	31.380	10.460	41.840		
Chintapalli (APHU)	14.733	11.050	0.400	0.300	1.60	1.200	0.05	1.250	12.600	4.200	16.800		
Kammarpally (APHU)	11.333	8.500	0.400	0.300	1.60	1.200		1.200	10.000	3.334	13.334		
Guntur (APHU)	15.466	11.600	0.400	0.300	1.60	1.700	0.10	1.800	13.700	4.567	18.267		
Solan (YSPUHF)	63.133	47.350	0.600	0.450	2.40	1.800		1.800	49.600	16.534	66.134		
Pottangi (OUAT)	23.666	17.750	0.400	0.300	1.60	1.200		1.200	19.250	6.417	25.667		
Jobner (RAJAU)	68.666	51.500	1.000	0.750	4.00	3.000	0.15	3.150	55.400	18.467	73.867		
Jagudan (GAU)	23.133	17.350	0.400	0.300	1.60	1.200	0.15	1.350	19.000	6.333	25.333		
Hisar (HAU)	51.426	38.570	0.400	0.300	1.60	1.200	0.10	1.300	40.170	13.390	53.560		
Dholi (RAU)	47.586	35.690	0.400	0.300	3.60	2.700	0.05	2.750	38.740	12.913	51.653		
Kumarganj (NDUAT)	77.333	58.000	0.600	0.450	2.40	1.800		1.800	60.250	20.083	80.333		
Pundibari (UBKVV)	37.000	27.750	0.600	0.450	2.40	1.800	0.05	1.850	30.050	10.017	40.067		
Dapoli (KKV)	63.980	47.985	0.600	0.450	2.40	1.800	0.05	1.850	50.285	16.762	67.047		
Raigarh (IGKVV)	17.400	13.050	0.600	0.450	2.40	2.45875	0.05	2.50875	16.00875	5.336	21.345		
AICRPS Workshop						0.31875		0.31875	0.31875		0.31875		
Total	782.306	586.735	10.200	7.650	48.130	38.2275	1.000	39.2275	633.6125	211.098	844.7110		

**ALL INDIA COORDINATED RESEARCH PROJECT ON SPICES
CENTREWISE AND HEADWISE RE 2011-12**

(Rs. In lakhs)

Name of the centre	Pay and Allowances		TA	RC		Tech. A (ICAR)	Total RC (ICAR)	Total		State Share	Grand Total
	Total	ICAR		Total	ICAR			ICAR Share	Total		
Name of the centre	1	2	3	4	5	6	7	8	9	10	11
Ambalavayal(KAU)	-	-	0.150	0.1125	2.80	2.100	-	2.100	2.2125	0.7375	2.950
Peechiparai (TNAU)	-	-	0.150	0.1125	2.80	2.100	-	2.100	2.2125	0.7375	2.950
Gangtok (ICRI)	-	-	0.150	0.1125	2.80	2.100	-	2.100	2.2125	0.7375	2.950
Sakleshpur (ICRI)	-	-	0.150	0.1125	2.80	2.100	-	2.100	2.2125	0.7375	2.950
Myladumpara (ICRI)	-	-	0.150	0.1125	2.80	2.100	-	2.100	2.2125	0.7375	2.950
ICAR R C NEHR, Barapani	-	-	0.150	0.1125	2.888	2.166	-	2.166	2.2785	-	2.2785
ICAR R C NEHR, Mizoram	-	-	0.150	0.1125	2.888	2.166	-	2.166	2.2785	-	2.2785
ICAR R C NEHR, Gangtok	-	-	0.150	0.1125	2.890	2.168	-	2.168	2.2805	-	2.2805
Pasighat (CAU)	-	-	0.150	0.1125	0.80	0.600	-	0.600	0.7125	-	0.7125
Pantnagar (GBPUAT)	-	-	0.150	0.1125	0.80	0.600	-	0.600	0.7125	0.2375	0.950
Kanke (BIRSAAU)	-	-	0.150	0.1125	0.80	0.600	-	0.600	0.7125	0.2375	0.950
Kalyani (BCKVV)	-	-	0.150	0.1125	0.80	0.600	-	0.600	0.7125	0.2375	0.950
Udaipur (MPUAT)	-	-	0.150	0.1125	0.80	0.600	-	0.600	0.7125	0.2375	0.950
Navasari (NAU)	-	-	0.150	0.1125	0.80	0.600	-	0.600	0.7125	0.2375	0.950
Jabalpur (JNKV)	-	-	0.150	0.1125	0.80	0.600	-	0.600	0.7125	0.2375	0.950
Total	-	-	2.250	1.6875	28.266	21.200	-	21.200	22.8875	5.1125	28.000
Grant Total	782.306	586.735	12.450	9.3375	76.396	59.4275	1.000	60.4275	656.500	216.2105	872.7105

ALL INDIA COORDINATED RESEARCH PROJECT ON SPICES

STATEMENT OF FUND RELEASE TO AICRP CENTERS 2011-12

(Rs. In lakhs)

Name of the centres	Amount Released		Technology Assessment	Additional Recurring Contingency	Additional Pay & Allowances 2011-12	Grand Total
	I & II half	II half				
Pampadumpara (KAU)	3.650	3.650	0.050		11.25	18.60
Panniyur (KAU)	5.525	4.525	0.050		37.51	47.61
Mudigere (UAS-B)	13.00	-			36.40	49.40
Sirsi (UAS-D)	4.550		0.050		42.45	47.05
Yercaud (TNAU)	5.050	-	0.050		19.10	24.20
Coimbatore (TNAU)	5.050	-	0.050	4.65	21.63	31.38
Chintapalle (APHU)	5.550	-	0.050		7.00	12.60
Jagtial (APHU)	5.000	-			5.00	10.00
Guntur (APHU)	4.100	-	0.100	0.50	9.00	13.70
Solan (YSPUHF)	5.750	-			43.85	49.60
Pottangi (OUAT)	3.500	-			15.75	19.25
Jobner (RAJAU)	10.900	-	0.150		44.35	55.40
Jagudan (GAU)	9.650	-	0.150		9.20	19.00
Hisar (HAU)	8.600	-	0.100		31.47	40.17
Dholi (RAU)	8.550	-	0.050	1.50	28.64	38.74
Kumarganj (NDUAT)	9.250	-			51.00	60.25
Pundibari (UBKVV)	9.300	-	0.050		20.70	30.05
Dapoli (KKV)	11.035	-	0.050		39.20	50.285
Raigarh (IGKVV)	3.650	3.650	0.050	0.65875	8.00	16.00875
Co-opting/Voluntary	22.8875					22.8875
AICRPS Workshop				0.31875		0.31875
Grand Total	154.5475	11.825	1.000	7.6275	481.50	656.50

Note: An amount of Rs. 2.00 Lakhs for the studies of standardization of root stock resistance to quick wilt and slow wilt diseases in black pepper and Rs. 2.00 Lakhs for quality analysis work of seed spices at TNAU, Coimbatore / Thadiyankudisai centers. Rs. 0.65 Lakhs released to TNAU Periyakulam (Testing centres) for evaluation of off season leafy coriander trial and Rs. 0.50 Lakhs to APHU, Hyderabad for the performance studies of seed spices of NRC on seed spices in various agro climatic regions. Additional Recurring contingency of Rs. 1.50 Lakhs to Dholi and Rs. 0.65875 to Raigarh centres were released and amount of Rs. 0.31875 Lakhs spent for XXII AICRPS Workshop.

WEATHER DATA

Chintapalli

Month	Rainfall (mm)	No. of Rainy days	Temperature (°C)		RH (%)	
	Actual		Actual	Max.	Min.	Max.
April 2011	5.0	1	31.1	14.4	32.6	73.2
May	15.0	2.0	32.6	21.1	69.5	49.5
June	59.0	5.0	29.0	22.4	74.6	66.0
July	242.2	12.0	26.9	21.4	82.4	78.0
August	319.4	18.0	26.2	21.5	89.3	85.0
September	169.0	11.0	26.5	20.7	86.0	74.7
October	42.4	3.0	28.2	17.3	82.3	58.3
November	17.0	1.0	26.7	11.4	81.9	45.8
December	20.0	3.0	26.0	10.5	86.3	49.2
January, 2012	9.0	2.0	25.2	11.1	85.8	46.8
February	3.6	1.0	29.1	11.6	72.8	33.7
March	11.0	1.0	31.8	15.0	71.9	69.0

Coimbatore

Month	Rainfall (mm)	No. of Rainy days	Temperature (°C)		RH (%)	
	Actual		Actual	Max.	Min.	Max.
April 2011	168.8	7	22.9	33.4	89	49
May	24.8	3	23.0	34.2	92	52
June	93.0	7	23.0	30.7	84	57
July	32.3	4	23.2	30.7	83	57
August	7.1	1	22.9	31.3	87	57
September	67.9	4	22.2	31.9	88	59
October	305.3	14	22.6	31.6	91	59
November	243.1	10	20.8	28.7	90	61
December	11.6	1	19.1	24.3	89	62
January 2012	1103.5		18.4	29.7	89	46
February	1.0	-	19.4	32.3	83	35
March	-	-	22.5	34.9	84	36


Dapoli

Month	Rainfall (mm)	No. of Rainy days	Temperature (°C)		RH (%)	
	Actual		Actual	Max.	Min.	Max.
April 2011	0.0	0.0	32.5	20.9	94.1	63.7
May	1.4	0.0	32.9	23.5	91.3	64.0
June	918.4	27.0	29.3	24.8	93.0	87.7
July	2034.2	30.0	28.1	23.1	97.9	91.8
August	1336.1	29.0	28.1	23.3	97.3	95.2
September	524.5	13.0	28.7	22.8	96.0	84.6
October	115.6	8.0	32.0	20.9	94.7	67.7
November	2.0	0.0	33.1	17.8	92.0	46.7
December	0.0	0.0	32.5	14.1	91.9	53.9
January 2012	0.0	0.0	29.8	11.8	92.5	58.1
February	0.0	0.0	32.6	12.1	90.3	48.3
March	0.0	0.0	32.2	14.7	91.1	52.4

Dholi

Month	Rainfall (mm)	Temperature (°C)		RH (%)	
	Actual	Max.	Min.	Max.	Min.
April 11	44.0	35.2	20.4	78	38
May	151.1	34.1	23.7	82	54
June	299.3	34.2	25.2	85	62
July	299.2	30.4	25.5	89	70
August	254.6	32.0	26.4	89	73
September	279.9	30.0	25.8	89	69
October	77.8	30.8	21.2	91	60
November	6.0	27.6	15.8	92	54
December	0.0	20.6	10.8	90	65
January 12	41.0	20.3	9.2	89	59
February	0.0	24.8	9.7	86	44
March	5.5	30.42	12.82	86	38

Guntur

Month	Rainfall (mm)	No. of Rainy days	Temperature (°C)		RH (%)	
	Actual	Actual	Max.	Min.	Max.	Min.
April 2011	26.3	3	36.5	24.8	82.4	53.7
May	9.6	2	41.7	27.9	75.0	41.4
June	52.4	6	38.8	27.8	79.0	53.0
July	265.2	14	35.7	25.9	70.5	54.0
August	244.6	14	32.6	25.4	78.9	63.4
September	64.0	8	34.7	25.8	75.0	54.0
October	62.8	5	34.4	24.3	76.9	59.8
November	0.0	0	32.3	20.2	77.8	48.9
December	58.6	2	31.3	18.8	85.0	48.5
January 2012	88.0	3	30.6	16.5	89.1	48.8
February	0.0	0	33.4	17.4	90.5	44.6
March	2.5	1	36.3	23.2	89.0	41.6

Hisar

Month	Rainfall (mm)	No. of Rainy days	Temperature (°C)		RH (%)	
	Actual	Actual	Max.	Min.	Max.	Min.
April 11	35.2	1	34.4	16.7	80.5	43.1
May	84.9	2	40.1	23.9	59.2	30.1
June	57.0	4	38.9	26.2	68.9	40.6
July	82.5	5	35.6	26.3	85.3	61.3
August	95.7	2	34.1	25.8	88.6	64.4
September	141.1	5	33.3	23.1	92.7	64.3
October	0.0	0	33.0	15.4	86.5	34.5
November	0.0	0	29.4	11.0	91.9	34.8
December	0.0	0	22.9	5.2	95.2	42.7
January 12	14.4	1	18.4	4.8	95.8	51.3
February	0.0	1	20.8	5.2	86.5	41.1
March	0.0	1	28.5	10.4	83.5	31.8


Jagudan

Month	Rainfall (mm)	No. of Rainy days	Temperature (°C)		RH (%)	
	Actual	Actual	Max.	Min.	Max.	Min.
April 2011	-	-	39.88	20.42	-	84
May	-	-	41.92	25.35	-	93.47
June	-	-	40.12	27	-	90.82
July	45.2	2.6	35.86	25.68	-	90.34
August	124.25	3.25	32.5	23.775	-	96
September	39.3	2.25	32.5	23.025	-	95.55
October	-	-	34.24	20.22	-	71.28
November	-	-	34.075	16.55	-	82.25
December	-	-	30	10.775	-	77.925
January 2012	1.0	1	26.72	7.84	-	80.32
February	-	-	27.925	8.85	-	80.425
March	-	-	33.2	12.9	-	74.65

Jobner

Month	Rainfall (mm)	No. of Rainy days	Temperature (°C)		RH (%)	
	Actual	Actual	Max.	Min.	Max.	Min.
April,11	000.4	-	37.0	18.6	53	20
May	-	-	42.0	26.0	67	30
June	055.4	5	38.4	27.3	65	42
July	083.2	9	34.0	25.7	82	57
August	116.8	12	31.3	28.9	92	72
September	081.6	8	32.0	22.4	89	58
October	-	-	34.0	14.9	73	24
November	-	-	30.3	10.8	79	30
December	-	-	25.2	5.4	86	34
January12	-	-	21.0	4.3	85	38
February	-	-	25.3	6.4	79	27
March	-	-	32.0	12.1	60	19
April	007.8	2	36.6	19.4	54	22

Kumarganj

Month	Rainfall (mm)	No. of Rainy days	Temperature (°C)		RH (%)	
	Actual	Actual	Max.	Min.	Max.	Min.
April 2011	0.0	0	37.3	18.2	53.7	21.5
May	31.4	5	38.5	24.4	68.9	36.0
June	233.8	12	35.2	26.2	78.5	54.5
July	240.8	12	32.7	26.5	87.4	69.2
August	412.7	14	32.6	26.2	89.9	73.8
September	295.9	12	32.1	25.5	91.3	72.7
October	0.0	0	32.0	17.5	87.6	59.4
November	0.0	0	28.4	13.7	90.9	54.0
December	0.0	0	21.9	7.9	90.0	62.2
January 2012	79.8	4	20.4	7.9	89.8	66.0
February	0.0	0	25.0	8.4	83.3	53.3
March	0.0	0	31.1	11.9	72.1	39.1

Pampadumpara

Month	Rainfall (mm)	No. of Rainy days	Temperature (°C)		RH (%)	
	Actual	Actual	Max.	Min.	Max.	Min.
April 2011	178.8	13	27.70	18.6	93	61
May	24	3	27.60	19.4	93	63
June	360.4	17	23.0	18.6	96.6	87.2
July	10.9	24	22.30	18.1	97.2	89.8
August	11.3	23	23.0	18.0	98.1	87.2
September	151.4	14	24.0	17.8	95.6	79.3
October	12.60	17	26.3	18.9	93.4	69.6
November	184	11	23.9	17.3	93.3	74.4
December	21	2	24.1	16.8	92	67.2
January 2012	6.8	1	24.1	15.1	89.2	54.3
February	0	0	26.30	16.0	84.3	44.4
March	2.4	1	29.10	18.6	88.1	44.6



Raigarh

Month	Temperature (°C)		RH (%)		Rainfall (mm)
	Max.	Min.	Max.	Min.	
January 2011	38.68	24.52	80.92	35	1.1554
February	42.925	26.55	76.55	29.375	0.6347
March	34.525	26.925	89.1	55.6	3.983
April	30.86	25.4	93.08	76.16	4.5772
May	29.325	25.575	95.95	83.695	5.8377
June	29.8	25.7	96.7	78.9	-
July	30.66	21.02	89.64	54.78	-
August	29.05	16.275	90.275	42.475	-
September	25.75	10.375	88.375	42.925	-
October	23.58	12.38	89.02	54.18	0.9906
November	29.025	14.225	82.575	37.275	-
December 2012	35.075	15.925	71.325	22.675	-

Solan

Month	Rainfall (mm)	No. of Rainy days	Temperature (°C)		Relative Humidity (%)
	Actual	Actual	Max.	Min.	
April, 2011	33.7	5	26.5	10.7	51
May	31.7	9	32.3	16.4	46
June	178.2	15	29.1	17.7	66
July	263.6	16	27.4	19.2	80
August	189.8	13	28.0	19.2	80
September	30.0	9	28.4	16.4	74
October	Nil	0	29.9	9.8	67
November	Nil	0	24.5	5.6	50
December	28.2	3	20.5	0.9	48
January, 2012	65.9	7	14.9	0.7	54
February	9.2	4	18.9	3.6	56
March	19.8	3	24.3	6.9	45



Sirsi

Month	Rainfall (mm)	No. of Rainy days	Temperature (°C)		RH (%)	
	Actual	Actual	Max.	Min.	Max.	Min.
April 11	44.60	4	32.8	86.3	56.6	19.4
May	46.30	1	27.1	89.3	73.5	20.0
June	714.70	26	26.0	91.1	86.1	19.6
July	672.60	29	26.0	92.1	87.7	19.1
August	425.10	29	27.0	93.8	86.4	19.2
September	423.30	20	31.6	91.7	80.2	18.9
October	109.80	10	31.6	86.4	64.0	20.9
November	53.20	2	30.4	84.0	50.7	16.7
December	0.00	0	30.3	85.9	62.1	14.0
January 12	0.00	0	30.5	81.8	57.8	12.9
February	0.00	0	33.1	83.7	28.1	13.9
March	0.00	0	34.5	86.5	38.4	18.3

Mudigere

Month	Rainfall (mm)	No. of Rainy days	Temperature (°C)		RH (%)	
	Actual	Actual	Max.	Min.	Max.	Min.
April-11	219.2	10	31.71	18.65	89.70	81.30
May	123.2	8	31.58	18.58	89.35	79.64
June	918.4	24	27.83	18.13	89.83	81.60
July	814.4	24	91.00	84.77	25.50	16.80
August	619.6	28	89.54	82.03	26.37	17.11
September	542.1	20	88.6	79.53	26.58	18.26
October	343.9	11	91.58	89.00	26.16	17.90
November	121.2	8	85.96	76.03	26.00	17.36
December	-	-	85.83	75.29	26.74	14.98
January-12	-	-	75.74	64.90	26.75	14.56
February	-	-	74.72	14.98	27.00	15.46
March	-	-	81.54	42.83	31.69	19.09



Pundibari

Month	Rainfall (mm)	No. of Rainy days	Temperature (°C)		RH (%)	
	Actual		Actual	Max.	Min.	Max.
April, 2011	96.4	5	29.4	18.9	85	66
May	275.0	16	30.5	23.1	89	72
June	491.8	16	33.9	25.3	88	71
July	362.2	15	30.8	25.3	90	84
August	427.2	16	31.7	25.2	94	90
September	387.9	7	31.2	25.1	91	88
October	18.0	1	29.8	17.2	93	81
November	18.3	3	26.8	16.4	91	74
December	0.0	0	21.3	11.4	93	69
January, 2012	2.5	2	21.2	9.6	99	57
February	9.0	2	25.0	10.9	99	46
March	7.0	1	29.1	15.2	94	37

Yercaud

Month	Rainfall (mm)	No. of Rainy days	Temperature (°C)		Relative Humidity (%)
	Actual		Actual	Max.	
March 2011	17.5	2	25.8	17.3	49.4
April	18.7	10	25.5	18.6	75.8
May	42.5	5	26.7	19.7	76.6
June	99.5	7	23.8	17.6	88.9
July	21.1	15	23.3	17.2	95.4
August	287.8	18	22.9	17.4	100
September	283.0	20	28.8	16.3	100
October	226.5	18	22.7	16.9	100
November	247.7	13	20.3	15.4	100
December	101.5	3	19.6	14.0	87.7
January 2012	-	-	21.0	13.5	75.2
February	-	-	22.6	15.9	50.0
March	5	1	24.5	17.9	54.6

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