CSIR-CIMAP

वार्षिक प्रतिवेदन
Annual Report
2017

सीएसआईआर–केन्द्रीय औषधीय एवं सगंध पौधा संस्थान, लखनऊ

CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow

वार्षिक प्रतिवेदन
Annual Report
2017

CSIR-Central Institute of Medicinal and Aromatic Plants

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From The Director's Desk....

I am delighted to present the annual report for 2017 during which CSIR-CIMAP was given the responsibility to lead the CSIR-Aroma Mission. By the end of this year, we also got the opportunity to play a key role in CSIR-Phytopharmaceutical Mission. This has been possible due to continuous efforts and inputs of our scientists, technical staff, research scholars and other supporting staffs who not only dedicated themselves to perform excellent scientific research but also to transfer the generated knowledge to the field and industries.

The CSIR flagship program, Aroma Mission, led by CSIR-CIMAP involves CSIR-NBRI Lucknow, CSIR-IHBT Palampur, CSIR-IIIM Jammu, CSIR-NEIST Jorhat and CSIR-URDIP Pune, will catalyze rural empowerment through cultivation, processing, value addition and marketing of aromatic plants. Under CSIR Phytopharmaceutical Mission, CSIR-CIMAP will be contributing through captive cultivation of selected medicinal plants (including Rare Endangered and Threatened plants), technology package development for the production of GMP grade medicinal plant extracts, Phyto-pharmaceutical drug development from medicinal plants (as per DCG(I) regulations) and conducting awareness programs about mission progress.

During this period, we published 87 high quality research articles. A transcription factor from *Mentha* was shown to play a role in water-logging stress by regulating a sugar transport. Another transcription factor was shown to regulate withanolide content and biotic stress tolerance in *Withania somnifera*. The role of two *Ocimum* Cytochrome P450 monooxygenase in pentacyclic triterpene biosynthesis was uncovered, and terpene synthase of terpenoid and carbazole alkaloid biosynthesis pathways were further identified in curry plant. The potential of

DNA barcoding towards authentication of three *Decalepsis* species was displayed which otherwise was not possible using conventional techniques. Our research also highlights the modulation of bacoside biosynthetic pathways by microbial challenges. Tests on *C. elegans* demonstrated the effectiveness of ursolic acid on increasing longevity. The anticancer activity of masilinic acid by *in silico* analysis and 1,2,3-triazole based artemisinin derivatives by *in vivo* assays was also predicted. Interestingly, our research indicate that thyme oil posseses antimicrobial activity against rice pathogen *Xanthomonas oryzae*. We also reported effectiveness of biochar from spent aromatic plants as metal absorbant from acidic solutions.

During this time, CSIR-CIMAP released a higher essential oil yielding, methyl cinnamate rich, cold tolerant variety of *Ocimum basilicum*. An essential oil based 'Acne Face Wash' and aroma molecule based 'Acne Cure Gel' for the prevention and cure of acne was also developed and released by the institute. A 'Polyherbal Toothpaste' was also released during this year. We also transferred 14 technologies to various industries like Naturaveda Organics Pvt. Ltd., Sujatha Biotech, Apex India Consortium Pvt Ltd., etc. This year, we have filed 5 patent applications and two have been granted. In 2017, our scientists have got recognitions by being elected to the fellowships of INSA, NASI, NAAS, etc.

On this occasion, I wish to sincerely thank and congratulate team CSIR-CIMAP for their valuable contributions in scientific, societal and technological fronts. I express my sincere gratitude to all our seniors and peers for their guidance and support towards filling the expectations of our nation.

Anil Kumar Tripathi

निदेशक की कलम से......

मुझे संस्थान का वर्ष 2017 का वार्षिक प्रतिवेदन प्रस्तुत करते हुए खुशी हो रही है, जिसके दौरान सीएसआईआर–सीमैप को एरोमा मिशन का नेतृत्व करने की जिम्मेदारी दी गई। वर्ष 2017 के अंत में हमें सीएसआईआर फाइटोफार्मास्यूटिकल मिशन में भी एक महत्वपूर्ण भूमिका निभाने का अवसर मिला। यह हमारे वैज्ञानिकों, तकनीकी कर्मचारियों, शोध छात्रों एवं अन्य सहायक कर्मचारियों के निरंतर प्रयासों और सहयोग के कारण संभव हुआ है, जिन्होंने उत्कृष्ट वैज्ञानिक अनुसंधान करने के साथ–साथ अर्जित ज्ञान को विभिन्न क्षेत्रों एवं उद्योगों तक स्थानांतरित करने के लिए स्वयं को समर्पित किया है।

सीएसआईआर सीमैप के नेतृत्व में सीएसआईआर की एक प्रमुख परियोजना सीएसआईआर–एरोमा मिशन चलाई जा रही है जिसमें सीएसआइआर –आईएचबीटी पालमपुर, सीएसआईआर–आईआईआईएम जम्मू, सीएसआईआर–एनईआईएसटी, और यूआरडीआईपी पुणे भी सम्मिलित हैं। यह परियोजना सगंध पौधों की खेती, प्रसंस्करण, मूल्य संवर्धन एवं विपणन के माध्यम से ग्रामीण सशक्तिकरण को बढ़ावा देगी। सीएसआईआर–फाइटोफार्मास्यूटिकल मिशन के तहत सीमैप औषधीय पौधों (दुर्लभ एवं लुप्त प्राय पौधों सहित) की खेती, जीएमपी ग्रेड औषधीय अर्क के उत्पादन के लिए प्रौद्योगिकी पैकेज का विकास, औषधीय पौधों से फाइटोफार्मास्यूटिकल दवा का विकास (डीसीजी(आई) के नियमानुसार) और मिशन प्रगति के बारे में जागरूकता कार्यक्रम आयोजित करके अपना योगदान देगा।

इस अवधि के दौरान सीएसआईआर–सीमैप ने 87 उच्च गुणवत्ता वाले शोध पत्र प्रकाशित किए। मेंथा में जल अधिकता से उत्पन्न तनाव के दौरान एक शुगर ट्रांसपोर्टर को विनियमित करने में एक ट्रांसफैक्टर की भूमिका स्थापित की गई। अश्वगंधा में विदानोलाइड की मात्रा एवं जैविक तनाव की सहनशीलता को नियमित करने के लिए एक अन्य ट्रांसक्रिप्शन फैक्टर का पता लगाया गया। तुलसी में पेंटासाइक्लिक

ट्राईटरपीन के जैविक संश्लेषण में दो साइटोक्रोम पी–450 मोनो ऑक्सीजिनेज की अहम भूमिका पाई गई। करी पौधे के टरपेनॉइड और करबाज़ोल अल्केलॉइड के जैविक संश्लेषण में सम्मिलित कुछ संभावित टरपीन सिंथेस को चिन्हित किया गया। तीन डेकालेसिक्स प्रजातियों के प्रमाणीकरण के लिए डीएनए बारकोडिंग की क्षमता प्रदर्शित की गई जो अन्यथा पारंपरिक तकनीकों के उपयोग से संभव नहीं था। हमारा शोध बेकोसाइड के जैविक संश्लेषण में सूक्ष्म जीवों के प्रभाव को भी दर्शाता है। हमारा परीक्षण *सी. एलीगेन्स* (*C. elegans*) नामक जीव का आयु काल बढ़ाने में और उर्सोलिक एसिड की प्रभावशीलता को प्रदर्शित करता है। कर्क रोग प्रतिरोधन में इन–सिलिको परीक्षण द्वारा मेसीलिनिक एसिड एवं इन्वाइवो परीक्षण द्वारा 1,2,3–ट्राईजोल आधारित आर्टीमिसनिन व्युत्पन्न की भूमिका का भी अनुमान लगा है। हमारे शोध से संकेत मिलता है की थाइम तेल चावल रोग जनक जंतु जैंथोमोनस ओराईजी के खिलाफ रोगाणु रोधी गतिविधि करता है। अम्लीय विलियन से बायोचार द्वारा धातु के अवशोषण की क्षमता को प्रदर्शित किया।

इस वर्ष सीएसआईआर–सीमैप ने तुलसी की अधिक सुगंधित तेल उत्पादित करने वाली, मिथाइल सिनामेट समृद्ध, शीत प्रतिरोधक किस्म को देश को समर्पित किया। मुहांसों की रोकथाम और उपचार के लिए एक सुगंधित तेल आधारित एक्ने फेस वॉश और सुगंध–अणु आधारित एक्ने क्योर जेल भी संस्थान द्वारा विकसित एवं जारी किया गया। इस वर्ष एक पॉलीहर्बल टूथपेस्ट भी विमोचित किया गया। हमने 14 तकनीकों को भी विभिन्न कंपनियों जैसे नेचुरावेदा ऑर्गेनिक्स प्राइवेट लिमिटेड, सुजाता बायोटेक, अपेक्स इंडिया कंसोर्सियम प्राइवेट लिमिटेड आदि को स्थानांतरित किया। इस साल हमने 5 पेटेंट आवेदन दायर किए एवं 2 को मंजूरी मिली। 2017 में हमारे वैज्ञानिकों को इंसा (INSA), नासी (NASI), नास (NAAS) आदि की फैलोशिप के लिए चुने जाने से मान्यता मिली है।

मैं इस अवसर पर टीम सीएसआइआर–सीमैप को वैज्ञानिक, सामाजिक और तकनीकी मोर्चों में उनके बहुमूल्य योगदान के लिए हृदय से धन्यवाद और बधाई देना चाहता हूं। मैं अपने सभी वरिष्ठ एवं साथियों को राष्ट्र की उम्मीदों को पूरा करने हेतु उनके मार्गदर्शन एवं सहयोग के लिए अपनी कृतज्ञता व्यक्त करता हूं।

अनिल कुमार त्रिपाठी

R & D Activities

Input: Saudan Singh

Agro-technology for the saving of geranium propagules during rainy season under sub-tropical plains of north-India

Generally, geranium multiplication is done by vegetative cuttings of stem which are obtained from main crop. However, during monsoon season (from July-September), crop is badly affected by excess water, high humidity and high temperature, which in combination leads to complete damage of mother plants in the field which otherwise are required for propagation of the crop in next cropping season. CSIR-CIMAP developed a technology for saving geranium propagules, which is cost effective and practically feasible at farmers field without any electricity requirement of AC glass house method.

Fig: Agrotechnology for saving geranium propagules

Agro-technology for enhancing productivity and quality of *Cassia angustifolia* Vahl.under northern Indian plains.

Field experiments were conducted to optimize suitable agricultural practices i.e. time of sowing, moisture regimes and optimum plant age corresponding to maximum sennoside yield in *Cassia angustifolia* Vahl. Development of cost-effective package of practices will lead to the improvement in quality of the plant material. It will encourage its cultivation and availability of raw material to the industry.

Fig: Field view of of the *Cassia angustifolia* and its pods

Input: Rajesh Kumar Verma

Diversifying cropping systems for better productivity and profitability in subtropical north Indian plains

Diversifying agro-ecosystems with incorporation of suitable aromatic crops could deliver great results pertaining to productivity, profitability

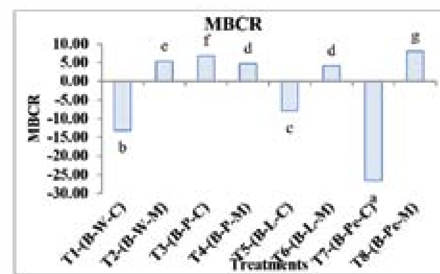


Fig: Marginal benefit cost ratio (MBCR) of different annual cropping systems in each season (average of four years) was calculated on the basis of economics of conventional rice wheat cropping system (*O–*Ocimum basilicum*(Basil); W–*Triticum aestivum* (Wheat); P–*Solanum tuberosum* (Potato); L –*Lens culinaris*(Letil/Masur); Pe –*Pisum sativum* (Pea); C –*Vigna unguiculata*(Cowpea); M *Mentha arvensis* (Menthol mint), mean followed by the same letter within one column (T_1, T_2, T_3,.....T_8) do not differ significantly at $P \leq 0.05$ (Duncan's multiple range test) and sustainability. The improvement in productivity of aromatic crop-based cropping systems productivity was examined.The research findings would help in providing information on integration of aromatic with food crops, their cultivation cost, economical indices, and profit earned by the farmers in addition to diversified cropping systems. Maximum gross returns (357 × 103 INR or 5.56 × 103 USD), net returns (250 × 103 INR or 3.90 × 103 USD), per day return (2.6 × 103 INR or 41 USD), benefit cost ratio (10.52), and marginal benefit cost ratio (8.04) was found in basil-pea-menthol mint cropping system. Diversified cropping system with basil, pea and menthol mint is suitable combination of annual cropping sequence. This would aid in sustaining higher yields and monetary returns to farmers.

Inputs: Puja Khare

Distillation residue-derived biochar is effective in immobilization of potentially toxic metals in the soil and reduces their uptake and translocation in *Mentha arvensis*

A greenhouse experiment was executed to evaluate the effect of biochar (BC) amendments in Pb and Cd spiked soil on immobilization and uptake of metals, plant growth, photosynthetic attributes (total chlorophyll, photosynthetic rate, transpiration rate, and stomatal activity) and oxidative enzymes (guaiacol peroxidase (POD), catalase (CAT) and superoxide dismutase (SOD). Results revealed amendment of BC immobilized the cadmium (Cd) and lead (Pb) and reduced their translocation in the *M. arvensis*. The photosynthetic attributes showed that biochar improved the significantly total chlorophyll, photosynthetic rate, transpiration rate, and stomatal activity in the plants. The incorporation of biochar in soil increase the Pb and Cd tolerance in *M. arvensis* and improved the biomass yield and nutrient intake. In addition, biochar has also reduced the POD, CAT and SOD in plant and improved the soil pH and enzymatic activities. Overall, biochar immobilized the Pb and Cd in soil by providing the binding site to the metals and reduced the phytotoxicity in *M. arvensis*. However, large-scale field trials of biochar are required for safe cultivation of herbs used in phyto-pharmaceuticals important.

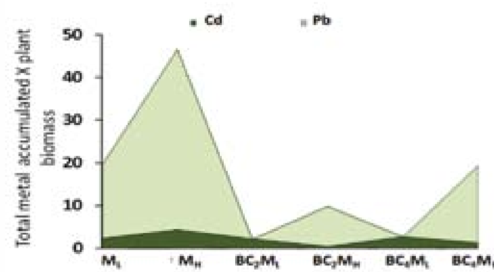


Fig: Total metal uptake per plant [Treatments: ML (soil+ML), MH (soil+ MH), BC2ML (soil+2% BC+ML), BC2MH (soil+ 2% BC+MH), BC4ML (soil+ 4% BC+ML) and BC4MH (soil+ 4% BC+MH)]

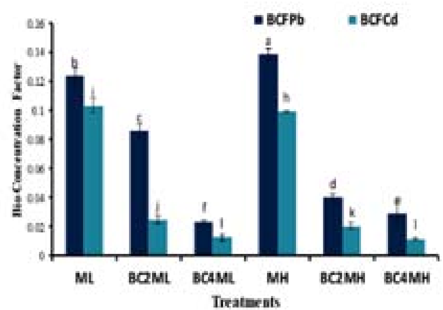


Fig: Bioconcentration factor for different treatments

Input: RK Upadhyay

Performance of Palmarosa cultivars in Tarai belt of Uttarakhand under AGTECH

Perfomrance of palmarosa cultivars were evaluated in Tarai belt of Uttarakhand. Palmarosa variety "CIM-Harsh" yielded highest average fresh herb (398.58 q ha^{-1} $year^{-1}$), oil content (0.71%), and oil yield (283.20 kg ha^{-1} $year^{-1}$) during two year test period (from four harvests per year) as compared to other existing varieties. The treatments are given in the table

Fig: Perfomrance of palmarosa variety "CIM-Harsh" cropin Tarai belt of Uttarakhand

Table Plant parameters of Palmarosa cultivars

Treatm-entst	Plant height (cm)	No. of tillerplant^{-1}	Fresh herb yield (q $ha^{-1}year^{-1}$)	Oil content (%)	Oil yield (kg $ha^{-1}year^{-1}$)	Geraniol (%)
V_1	181	114	374.00	0.70	262.18	83.1
V_2	182	138	398.58	0.71	283.20	88.6
V_3	185	118	343.55	0.69	236.55	75.9
V_4	176	95	385.20	0.37	142.25	89.9
V_5	161	103	345.95	0.51	174.93	64.2
V_6	143	105	347.23	0.53	184.27	58.2
$SEm_{\pm}$	3.60	0.59	5.89	0.01	4.42	-
$LSD_{(P=0.05)}$	10.87	1.79	17.75	0.02	13.33	-

Input: Rakesh Kumar

Effect of sowing dates and different spacing on growth, oil and seed yield of sweet basil

Basil is sensitive to plant density and sowing date. Early sowing in dry land Basil resulted in critical increase in seed yield, possibly due to higher aboveground biomass, number of inflorescence per plant and plant height. Lower densities do not produce sufficient seeds per unit area. However, relatively small absolute differences in seed yield between few tested plant growing densities demonstrated the remarkable compensation capacity of basil between the different yield components.

Treatment	Plant height (cm)	No. of Primary Branches/ plant	No.of inflorescence/ Plant	Days to Maturity	Herbage yield (q/ha)	Oil (%)	Oil yield (kg/ha)	Seed yield (kg/ ha)
Sowing Dates								
D1 (3rd Week of July)	80.67	13.11	107.33	118.67	205.56	1.04	213.46	210.67
D2 (4th Week of July)	77.33	12.00	95.00	115.67	191.89	0.98	187.46	184.00
D3 (1st Week of August)	73.00	9.33	91.00	110.67	180.56	0.96	172.47	173.33
Sem ±	0.72	0.29	0.27	0.31	1.10	0.02	3.37	1.09
LSD (p=0.05)	2.00	0.80	0.76	0.87	3.05	0.04	9.36	3.02
Planting Distance								
S1 (50×30 cm)	71.00	9.67	85.00	114.33	218.89	0.94	206.82	176.67
S2 (50×45 cm)	76.33	11.44	94.67	115.33	185.22	0.98	181.45	186.67
S3 (50×60 cm)	83.67	13.33	113.67	115.33	173.89	1.06	185.12	204.67
Sem ±	0.70	0.51	1.05	0.75	0.74	0.02	3.78	1.09
LSD (p=0.05)	1.53	1.10	2.30	NS	1.61	0.04	8.23	2.38
Interaction (S×D)	NS	NS	*	NS	*	NS	*	*

NS: Non significant difference, * Significant difference

Input: Jnanesha AC

Varietal evaluation of essential oil yield and chemical composition of seven vetiver (*Vetiveria zizanioides*) cultivars under Southern region

A field experiment was undertaken to evaluate comparative analysis of existing vetiver (released by CIMAP, KS-1, Gulabi, Dharani, Kesari, Kushnalika, CIM-Virdhi& CIM-Samridhi) varieties with respect to root yield and essential oil under tropical/subtropical.

Fig: field view of Vetiver Cultivation

Input: Abdul Samad and Birendra Kumar

Uraria Blossom Blight-a new fungal disease caused by *Colletotrichum siamense*

Uraria picta (Prishniparni) is a perennial medicinal herb, distributed across tropical Africa and Asia, including India, Sri Lanka, and Malay Islands. The flavonoid content of *U. picta* imparts antithrombotic, anti-inflammatory, and hepato-protective activities. During August 2016, a new fungal disease was observed on the inflorescences of young *U. picta* plants. Disease incidence ranged from 20 to 25% in the 200 m^2 experimental field at Council of Scientific and Industrial Research - Central Institute of Medicinal and Aromatic Plants (CSIR-CIMAP), Lucknow. Initially, symptoms appeared on inflorescences as small brown necrotic lesions that later coalesced to form larger lesions. Infection moved from the inflorescence to twigs and gradually caused a dieback that led to premature death of the plant. Plant samples were cut into small pieces, surface sterilized, placed on to potato dextrose agar (PDA), and incubated at 28°C for 4 to 5 days. The isolated fungal culture (CIMAP: Up-72013) was initially white, turned grayish black with age, and the reverse side was pale yellow. Conidiophores were branched, hyaline, and cylindrical to ampulliform. Conidia were hyaline, fusiform, obtuse to slightly round ends and sometimes oblong, with dimensions in the range of 3.5 to 6 × 11.5 to 14 μm. On the basis of these characteristics, the fungus was identified as *Colletotrichum* sp. Identification of pathogen was confirmed by sequence analysis of ITS, TUB2, CAL, GPDH, and ApMat regions of the amplified DNA and data were deposited in GenBank (accession nos. KJ617392, KT025246, KT025247, KT025248, and KU925900, respectively). The BLASTn results of ApMat sequence showed 98% similarity with *C. siamense* strain LC0148 (KJ954494). Phylogenetic tree revealed its genetic relatedness with *C. siamense* and was deposited to CSIR-IMTECH, India (MTCC 12607). Identification of the reisolated pathogen using molecular technique fulfilled the Koch's postulates. Fungal diseases such as stem rot caused by *Fusarium thapsinum* have been reported earlier on *U. picta*. This is the first report of Uraria blossom blight caused by *C. siamense* in India. In conclusion, *C. siamense* is a known pathogen having a wide host range and represents a serious threat for the cultivation of this valuable crop in India.

Fig : Healthy inflorescence and severely infected of UrariaPicta

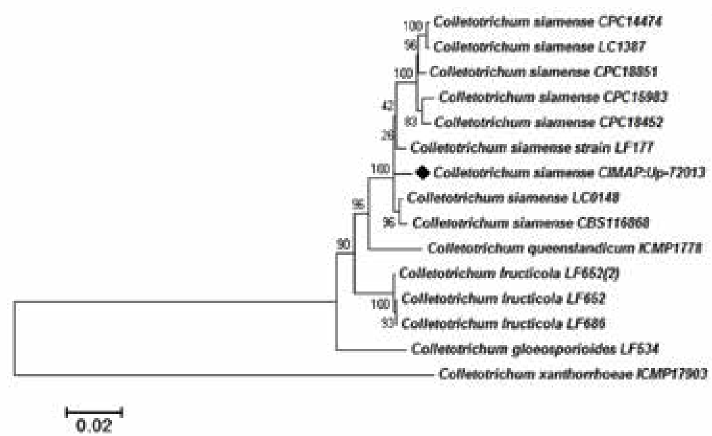
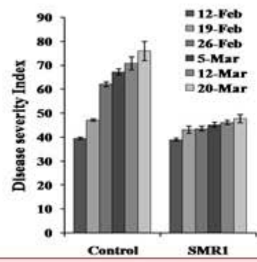
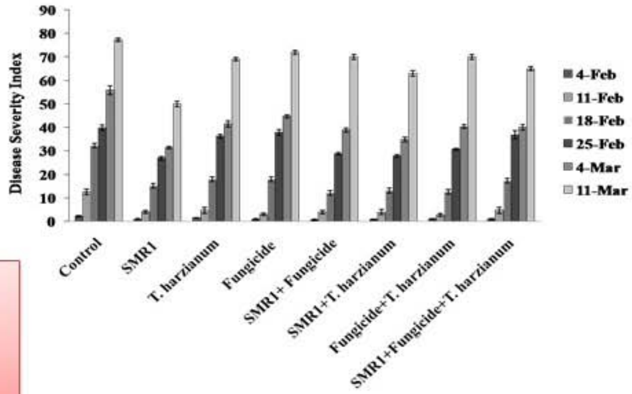


Fig : The phylogenetic tree, based on concatenated sequences of TUB-2, GAPDH, CAL, ITS and ApMat. The tree is rooted with *Colletotrichum xanthorrhoeae*.

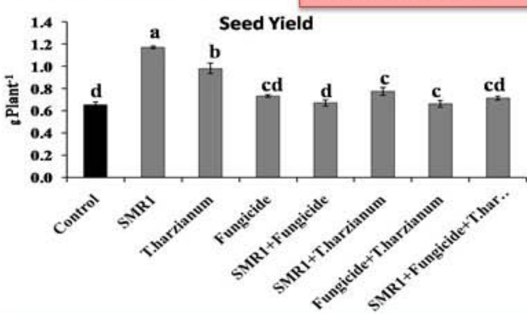
Input: Alok Kalra

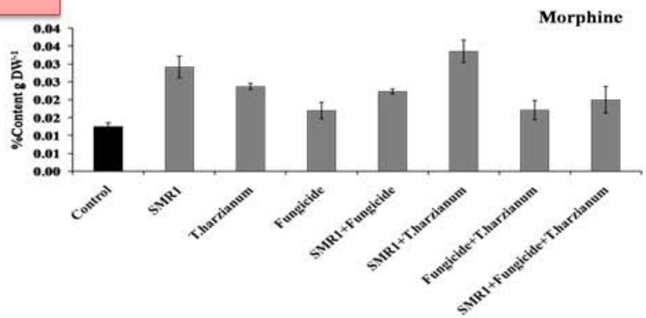
Plant-endophyte interactions responsible for reducing severity of downy mildew disease and enhancing yields in opium poppy





Endophyte *Microbacterium* SMR1 protecting opium poppy plant from downy mildew disease

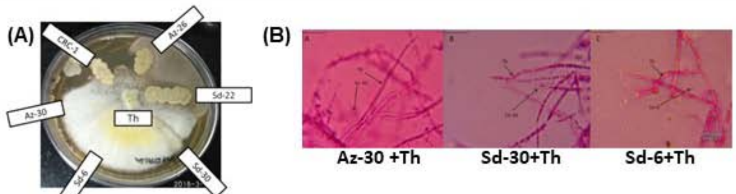


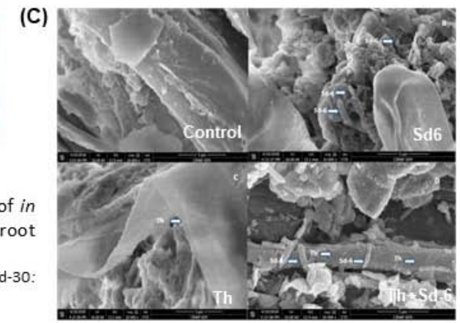


Inoculation of root endophyte *Microbacterium* SMR1 protected opium poppy plants from downy mildew disease. The protection provided by SMR1 alone was better than fungicide, biocontrol agent *Trichoderma harzianum* and their combination (SMR1+fungicide+*T. harzianum*)

Input: Alok Kalra

Impact of co-inoculation of *Trichoderma harzianum* (Th) with the plant growth promoting rhizobacteria (PGPRs) on the growth and essential oil yield of *Mentha arvensis*





(A) *In vitro* compatibility test of *T. harzianum* against PGPRs. **(B)** Microscopic image of *in vitro* developed Biofilms. **(C)** Scanning Electron micrograph depicting *Mentha arvensis* root colonization by Th and Sd-6 biofilm.

Th: *Trichoderma harzianum*; Az-30: *Stenotrophomonas spp*; Sd-6: *Brevibacterium halotolerans*; Sd-30: *Bacillus flexus*; Az-26: *B. subtilis*; Sd-22: *Alcaligenes faicalis*; CRC-1: *Pseudomonas monteilli*.

Trichoderma harzianum **(Th) did not antagonize** ***Stenotrophomonas*** **spp (Az-30),** ***Bacillus flexus*** **(Sd-30) and** ***Brevibacterium halotolerans*** **(Sd-6)**

Effect of bioinoculants on the fresh herb weight and oil yield of ***M. arvensis*** **in field experiment**

Treatments	Fresh Herb weight ($t\ ha^{-1}$)	Oil Content (%)	Oil Yield ($kg\ ha^{-1}$)	Fresh Herb weight ($t\ ha^{-1}$)	Oil Content (%)	Oil Yield ($kg\ ha^{-1}$)
	First Harvest			Second Harvest		
Control	9.31 ± 0.29^{d}	0.57 ± 0.03^{e}	47.22 ± 3.68^{e}	4.52 ± 0.55^{e}	0.67 ± 0.15^{c}	26.91 ± 7.76^{d}
Th	11.00 ± 0.43^{b}	1.37 ± 0.06^{b}	133.65 ± 0.68^{b}	4.29 ± 0.36^{e}	1.07 ± 0.12^{b}	40.69 ± 5.43^{c}
Az-30	10.55 ± 0.18^{bc}	1.23 ± 0.06^{c}	115.83 ± 7.14^{c}	4.76 ± 0.21^{e}	1.03 ± 0.15^{b}	43.97 ± 8.42^{c}
Sd-30	10.24 ± 0.21^{c}	0.82 ± 0.03^{d}	74.43 ± 3.63^{d}	5.59 ± 0.41^{cd}	0.97 ± 0.06^{b}	47.99 ± 0.55^{c}
Sd-6	10.59 ± 0.21^{bc}	1.23 ± 0.06^{c}	116.23 ± 3.12^{c}	6.43 ± 0.36^{b}	1.03 ± 0.15^{b}	58.80 ± 5.42^{b}
Az-30+Th	10.12 ± 0.39^{c}	1.30 ± 0.10^{bc}	116.89 ± 5.94^{c}	5.00 ± 0.36^{de}	0.93 ± 0.06^{b}	41.63 ± 5.42^{c}
Sd-30+Th	10.59 ± 0.21^{bc}	1.40 ± 0.10^{b}	132.12 ± 11.66^{b}	5.71 ± 0.36^{c}	1.00 ± 0.10^{b}	50.65 ± 1.92^{bc}
Sd-6+Th	$\mathbf{11.86\pm0.38^{a}}$	$\mathbf{1.63\pm0.06^{a}}$	$\mathbf{172.24\pm1.17^{a}}$	$\mathbf{7.26\pm0.41^{a}}$	$\mathbf{1.47\pm0.06^{a}}$	$\mathbf{94.72\pm4.89^{a}}$

Combined inoculation of ***Trichoderma harzianum*** **and** ***Brevibacterium halotolerans*** **Sd-6 enhanced growth and oil yield in** ***Mentha arvensis*** **under greenhouse and field conditions**

Input: Kishore B Bandamaravuri

Identification of pathogen in selected MAPs

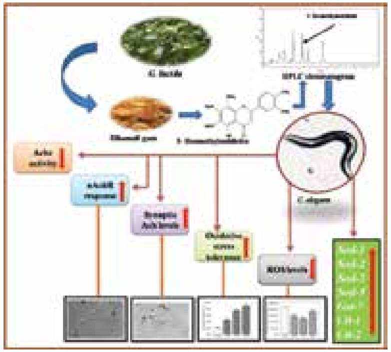
- Aromatic crops under farmers' fields, experimental fields and germplasm blocks were surveyed.
- *Mentha sp.,* gerenium, lemon grass and *Ocimum* diseases such as root rot, block root rot, leaf yellowing and stem rot disease causing pathogens, respectively, were isolated.
- The fungal pathogens such as *M. pahseolina*, *Lasiodiplodia brasiliansis* and *Sclerotinia sclerotiorum* were identified and characterised.
- Further, different varieties (either old or new) of *Mentha sp.,* geranium, lemon grass and *Ocimum sp.* will be tested against these pathogens towards Disease Resistance Indexing (DRI).

Fig: Root root disease caused by *M. phaseolina* on *Mentha arvensis*

Fig: Dieback disease of *Pelargonium graveolens* (geranium) caused by *Lasiodiplodia* sp.

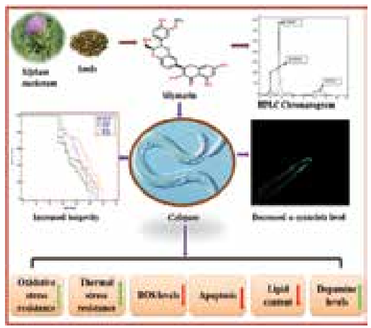
Input: Rakesh Pandey

5-Desmethylnobiletin augments synaptic ACh levels and nicotinic ACh receptor activity: A potential candidate for alleviation of cholinergic dysfunction



Cholinergic function is compromised in plethora of neurodegenerative disorders especially Alzheimer's disease. Increasing acetylcholine (ACh) levels has been the mainstay in majority of the therapeutic regimens, accepted for management of disease. The present study investigates the efficacy of 5-Desmethylnobiletin (DN), a polymethoxyflavone in augmenting cholinergic function using *Caenorhabditis elegans* as a model organism.The studies revealed significant elevation in cholinergic transmission mediated through increased levels of ACh and activity of nicotinic acetylcholine receptors (nAChR). Further investigation into themechanistic aspects indicated that DN enhanced cholinergic function through down modulation of acetyl-cholinesterase activity at enzyme and transcript level along with upregulation of non alphasubunit,unc-29 which could be linked with enhanced nAChR activity as evident from levamisole assay. Additionally, studies on antioxidant properties, implicated significant potential of DN in curtailing ROS, both in vivo and in vitro.*Neuroscience letters*,2017; 657, 84-90.

Silymarin extends lifespan and alleviates Parkinson's associated pathologies in *Caenorhabditis elegans*

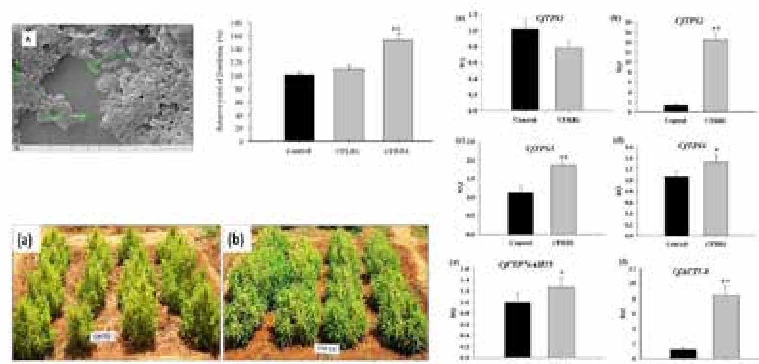


The naturopathic treatment, preventing the disease has gained much attention since ancient times and gaining momentum presently. Aging is an unavoidable phenomenon, often afflicting structure and functionality of body, marked with onset of age associated manifestations. Parkinson's disease (PD), the second most common form of dementia is manifested with Lewy body formation and dopaminergic dysfunction. In the present studies we explored silymarin, a known hepatoprotective regimen for its efficacy antiageing and antiparkinson activities using *Caenorhabditis elegans* multicellular model system. Silymarin positively modulated longevity, reduced oxidative stress, independent of feeding behaviour. Upregulation of longevity and stress related genes daf-16, sod-3, gst-4 and skn-1 indicate the possible involvement of these genes for regulating longevity. In addition silymarin alleviated parkinson disease (PD) symptoms by reducing alpha-synuclein levels, lipid accumulation and enhanced dopamine function. Silymarin executes its beneficial effects through mitigation of free radicals, while achieving alleviation in Parkinsonism possibly through pdr-1 mediated recruitment of ubiquitin proteasome system as evident from qPCR studies. Altogether, silymarin emerged as a potent molecule for its use in ageing and age related disorders.*Journal of Functional Food* (2017), 31: 32-43.

Input: CS Vivek Babu

Plant endophyte interaction in *Coleus forskohlii*

Plant-endophyte interaction promotes plant productivity and improves crop health. *Coleus forskohlii* is one of the well-known herb for its medicinal properties containing forskolin within root system, which has a wide range of pharmaceutical applications. In the present investigation, bacterial endophytes of *C. forskohlii* such as CFLB1 and CFRB1 isolated from leaf and root system, were evaluated their plant productivity and enhanced forskolin content. Among them, CFRB1 (*Alcaligenes faecalis* MH998155) endophyte has showed significant enhancement of plant biomass and forskolin content under both pot and field conditions. Expression analysis of functional genes involved in the forskolin biosynthesis were carried out for *C. forskohlii* plants treated with CFRB1, endophyte in field conditions. The expression of four *C. forskohlii* diterpene synthases (*CfTPS*) such as *CfTPS1*, *CfTPS2*, *CfTPS3* and *CfTPS4* along with cytochrome P450 (*CfCYP76AH15*) and acyltransferase (*CfACT1-8*) genes were differentially upregulated in CFRB1 endophyte treated *C. forskohlii* plants. Overall, our experimental results demonstrate, cross talk of plant-endophyte in medicinal plant



C. forskohlii resulted in a beneficial interaction leading to enhanced forskolin content through modulation of forskolin biosynthetic pathway genes, along with increased primary plant productivity. Hence, *Alcaligenes faecalis* MH998155 (CFRB1) endophytic isolate, could be considered as forskolin biostimulant during cultivation of *C. forskohlii*.

Input: Venkata Rao DK

Mevalonate and ergosterol pathway in yeast

The metabolic flux towards designated pathway is sustainable alternative approach to meet the global demand of various mono- and sesqui-terpenes. Yeast has been widely simple eukaryote to produce various biochemicals at industrial scale. Our research work is mainly focussed on the role various knockout yeast strains involved in metabolic flux to other biochemical pathways such as mevalonate and ergosterol pathway. In our study, we identified and screened the yeast knockout strains designated as KO_1, KO_2 and KO_3 which overproduce the intermediate metabolites and end product of ergosterol pathway. Further, quantitative PCR data demonstrated the upregulation of mevalonate pathway genes in KO_1, and KO_2 yeast strains as compared to the reference wild type strain. We use these KO strain for further engineering to improve the production of various terpenoid compounds.

Figure1

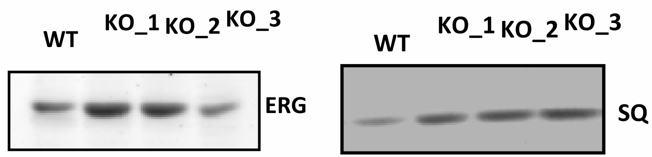


Fig : Quantification of ergosterol (ERG) and squalene (SQ) in yeast mutants.

Figure2

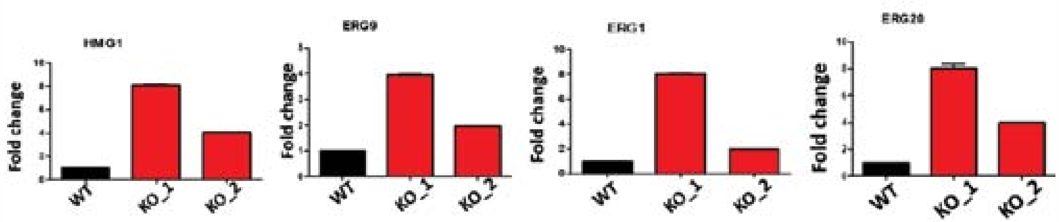


Fig : Quantitative PCR data of mevalonate and ergosterol pathway in yeast. The quantitative PCR was performed using cDNA of wildtype, KO_1 & KO_2 strains. The relative expression of *HMG1, ERG9, ERG1,* and ERG20 was measured and calculated the relative gene expression as compared with the reference strain. The elevated gene expressions of mevalonate and ergosterol pathway were observed in yeast knock out strains, suggesting the promising mutant strains for the overexpression of terpene synthases for high production of mono & sesquiterpenes.

Inputs: Venkatesh KT

Genetic improvement of spearmint (*Mentha spicata*) for high oil yield and high carvone content

About 105 half-sib progenies of spearmint were evaluated for agro-morphological traits and chemical constituents of oil. Oil percentgae in these half-sib progenies ranged from 0.30% to 0.90 %. The carvone content from 32.65 % to 78.11 %.

Selection of thymol rich oregano (*Origanum vulgare* L.) genotype for commercial cultivation

To assess the magnitude of morphological and chemical variability prevailing in Indian oregano (*Origanum vulgare* L.) and to develop a thymol rich oregano genotype. A total of fourteen oregano accessions were evaluated by growing in a randomized block design (RBD) with two replications. A significant amount of genetic variability was recorded for all the agro-morphological traits studied. Mean herb yield was variedfrom 58 g - 360 g / plant, oil percent is ranged from 0.11% - 0.58 % and thymol was ranged from 23.53 %-53.83 %, respectively. Seed progenies of all the above accessions were under evaluation.

Input: Tripta Jhang

Development of Withanolide-A rich, high yielding advance breeding line of Ashwagandha (*Withania somnifera*) with commercially accepted root quality

Fig : A field view of proposed line E3-5-1 at anthesis stage showing tolerance to leaf blight (*Alternaria alternata*)

Table: Trait charactistic of mentioned vareties

Trait	E3-5-1	Jawahar Asgandh20
Leaf	Highly wavy, with 7.39x3.64cm dimensions	Non wavy, 6.89 x 2.96cm dimensions
Stem	Strong semi erect culm angle 45-55	Spreading, culm angle 65-55
Berry	Yellow orange berry berry, diameter 4.37 mm and test weight 124.8mg	Yellow orange berry, diameter 45.22mm and test weight 90.87mg
Root	smooth with even fracture, 21-25cm long starch to fiber ratio of 1.23	smooth with even fracture, 12-18cm long starch to fiber ratio of 1.18
Plant Height	Semi-dwarf (68.59 cm)	Dwarf (58.59 cm)
Maturity	175-190 DAS	178-190 DAS
Dry herb(q/ha)	629.42	397.73
Dry Root(q/ha)	10.09	3.72
Resistance to leaf blight	Tolerant	Susceptible
Withanolide A	0.785 mg/g dry weight basis	1.01 mg/g dry weight. basis
Withanolide B	0.460 mg/g dry weight basis	0.248 mg/g dry weight. basis
Withanone	0.006 mg/g dry weight basis	0.020 mg/g dry weight. basis

Inputs: Channayya Hiremath

Crop improvement of Rosemary

Breeding work was initiated in rosemary crop for carnosic acid, Rosemarinic acid, 1,8-cineole and herb yield. We selected around 500 phenotypically superior plants. Based on the oil data and chemical constituents further selected 50 superior plants. Selected plants oil content ranges for 1.00 to 1.30%, 1,8-cineole content ranges from 26.00% 33%, carnosol and carnosic acid content ranges from 1.00 to 4.25% on dry weight basis.

Fig : Field view of Rosemary

Crop improvement of Ocimum

Development of Linalool rich and high herb yielding lines suitable for tropical and subtropical conditions was excuted *Ocimum* interspecific hybrid (*O. basilicum* × *O. africanum*) with high herb and essential oil and linalool rich strain developed. Herbage yield ranges from 200g to 865g per plant (-) Linalool content -75-80%.

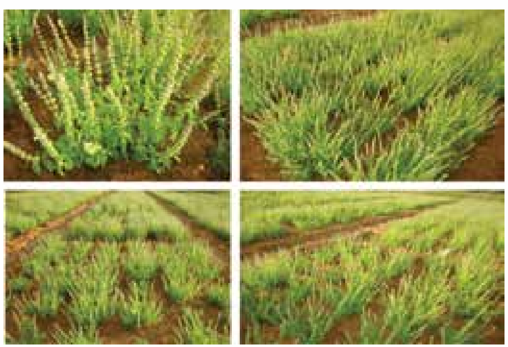


Fig : Field view of Ocimum

Input: Anil K Gupta

Genetic variability and correlations of essential oil yield with agro-economic traits in *Mentha* species and identification of promising cultivars*

Mint is an important medicinal and aromatic plant, belongs to 'Lamiaceae' family. Its oil contains large number of aroma chemicals like menthol, menthone, isomenthone, menthyl acetate and menthofuran which are used in pharmaceutical, food, flavor, cosmetics and beverage industries. The hydro distilled essential oils of twenty-seven cultivars of six *Mentha* species, viz. *Mentha arvensis* L., *Mentha piperita*, *Mentha spicata* L. *Mentha citrata* Ehrh., *Mentha spicata L.var. virdis*and *Mentha cardiaca* were analyzed and compared by gas chromatography and gas chromatography-mass spectrometry. Agro-morphological and chemical analysis data of all twenty-seven varieties of six *Mentha* species were evaluated. The variation, among the twenty-seven varieties was highly significant for all the economic traits examined indicating enough genetic variations were present among the varieties for all the traits. The results of genetic correlations studies revealed that oil yield was highly significant and positively correlated with oil content (r^2 = 0.87**) whereas, positive genetic correlation expressed between oil content and thickness of sucker (r^2 =0.43*) and number of internodes (r^2 =0.43*). Therefore, these traits may be considered for the selection of high yielding cultivars through correlated response to selection as these traits are contributing indirectly to oil yield. While other characters like plant height and fresh herb yield was not correlated with oil yield. It was found that the cultivar Kosi (168 ml) followed by Sambhav (154 ml) of *Mentha arvensis* are the highest oil yielding varieties. In the same way Pranjal (55 ml) followed by Kukrail (51 ml) of *Mentha piperita* gives maximum oil yield per plot. The cultivar Arka (48 ml) of *Mentha spicata*, MCAS-2 (105.3 ml) of *Mentha cardiaca*, cultivar Kiran (48 ml) of *Mentha citrata* have minimum oil yield. Therefore, these promising

Table: Chemical composition of twenty seven cultivars/varieties belonging to six Mentha species

Mentha arvensis	Ment hol	Ment hone	Iso menthone	Menthyl acetate	Mentho furan	1,8-cineole	Neo mentho l	Puleg one	Limo nene	Born eol	Cis-dihydrocarv one	Germac rene D	Piperitino ne oxide	Carv one	α pinen e	Myrece ne	β pinen e	Linal ool	Linalyl acetate	β caryophyl lene	α terpinol ene
Himalaya	77.7	5.5	3.1	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kosi	78	5.5	3.2	2.1	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-
Saksham	78	6.6	3.2	2.1	-	-	-	-	-	0.4	-	-	-	-	-	-	-	-	-	-	-
Kushal	78	6.9	3.3	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sambhav	78	5.2	3.5	3.3	-	-	-	-	-	0.9	-	-	-	-	-	-	-	-	-	-	-
Kalka	81	1.9	2.1	2.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shivalik	77	5.1	4.6	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gomti	77	4.5	4.5	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Damroo	79	6.3	3.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mentha piperata																					
Kukrail	30.6	23.1	3.9	-	6.7	6.1	3.1	2.9	3	-	-	-	-	-	-	-	-	-	-	-	-
CIM-Indus	12.7	1.4	3.4	-	20.2	10.5	2.3	13.2	5.3	-	-	-	-	-	-	-	-	-	-	-	-
CIM-Madhuras	33.5	25.2	3.9	-	5.3	5.7	3.3	2.5	2.7	-	-	-	-	-	-	-	-	-	-	-	-
Tushar	30.2	21.3	4.1	-	7.8	6.7	3.3	4.1	3.9	-	-	-	-	-	-	-	-	-	-	-	-
Pranjal	33.3	19.5	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mentha spicata L. var. Virdis																					
Ganga	-	-	-	-	-	1.3	-	-	7.8	-	-	-	66	0.9	-	-	-	-	-	-	-
Ganga-selection	-	-	-	-	-	5.5	-	46.2	15.4	-	9.6	-	-	10.7	-	-	-	-	-	-	-
Supriya	-	-	-	-	-	1.2	-	-	31.7	-	-	-	-	53.7	-	-	-	-	-	-	-
Rubea	-	-	-	-	-	0.2	-	46.2	25.6	-	0.9	-	-	63.2	-	-	-	-	-	-	-
Mentha spicata																					
Arka	-	-	-	-	-	2.5	-	-	19.6	-	-	-	-	59.8	0.8	2.3	0.6	-	-	-	-
Neera	-	-	-	-	-	5.1	-	-	17.5	-	-	-	-	54	0.8	4.6	0.9	-	-	-	-
Neerkalka	-	-	-	-	-	0.8	-	-	31.1	0.9	-	-	-	54.5	0.7	0.9	0.5	-	-	-	-
MSS-5	-	-	-	-	-	2.1	-	-	21.7	-	-	-	-	52.8	0.8	2.1	-	-	-	-	-
Mentha cardiaca																					
Mukta	-	-	-	-	-	2.1	-	-	17.6	-	2.3	1.2	-	61.3	-	2.3	-	-	-	-	-
MCAS-2	-	-	-	-	-	1.5	-	-	28.9	-	0.4	0.3	-	55.9	-	0.9	-	-	-	-	-
Mentha citrata																					
Kiran	-	-	-	-	4.6	-	-	-	-	-	-	-	-	-	-	-	1.3	50.4	25.6	1.8	1.9

varieties/cultivars with better quality of oil are suitable for exploitation on commercial scale (*Industrial crop and products, 95: 726-732, IF 3.849).

Inputs: Birendra Kumar

Identification of *Swertia chirayita* genotype (s)/strain (s) performing well under lower Himalayan altitude of Uttarakhand

Three accessions from Chakarata (Dehradun), Sukhia (Darjeeling) and Yoksom (West Sikkim) were collected and planted at Gwaldam, Uttarakhand to study the comparative growth performance.Only Yuksom genotype was flowered and produce viable seeds. Based on chemical profile among three genotypes (% content, DW basis), Yuksom genotype is best having all three major chemical constituents viz. swertiamerin, mangiferin and sweroside. At molecular level, all three genotypes are genetically diversed. Seeds were collected from Gwaldam planted Yuksom genotype and raised nursery in earthen pot at CSIR-CIMAP, Lucknow for multiplication and to be planted at Gwaldam, Kaushani and CRC-Purara for further study of growth performance/adaptation.

Fig : *Swertia chirayita and its Nursury*

Conservation and genetic improvement of Prishnparni (*Uraria picta*) a critically endangered dashmool drug

- Twenty-three accessions of *Uraria picta* were collected from Uttar Pradesh and Uttarakhand and planted in RBD design at CIMAP Experimental Farm, Lucknow to study the morpho-metric, quality and yield attributes for variability among accessions.
- On the basis of chemical profile among 23 collected/ planted genotypes; Highest rhiofolin content was recorded in root part of genotype UP18-47 (0.19%) followed by UP05-11 (0.18%) and maximum rhiofolin content was observed in aerial part of genotype UP21-Pad (1.01%) followed by UP19-48 (0.78%), UP11-25 (0.75%), UP17-44 (0.69%) and UP18-47 (0.67%).
- Based on growth and yield performance at CSIR-CIMAP, Lucknow, UP21-Pad and UP22-Basti genotypes performed well as compared to rest of the genotypes.
- At molecular level, UP01-1, UP22-Basti, UP20-Hald and UP23-AN genotypes are genetically diversed.
- Based on growth, yield performance and rhiofolin content in root and aerial parts: UP21Pad, UP22-Basti and UP18-47 genotypes, grown at CIMAP, Lucknow are the best and performing well.

Input: VR Singh

Development of post harvest processing technology for quality production of satawar (*Asparagus Ascendance Roxb.*)

The different concentration of sodium hydroxide (NaOH) solutions viz; 2%, 3% and 5%, and only water were used as boiling of satawar roots to facilitate easy peeling and for good quality dry root yield. The effects of chemical on peeling of satawar were determined by physical properties, physical appearance, quality, and dry root yield of satawar. However, the physical appearance was excellent in 2% concentration of satawar appeared a light yellowish colour to golden colour with dry root yield 40.62 quintal ha^{-1}. Therefore, it is recommended that boiling of satawar in 2% NaOH solution at 100°C for 35 minutes followed by peeling and drying is the best method for postharvest processing to obtain excellent quality and profitable higher yield.

Fig : Post harvest and well processed satawar

(Boiling of satawar in 2% NaOH solution at 100°C for 35 minutes)

Fig : Post harvest and well processed satawar

(Boiling of satawar in 100°C for 80 minutes)

Input: Ram Suresh and Ramesh K Srivastava

Adoption pattern and profitability of mint cultivation in Dudhwa land of Uttar Pradesh

The present study of menthol mint (*Mentha arvensis)* cultivation technology adoption has been carried out in tribal farmer's field at Dudhwa Tiger Reserve of Uttar Pradesh which has been introduced for the first time among the *tharu* tribes of the tiger reserve. During the study period, menthol mint cultivation was demonstrated on the farmer's field of two villages namely Dhuskia (Chandan Chowki range) and Chhedia Paschim (Bankati range) of Dudhawa under Palia tehsil of district Lakhimpur Kheri. The primary data were collected from the selected farmer's field on adoption pattern and profitability of mint cultivation. Simple analytical tools and technique were used for data analysis and the cost of cultivation. The socio-economic and resource structure was workout by analyzing the family size, literacy rate, occupation, cropping pattern, farm assets and land holding. It was observed that medium level adoption of menthol mint cultivation was found higher and followed by high- and low-level adoption. The total cost of cultivation and gross return of menthol mint has been found Rs.37239/- and Rs. 71400/- per hectare respectively. The net return was found to be Rs 34161/- per hectare. The observed benefit cost ratio was 2.43 and 1.92 at cost A1 and Cost C, respectively.

Market Survey of MAPs in northern Uttar Pradesh

Major markets of medicinal and aromatic plants were surveyed at different locations in northern part of the Uttar Pradesh. These included Faizabad, Bareilly, Barabanki and Lucknow. Major commodities traded in these markets were found as ashwagandha, satavar, kalmegh, serpgandha, amla, dry rose flowers and in essential oils menthol mint, lemongrass, palmarosa, vetiver and tulsi. About 20 whole sellers, retailers and buyers were contacted/ interviewed during the study.

Input: Narendra Kumar

Pharmacognostical standardization of *Euphorbia L.* species

Euphorbia thymifolia L. is an important medicinal plant used in traditional system of medicine. During survey, it has been found that *E. prostrata* and *E. hirta* are used as substitute due to similar names and phenotypic characters. In this study, phenotypic, anatomical characters and ISSR marker based studies were carried out to delineate these species. Phenotypic characters i.e. distribution of hairs on capsules, and stipules morphology; anatomical characters i.e. thickness of xylem region and pith region in the stem and midrib size in the leaf are distinguishing characters. These characters integrated with ISSR based molecular fingerprinting showed species-specific demarcation in *Euphorbia* species.

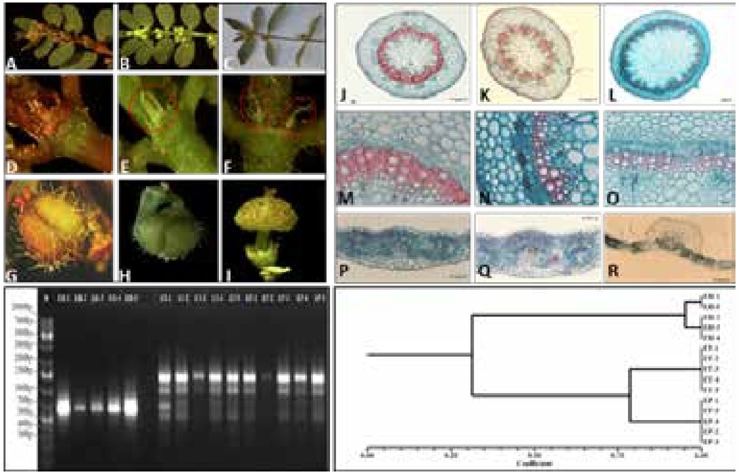


Fig : Morphological, microscopic and molecular authentication of Euphorbia L. species

Inputs: V Sunderesan

ISSR-derived species-specific SCAR marker for authentication of *Ocimum tenuiflorum* L.

Ocimum tenuiflorum L. has been widely used in traditional medicine and has high medicinal value. High volume trade of this potential medicinal plant species led to unscrupulous adulteration of both crude drugs as well as formulations. This study was aimed at developing species-specific DNA marker(s) for the authentication of *O. tenuiflorum*. A species-specific amplicon (279 bp) generated in all individuals of *O. tenuiflorum* was cloned, sequenced and a primer pair was developed (designated as CIM-OT-835F/CIM-OT-835R). The newly developed SCAR marker was validated through PCR amplification in all available seven species of *Ocimum* and its specificity for *O. tenuiflorum* was confirmed with consistent generation of an amplicon of 177 bp. This marker can be used for accurate and rapid identification of the species for certification purpose and will be useful in quality control of medicinal preparations containing this important medicinal species.

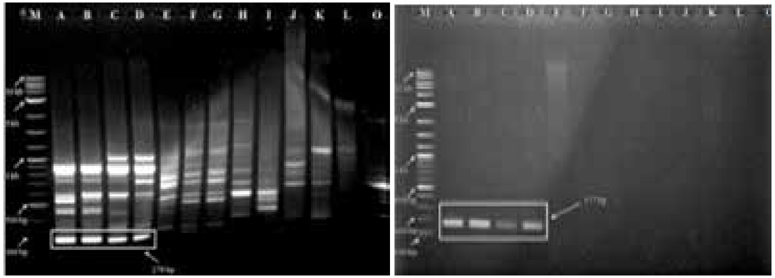


Fig : Agaose gel image indicating species-specific DNA amplification profiles using ISSR and SCAR markers in *Ocimum sp.* (A) ISSR profile of different *Ocimum* species clearing indicaing a 279 bp DNA band (in box) detecting *O. tenuiflorum*. SCAR profile of different *Ocimum* species clearing indicaing a 177 bp DNA band (in box) detecting *O. tenuiflorum*.

Character-based DNA barcoding for authentication and conservation of IUCN Red listed threatened species of genus *Decalepis* (Apocynaceae)

The steno-endemic species of genus *Decalepis* are highly threatened by destructive wild harvesting. The medicinally important fleshy tuberous roots of *Decalepis hamiltonii* are traded as substitute, to meet the international market demand of *Hemidesmus indicus*. In addition, the tuberous roots of all three species of *Decalepis* possess similar exudates and texture, which challenges the ability of conventional techniques alone to perform accurate species authentication. This study was undertaken to generate DNA barcodes that could be utilized in monitoring and curtailing the illegal trade of these endangered species. The DNA barcode reference library was developed in BOLD database platform for candidate barcodes *rbcL, matK, psbA-trnH, ITS* and *ITS2*. The average intra-specific variations (0–0.27%) were less than the distance to nearest neighbour (0.4–11.67%) with *matK* and *ITS*. Anchoring the coding region *rbcL* in multigene tiered approach, the combination *rbcL + matK + ITS* yielded 100% species resolution, using the least number of loci combinations either with PAUP or BLOG methods to support a characterbased approach. Species-specific SNP position (230 bp) in the *matK* region that is characteristic of *D. hamiltonii* could be used to design specific assays, enhancing its applicability for direct use in CITES enforcement for distinguishing it from *H. indicus*.

A B

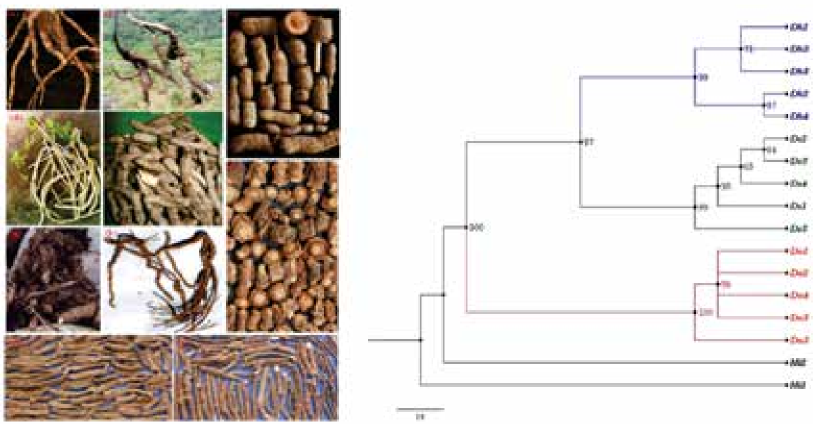


Fig : Morphology and relationship between different *Decalepsis* species. (A) Morphological view of (a - b) *Decalepis arayalpathra* fresh roots in wild (c) and Raw drug samples in markets (d), *D. hamiltonii* fresh roots (e) and dried roots in wild (f) and raw drug samples in markets (g), *D. salicifolia* fresh roots in wild (h) *Hemidesmus indicus* fresh roots in wild (i) Raw drug samples of *H. indicus* roots in markets (j) Raw drug samples of *H. indicus* stems in markets. (B) Strict consensus tree showing the relationship of *Decalepis* species resulting from maximum parsimony analysis using the barcode rbcL + matK + ITS. Tree length = 146, CI = 85%, RI = 91, RC = 78%. Bootstrap support values below 60% are not shown. Individuals corresponding to species monophyly: Red: *D. arayalpathra,* Green: *D. salicifolia*, Blue: *D. hamiltonii*.

Input: Rakesh K Shukla

Identification of transcripts encoding key enzymes of bacoside synthesis in *Bacopa monnieri*

Bacopa plant extract and isolated bacosides have well proven neuropharmacological activity. It's a unique single plant-based formulation containing enriched bacosides fraction with memory-enhancing effect. The major limitation with bacosides is its availability as the bacoside content is low in plants and they start degrading once the leaf is harvested from the plants. With this much of background information, in the present project, we have studied the tissue-specific transcriptome analysis of *Bacopa monnieri*. The analysis with two independent biological replicates has identified many pathway enzyme transcripts with its tissue-specific expression. These specific rate-limiting enzymes and their isoforms are under process of characterization to divert the flux towards higher saponin content. The regulators of the bacoside biosynthetic pathway and modifying enzymes are also taken up for characterization to reduce the postharvest loss of bacosides. Some of the pathway enzymes are shown to be a target of small RNA in this important medicinal plant. We have validated these miRNA and their enzyme targets *in-vitro*. Presently we are characterizing these miRNAs to divert the metabolic pathway. Taken together, we are characterizing the identified biosynthetic pathway enzyme transcripts and regulators with an aim to either enhance the bacoside content or to reduce the postharvest loss in *Bacopa monnieri* for human health benefits

Inputs: Sunita Singh Dhawan

Development of a perennial, resistant to logging, evergreen cold tolerant linalool rich *Ocimum* HYBL-1

A new perennial evergreen cold tolerant Ocimum HYBL-1 with high herb, essential oil yield, linalool rich strain developed. Essential oil yield = 200kg/ha V/s check = 140 kg/ha; (-) Linalool content =75-80% / 70%. In check variety CIM- Surabhi, it is ever green, resistant to logging and perennial in nature with suitability to multicutting v/s CIM-Surabhi. Expression profiling was done to demonstrate the cold tolerant behaviour and changed chemical profiles.

Analyzing trichomes and spatio-temporal expression of a cysteine protease gene mucunain in *Mucuna pruriens* L. (DC)

The mucunain was found in every stage of plant growth, but it was highly expressed during maturity (about 170 days) with a high FPKM value. The white-seeded variety compared to wild genotype (largest trichome length 2015 ± 29 μm) was most suitable due to small trichome size and less trichome density. Spatio-temporal quantification of the putative l-DOPA biosynthetic pathway genes and its correlation with respective metabolites was established. L-tyrosine, l-DOPA and dopamine from all plant parts were quantified..

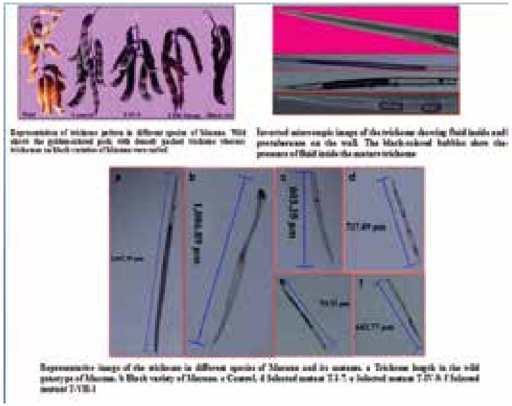


Fig : Spatial temporal analysis of the putative l-DOPA pathway in *M .pruriens*

Input: Ashutosh K Shukla, Ajit K Shasany and Feroz Khan

Differentially expressed peroxidases from *Artemisia annua*

The role of peroxidases has been hypothesized in artemisinin metabolism in *Artemisia annua* owing to the presence of an -O-O- linkage in the sesquiterpene lactone molecule. Earlier, a microarray was done to identify differentially expressed genes, including peroxidases, in *A. annua* growth stages having contrasting artemisinin content. Here, three predicted Class III *A. annua* peroxidases, Aa547 (higher expression in low-artemisinin stage) and Aa540 and Aa528 (higher expression in high-artemisinin stage), showing strong gene expression pattern (as per EST counts in UniGene) associated with trichomes were selected for full-length cloning, tissue-specific expression profiling and *in-silico* analyses.The full length coding sequences of these genes were submitted to the NCBI GenBank under Accession Numbers JX846611 (Aa547), KT726911 (Aa540) and KT726910 (Aa528).The upstream genomic region of *Aa547* was cloned and various cis-regulatory elements were identified. This region containing the partial CDS, 5′ UTR and promoter of Aa547 was submitted to gene bank under accession number KT778248.

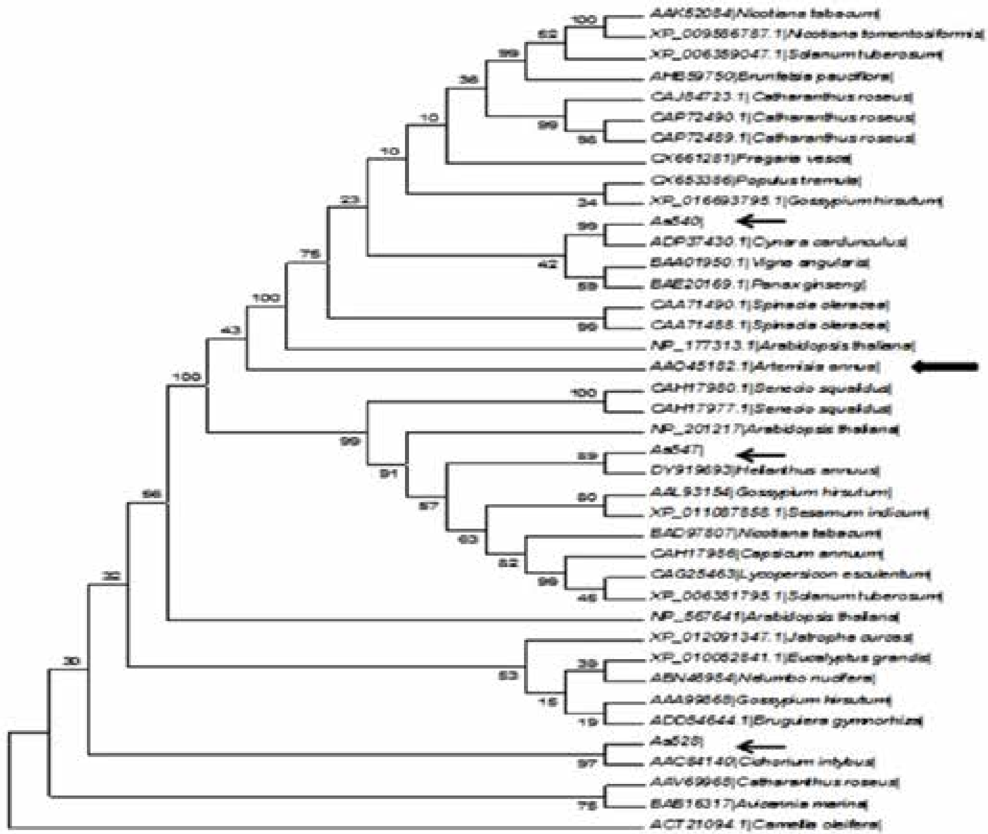


Fig : Unrooted maximum parsimony phylogenetic tree comparing the predicted amino acid sequences of *A. annua* peroxidases (from this study, marked with arrows) with those of earlier reported peroxidases from various plant species (including *A. annua*, indicated by a box arrow).

Input: Vikant Gupta

Studies on secondary metabolism and trichome development in Artemisia annua

Artemisinin, the renounced anti-malarial sesquiterpene lactone, is synthesized and accumulated in the glandular trichomes of stems, leaves and inflorescences of *Artemisia annua* L (Family: Asteraceae). It is believed that the development and biochemical contents of glandular trichomes are regulated by defence-related pathways. This developmental pathway and many involved genes are well studied in the model plant *Arabidopsis thaliana*. Trichome development-related gene homologs such as *GL2, TTG1, MIXTA-like* gene (*nok* gene) were previously identified and cloned from *A. annua*, and were preliminary characterized in the model plant *Arabidopsis*. *AaMIXTA-like 2* from *A. annua* was found to alter the trichome structure in *Arabidopsis* and could compliment the nok mutant phenotype. *AaMIXTA-like 2* was able *to* induce twin trichomes in the model plant studied. Assuming that it may alter the trichome architecture and number of trichome cells, it is being over-expressed in A. annua (homologous system). The standardization of induction of callus, transformation, regeneration of plantlets through calli is under progress for further obtaining transformants of *A. annua* plant. Similarly, *AaWRKY* and *AaMYC* homologs from *A. annua* were studied previously which positively regulated the secondary metabolism. Attempts are also being made to overexpress these genes in this plant for enhancing the secondary metabolite content.

Input: Dinesh A Nagegowda

Deciphering the regulation of withanolides biosynthesis in Ashwagandha

Ashwagandha (*Withania somnifera*) a medicinal plants of high repute owing to the presence of steroidal lactone triterpenoids called withanolides. However, not much work has been done towards understading the biosynthesis and regulation of withanolides. Here, we have functionally characterized a WRKY (*WsWRKY1*) transcription factor from Ashwagabndha and demonstrated its role in withanolides biosynthesis using *in planta* molecular approaches. Virus-induced gene silencing (VIGS) of *WsWRKY1* resulted in stunted plant growth, reduced transcripts of phytosterol pathway genes with corresponding reduction in phytosterols and withanolides in *W. somnifera*. Its overexpression elevated the biosynthesis of triterpenoids in *W. somnifera* (phytosterols and withanolides), as well as tobacco and tomato (phytosterols). Moreover, WsWRKY1 binds to W-box sequences in promoters of *W. somnifera* genes encoding squalene synthase and squalene epoxidase, indicating its direct regulation of triterpenoid pathway. Furthermore, while *WsWRKY1* silencing in *W. somnifera* compromised the tolerance

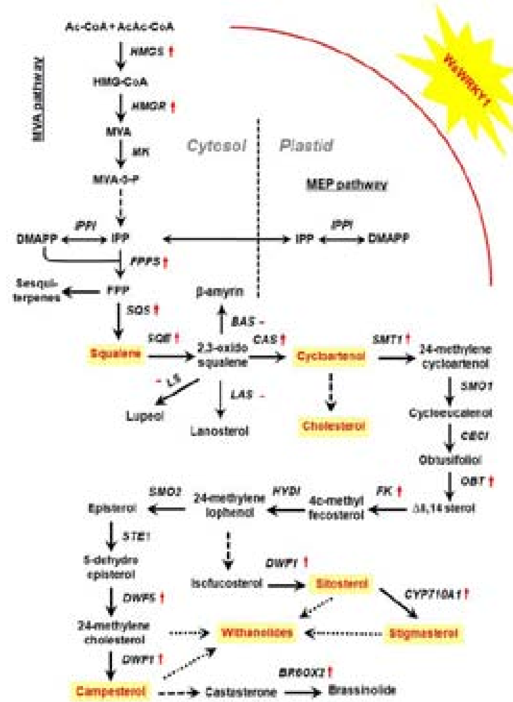


Fig : Schematic summary of effect of WsWRKY1 on triterpenoid pathway genes and metabolites. Arrows and boxed metabolites indicate upregulation to bacterial growth, fungal infection, and insect feeding, its overexpression in tobacco led to improved biotic stress tolerance. Overall, our findings demonstrate that *WsWRKY1* has a positive regulatory role on phytosterol and withanolides biosynthesis, and defense against biotic stress, highlighting its importance as a metabolic engineering tool for simultaneous improvement of triterpenoid biosynthesis and plant defense.

Insights into the biosynthesis of terpenoid and carbazole alkaloids in curry leaf (Murraya koinigii)

Curry tree (*Murraya koenigii* L.) is a rich source of aromatic terpenes and pharmacologically important carbazole alkaloids. To understand the biosynthesis of leaf volatile terpenoids and pharmaceutically important carbazole alkaloids, leaf transcriptome sequence data was generated using NGS technology. Analysis of de novo assembled contigs yielded genes for terpene backbone biosynthesis and terpene synthases. Also, gene families possibly involved in carbazole alkaloid formation were identified that included polyketide synthases, prenyltransferases, methyltransferases and cytochrome P450s. Further, two genes encoding terpene synthases (*MkTPS1 and MkTPS2*) were cloned and functionally characterized. Enzymatic characterization of recombinant proteins revealed that MkTPS1 produced primarily monoterpene (-)-sabinene from geranyl diphosphate (GPP), whereas and MkTPS2 catalyzed the formation of sesquiterpene α-farnesene. Overall, the transcriptome data generated in this study will be a great resource and the start point for characterizing genes involved in the biosynthetic pathway of terpenoids and medicinally important carbazole alkaloids.

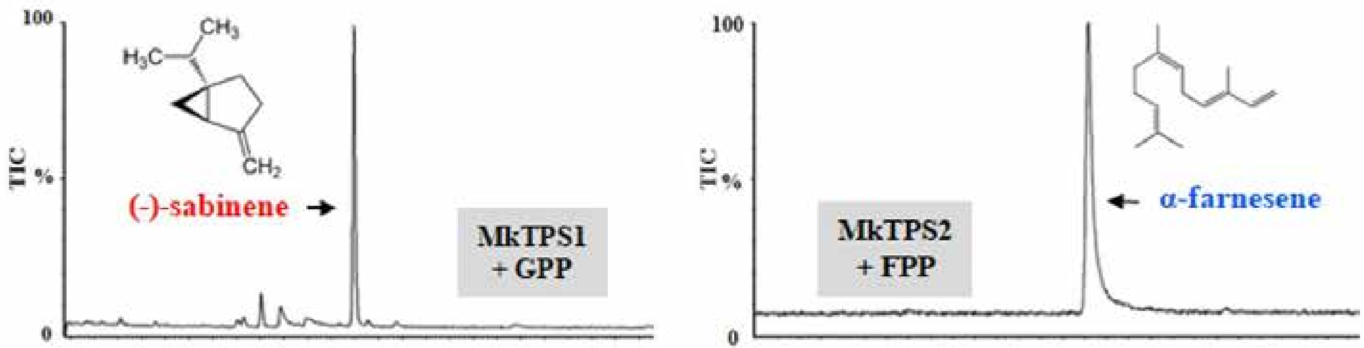


Fig : GC-MS analysis of products formed by recombinant MkTPS1 and MkTPS2 in presence of FPP and GPP, respectively

Input: Feroz Khan

- **Developed 3D Quantitative Structure-Activity Relationship (QSAR) model for Maslinic acid** analogs based on *in vitro* antiproliferative activity data of breast cell line MCF7, revealing anticancer mechanism via targets AKR1B10, NR3C1, PTGS2 & HER2 for analog P-902.
- **Developed 2D QSAR model for Tormentic acid derivatives** based on *in vitro* antiproliferative activity data of breast cell line MCF7, revealing anticancer mechanism via targets CD28, IL-1, NF-kB & MIF for analog NB-12.
- **Developed 2D QSAR model for Withanolidean alogs** based on *in vitro* antiproliferative activity data of breast cell line MCF-7/BUS & SKBR3, revealing anticancer mechanism via target beta-tubulin for Withanolide E & analog AC1MOP9K.
- **Identified structure-activity relationship based mechanism of action of Serpentine and Gallic acid** through *in vitro* evaluation for anticancer activity targeting PI3Kγ signalling pathway.
- **Reviewed a case study** of past 18 years on international trade trends in medicinal and aromatics plants.
- **Developed QSAR models based anticancer activity prediction & virtual screening** online tool for selected chemical series (Q-Lead) (http://bioinfo.cimap.res.in/qlead/) and Aroma small molecules database (Aroma Db) (http://bioinfo.cimap.res.in/aromadb/).

Fig : Snapshots of webpages of Q-Lead and AROMA databases

Database Developed

- Developed an online tool viz., Q-Lead for anticancer activity prediction/virtual screening of active compounds for selected chemical series through in-house derived 2D QSAR models (http://bioinfo.cimap.res.in/qlead/ .
- Developed an online aroma/fragrance small molecules data base viz., Aroma Db database based on aromatic & medicinal plants, essential oils, activity, induced human genes information for aroma therapy purposes, and trade information (http://bioinfo.cimap.res.in/aromadb/).

Inputs: Laiq-Ur-Rehman

Cloning and functional characterization of quinolinic acid phosphoribosyl transferase (QPT) gene of *Nicotiana tabacum*

The quinolinic acid phosphoribosyl transferase (QPT) is a key enzyme; known to convert the quinolinic acid into nicotinic acid mononucleotide. This QPT gene also plays an essential role in pyridine nucleotide cycle along with nicotine alkaloid biosynthetic pathway. However, the clear role is yet to be characterized to validate the actual function of this gene in planta. In the present study, RNAi approach has been applied to reveal the role of QPT. Firstly, the hairy roots were induced via RNAi construct using leaf explants and further regenerated into plants and shifted to glasshouse. The HPLC analysis of hairy roots and regenerated plants containing silenced QPT gene has shown altered alkaloid biosynthetic cycle, with substantially reduced content of nicotine and anabasine. Indeed, apart the regenerated QPT silenced plants follows a significantly altered phenotype and growth pattern. The silencing of QPT resulted in decrease in chlorophyll content, maximum quantum efficiency of PSII, net CO2 assimilation and starch content. Overall results obtained during the study, clearly demonstrate that QPT is a crucial gene of alkaloids biosynthesis as well as in plant growth and development.

Comparative transcriptome analysis reveals candidate genes for the biosynthesis of natural insecticide in *Tanacetum cinerariifolium*

Tissue specific transcriptome analysis of the non-model plant *T. cinerariifolium*, a total of 23,200,000 and 28,500,110 high quality Illumina next generation sequence reads, with a length of 101 bp, were generated for the flower and leaf tissue respectively. After functional enrichment analysis and GO based annotation using public protein databases such as UniRef, PFAM, SMART, KEGG and NR, 4443 and 8901 unigenes were identified in the flower and leaf tissue respectively. These were assigned to 13344 KEGG pathways and the pyrethrin biosynthesis was contextualized. The 2-C-methyl-D-erythritol 4-phosphate (MEP) pathway was involved in the biosynthesis of acid moiety of pyrethrin and this pathway predominated in the flowers as compared to the leaves. However, enzymes related to oxylipin biosynthesis were found predominantly in the leaf tissue, which suggested that major steps of pyrethrin biosynthesis occurred in the flowers. Transcriptome comparison between the flower and leaf tissue of *T. cinerariifolium* provided an elaborate list of tissue specific transcripts that was useful in elucidating the differences in the expression of the biosynthetic pathways leading to differential presence of pyrethrin in the flowers. The information generated on genes, pathways and markers related to pyrethrin biosynthesis in this study will be helpful in enhancing the production of these useful compounds for value added breeding programs.

Inputs: Mukti Nath Mishra

Metabolic engineering in *A. brasilense* to by *rpoE1* deletion to switch-off high-flux isoprenoid pathway and enhance FPP accumulation

Farnesyl pyrophosphate (FPP) can be converted to amorphadiene (an artemisinin precursor) by amorphadiene synthase. Our earlier studies show that RpoE1 (ECF sigma factor) positively regulates carotenoid biosynthesis in *A. brasilense*, and this sigma factor and carotenoids are dispensable for this bacterium. we deleted *rpoE1* from *A. brasilense* genome to develop Δ*rpoE1* strain. which completely lacks the carotenoids,. This would help to uncouple the growth and production phase, which is a major requirement for fermentation processes to formulate appropriate media for growth and production phase.

Metabolic engineering in *A. brasilense* to by *crtE1* deletion to minimize the carbon flux toward GGPP and enhance FPP accumulation

Our studies have shown that *A. brasilense* has two paralogs of FPP/GGPP synthase, CrtE1 and CrtE2, and CrtE1 is more efficient than CrtE2, Additionally, both crtE1/2, are bifunctional enzymes catalyzing the synthesis of FPP and GGPP from amorphadiene synthase (ADS) needs FPP as a substrate, we engineered the strain to reduce the carbon flux to GGPP. To achieve this, *crtE1*was deleted in Δ*rpoE1* to develop Δ*rpoE1*-Δ*crtE1*.

Development of efficient expression system to express exogenous genes in *A. brasilense*

A system for efficient expression of exogenous genes in *A. brasilense*, a prerequisite for metabolic engineering, is presently lacking. The activities of the available bacterial expression systemss are suited only for Enterobacteriaceae as they require expression systems located on broad-host range (BHR) vectors, which are usually very low in copy number, and hence low expression efficiency. The issue can be resolved by using an more efficient promoter of gene expression. We have selected aldehyde dehydrogenase promoterof *A. brasilense* and developed an expression system which is >25-fold stronger than *lacI*-P_{lacZ} expression system.

Inputs: Pradipto Mukhopadhyay

Increasing abiotic/biotic stress tolerance in Rose-scented geranium (Pelargonium graveolens cv CIM-Pawan) usimg CRISPR technique

Rose-scented geranium cultivation is highly profitable (essential oil CIMAP price: Rs18000/kg) but the crop is destroyed every year by fungal infections during the humid and rainy season. As a part of the CSIR-Aromamission, my lab is trying to develop new varieties of this plant utilizing CRISPR-Cas technology which are expected to have better resistance to fungal infection. For this, homologs of gene coding of cell wall-related and endogenous signaling pathway proteins are being searched in the available *Pelargonium* transcriptome database for designing efficient CRISPR construct against suitable genes.

Improving root biomass/texture in *Withania somnifera*

Withania somnifera (an internationally recognized high-on-demand medicinal plant for its roots) is represented by a large number of varieties. Of these, the most elite one, Nagori suffers badly from low root biomass while other commercial varieties like Poshita develop undesirable fibrous texture. My lab is presently trying to identify the factors involved in root biomass development and fibrous texture generation which will be targetted by CRISPR technology to develop better varieties. We have identified a few genes encoding peptides similar to the CLE class in *Withania* transcriptome data which are being analyzed further. Under CSIR-Phytopharmaceutical mission program, the plants will be treated with various physicochemical agents to increase the biomass of the roots of *Withania* plants.

Identifying genes associated with the synthesis of high importance metabolites in *Eclipta prostrata*

Eclipta prostrata is another highly important medicinal plant which has hair growing and liver protection activities and is a source of many important and high demand phytochemicals like wedelolactone and few triterpene saponins. Initial studies in my lab indicate the abundance of wedelolactone varies concerning the developmental stage of the plant parts. My lab is trying to identify the genes associated with their sytheisis and a project (for funding) submitted to an external agency in context to the same is under review.

Knocking out antibiotic selection markers from transgenics: My lab has also developed a CRISPR Contruct against Kanamycin gene to knowckout the same from overexpression transgenics so that they become commercially acceptable.

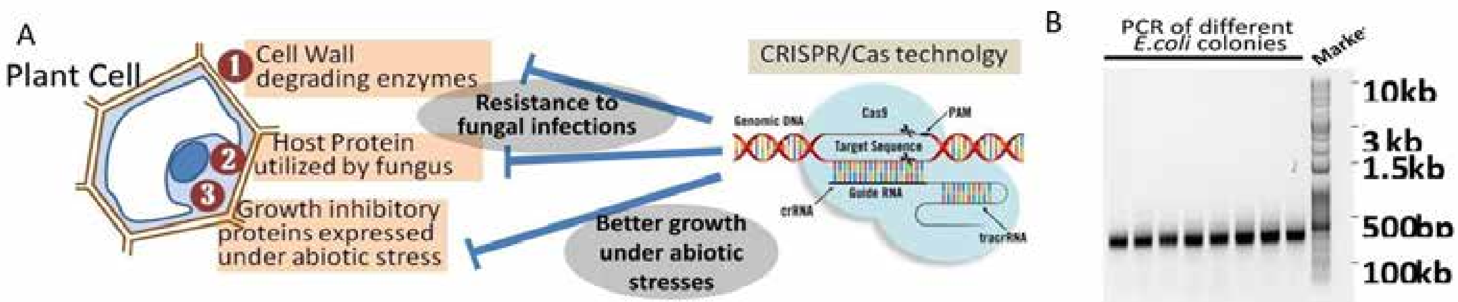


Fig : CRISPR target selection and sgRNA cloning for developing superior varieties of MAPs. (A) Different categories of genes being targeted by CRISPR-technology for generation of better varieties of Rose-scented Geranium plant. (B) Agarose gel image showing CRISPR Cconstruct preparation against kanamycin resistance Gene.

Input: Sumit Ghosh

Ocimum basilicum CYP716A252 and CYP716A253 catalyze C28 oxidation in the pentacyclic triterpene biosynthesis

Sweet basil (*Ocimum basilicum*) accumulates bioactive ursane- and oleanane-type pentacyclic triterpenes (PCTs), ursolic acid and oleanolic acid, respectively, in a spatio-temporal manner. However, specific biosynthetic enzymes remained to be elucidated. We identified two CYP716A subfamily cytochrome P450 monooxygenases by screening a methyl jasmonate (MeJA)-responsive expression sequence tag (EST) collection and functionally characterized these P450s, employing yeast (*Saccharomyces cerevisiae*) expression platform and adapting virus-induced gene silencing (VIGS) in sweet basil. Combinatorial expression of amyrin synthases (ObAS1 and ObAS2), CPR, CYP716A252 and CYP716A253 in yeast revealed that both CYP716A252 and CYP716A253 catalyzed C-28 oxidation of α-amyrin and β-amyrin to ursolic acid and oleanolic acid, respectively, albeit with a different efficiency. A comparison of the relative levels of PCTs revealed higher amounts of α-amyrin- and β-amyrin-oxidation products in yeast strains-expressing *CYP716A253*, suggesting a better efficiency of CYP716A253 as compared with CYP716A252. Silencing of *CYP716A252* and *CYP716A253* by VIGS resulted in significantly reduced levels of these transcripts, and ursolic acid and oleanolic acid in sweet basil leaves suggesting essential roles of CYP716A252 and CYP716A253 for the *in planta* biosynthesis of PCTs. However, a major role of *CYP716A253* than *CYP716A252* was assumed in elicitor-induced PCT biosynthesis owing to its higher responsiveness to elicitor treatments and were also substantiated by a increased concentration of ursolic acid and oleanolic acid was determined in *CYP716A252*-silenced but not *CYP716A253*-silenced seedlings following MeJA treatment. These results confirmed an important function of CYP716A253 in elicitor-induced biosynthesis of PCTs.In summary, two P450s (CYP716A252 and CYP716A253) of sweet basil were identified and found to participate *in planta* PCT biosynthesis. These two genes might be useful in plant genetic improvement for increased PCT content and for developing alternate sustainable production hosts for PCTs following a synthetic biology approach.

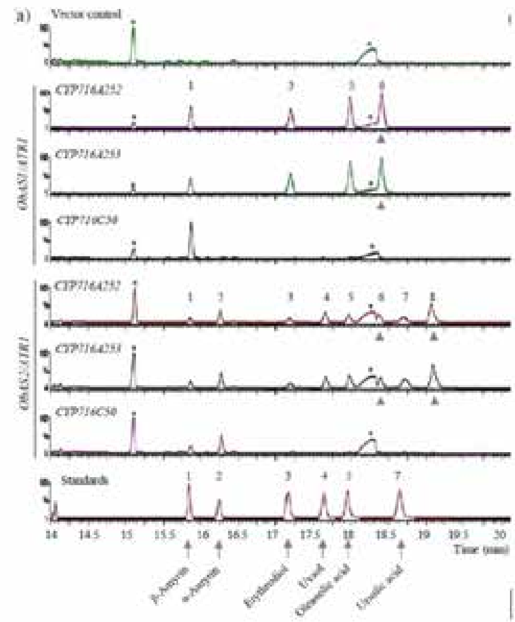


Fig : GC-MS chromatograms showing oxidation of α-amyrin and β-amyrin to ursolic acid and oleanolic acid, respectively, by CYP716A252 and CYP716A253 but not by CYP716C50, in engineered yeast strains. Vector control strain was transformed with empty vectors.

Inputs: Abha Meena and Suaib Luqman

Establishment of Murine Tumor Models

At CSIR-CIMAP, we have standardized two types of tumor models for evaluating potent anticancer molecules, fractions and extracts.

a. **Ehrlich Ascites Carcinoma**: It is an undifferentiated carcinoma that grows inside a peritoneal cavity in ascites form and is maintained in inbred BALB/c mice by serial intraperitoneal (i/p) passages. It has highly transplantable capability. It has no-regression, shows rapid proliferation with shorter lifespan and high malignancy.

b. **Sarcoma-180 Ascites**: It is a tumor of mouse mesenchymal tissues. It grows inside the peritoneal cavity of Swiss Albino mice in ascites form. It has the higher transplantable capability with no-regression. It proliferates rapidly, has a shorterlifespan with ~100% malignancy rate.

Two compounds (267 and 269) along with 5 Florouracil (standard) have been tested in mice and the observations were recorded.

Input: Prema G Vasudev

Isolation of novel insecticidal protein from *Tecteria macrodonta*

A novel insecticidal protein, Tma12, isolated from the fern *Tecteria macrodonta,* has been unambiguously characterized as a lytic polysaccharide monooxygenase (LPMO) through X-ray crystallographic studies in collaboration with CSIR-NBRI. The 2.2Å resolution crystal structure of this protein provides the first evidence of the occurrence of LPMOs in plants.

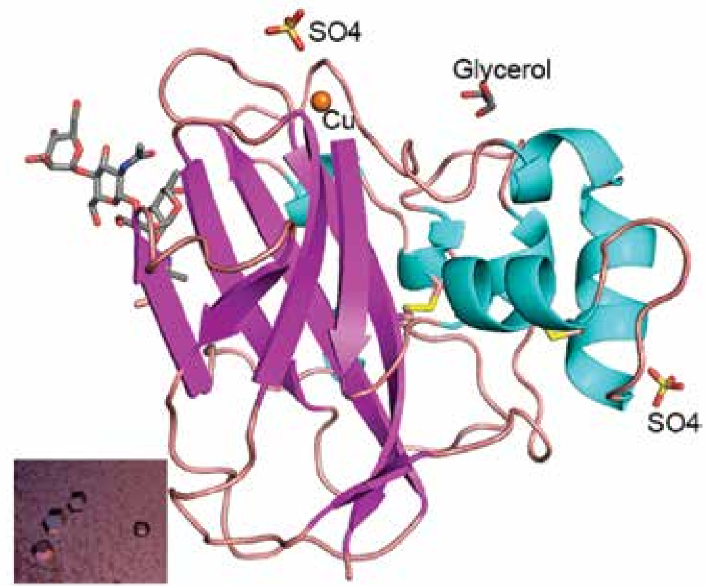


Fig : Crystal structure of Tma12 and single crystals used for the study (inset)

Input: MP Darokar

Synergy of phytomolecules with antibiotics

Citral, a monoterpenoid aldehyde was found to interact synergistically, reducing minimum inhibitory concentration (MIC) of Norfloxacin, a fluoroquinolone class of antibiotics up to 4-32 folds with fractional inhibitory concentration index (FICI) ≤ 0.50 against methicillin resistant clinical isolates of *Staphylococcus aureus* (MRSA). In *in vivo* assay using Swiss albino mice, combination of Citral and Norfloxacin could reduce the staphylococcal load of spleen and liver tissues in a dose-dependent manner and did not exhibit any mortality or morbidity up to a single dose of 500 mg kg^{-1} body weight. Similarly, Chanoclavine isolated from *Ipomoea muricata* exhibited synergy with Tetracycline against multidrug resistant clinical isolate of *Escherichia coli* (MDREC). Although chanoclavine did not show antibacterial activity of its own, but in combination, it could reduce the minimum inhibitory concentration (MIC) of tetracycline (TET) up to 8-16 folds. Chanoclavine was found to inhibit the efflux pump which seems to be ATPase dependent. In real time expression analysis, chanoclavine showed down regulation of different efflux pump genes and decreased the mutation prevention concentration of tetracycline. Further, *in silico* docking studies revealed significant binding affinity of chanoclavine with the proteins known to be involved in bacterial drug resistance. (Phytomedicine 2017, 34: 85-96)

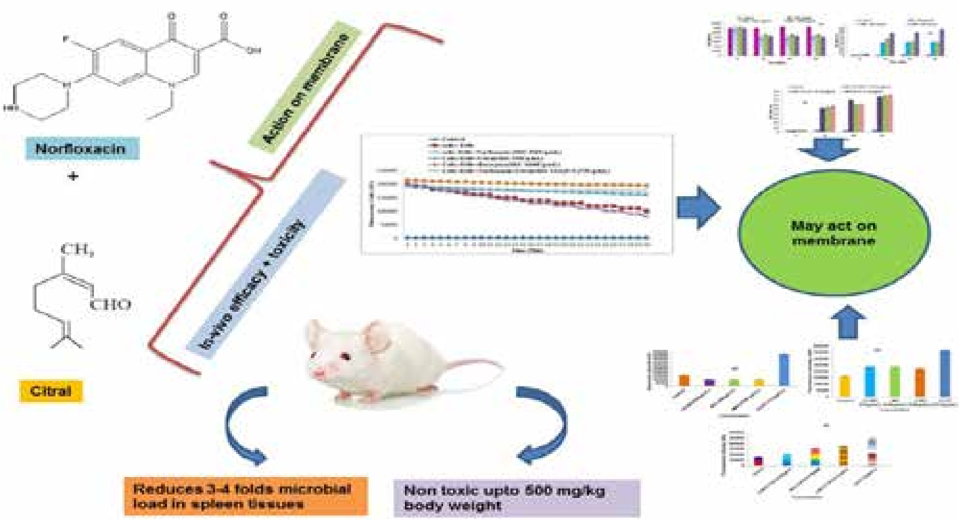


Fig : Citral interacts synergistically with norfloxacin against methicillin resistant *S. aureus*

Input: DU Bawankule

Essential oil from waste peels of *Citrus limetta* (*Clp-EO*) alleviate skin inflammation

Citrus limetta Risso (Rutaceae), commonly known as sweet lime is one of the important commercial Citrus fruit crops used by juice processing industries in the all continents. *C. limetta* comprised of 8–10% peel, which is perishable waste material creates a big challenge in processing industries as well as pollution monitoring agencies. One of the important products of citrus fruit peels is the essential oil, which is pleasant sensory characteristics and it is broadly used in cosmetic and pharmaceutical products. In this study, we investigated the chemical composition and *in-vitro*, *in-vivo* anti-inflammatory potential of essential oil extracted from the waste peels of *Citrus limetta* (*Clp-EO*). Results of the study demonstrated the presence of monoterpene hydrocarbon and limonene as the major component. Pre-treatment of *Clp-EO* to the macrophages was able to inhibit the production of pro-inflammatory cytokines (TNF-α, IL-6, IL-1β) in LPS-induced inflammation as well as the production of reactive oxygen species (ROS) in H2O2-induced oxidative stress. In *in-vivo* study, topical application of Clp-EO was also able to reduce the 12-O-tetradecanoylphorbol-13-acetate (TPA)-induced ear thickness, ear weight, lipid peroxidation, pro-inflammatory cytokines production and ameliorate the histological damage in the ear tissue. *In-vitro* and *in-vivo* toxicity study indicate that it is safe for topical application on skin. These findings suggested the preventive potential of *Clp-EO* for the treatment of inflammation linked skin diseases. (Journal of Ethnopharmacolology; doi: 10.1016/j.jep.2017.10.018)

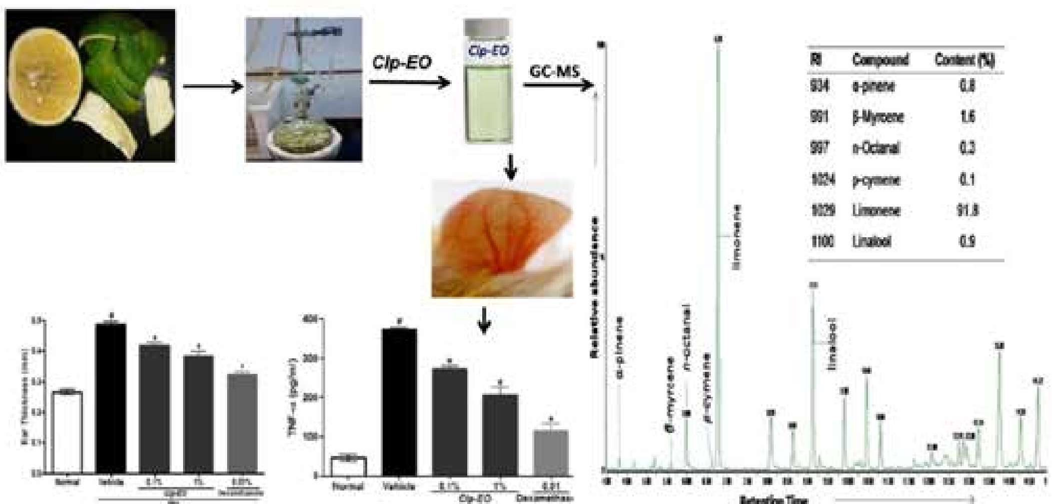


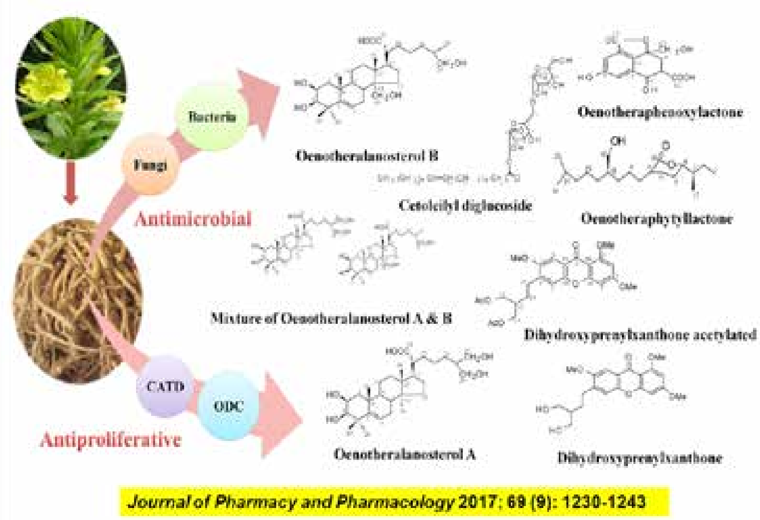
Fig: Graphical extract of preperation and characterization of Essential oil from waste peels

Inputs: Suaib Luqman, MP Darokar, A Pal, DU Bawankule, K Shanker and A Ahmad

Fraxetin and ethyl acetate extract from *Lawsonia inermis* L. (Henna) ameliorate oxidative stress in *P. berghei* infected mice by augmenting antioxidant defence system.

Antiproliferative and antimicrobial activity of compounds isolated from the roots of *O. biennis* L

Antiproliferative and antimicrobial activity of compounds/mixture (1-8) isolated and characterized from the roots of *O. biennis* L. A possible mechanism of antiproliferative activity was also studied by targeting ornithine decarboxylase (ODC) and cathepsin D (CATD). Oenotheralanosterol B (3) exhibited stronger antiproliferative and antimicrobial potential with respect to the other compounds tested, whereas oenotheralanosterol A (1) was a potent inhibitor of ODC and CATD.



Input: DN Mani

Bioevalution of selected medicinal and aromatic plants (MAPs) for their antipyretic potential

Pyrexia or fever is defined as an increase in body temperature. According to *Ayurveda*, pyrexia occurs due to the combined effect of indigestion, alteration in environmental condition or seasonal change. Several indigenous drugs have been described in *Ayurvedic* texts for the management of pyrexia. After a thorough search and pre-analysis, three plant extracts (T1, T2 and T3) were found highly effective in normalizing the elevated body temperature. Promising antipyretic activity was observed for them in the brewer's yeast-induced hyperthermia (in rat model), whereby paracetamol was used as the standard antipyretic drug.

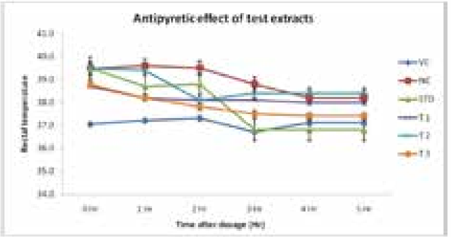


Fig : Temperature curves of the normal rats and the fever rats (mean $\pm$ SE, $n = 6$)

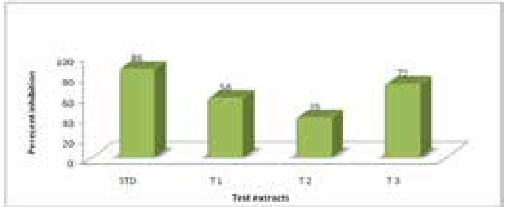


Fig : Percentage reduction of rectal temperature of standard and test extracts.

Input: D Chanda

Cardiovascular potential of natural products

The recent observations from *in-vitro*, *ex-vivo* and *in-vivo* studies showed potent cardiovascular potential of benzimidazole and naphthoquinone class of compounds. Potassium channel sensitive vasorelaxation responses were recorded in isolated mesenteric artery and aorta by one class of compounds while another class of compounds showed potent calcium channel dependent response against vascular hyporeactivity and producing concentration dependent contraction of arterial tissues. *In-vivo* evaluation of the compounds having vasorelaxation responses showed potential for anti-hypertensive activity and are under evaluation. On the contrary, compounds producing contractions showed strong potential against vascular hyporeactivity associated with sepsis and endotoxaemic shock in vascular tissues like aorta and mesenteric artery in mice. The molecules are under *in-vivo* evaluation for survival kinetics, hemodynamic profiles and expression of important marker proteins. In a collaborative research with CSIR-CDRI, voltage dependent calcium channels have been found to be a major target in the reversal of vascular autophagy by chloroquine in renovascular model of hypertension in Wistar rats.

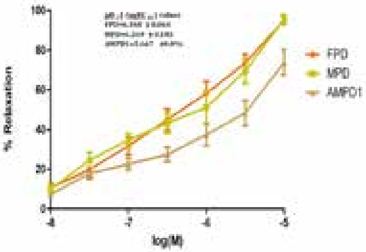


Fig : Compounds producing vasorelaxation in isolated mesenteric artery from Wister rats

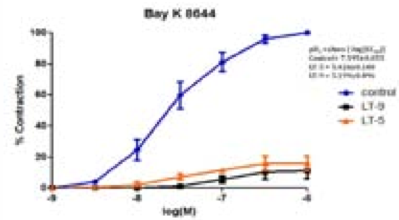


Fig : Concentration response curve of BayK 8644 (calcium channel agonist) in control mice aorta before and after treatment with LT9 (10μM)

Inputs: NP Yadav, S Luqman and D Chanda

Development, optimization, and characterization of a novel tea tree oil nanogel using response surface methodology

Nanoemulsion (NE)-based emulgel (EG) formulation was developed and optimized as a potential vehicle for topical delivery of tea tree oil (TTO). Central composite design was adopted for optimizing the processing conditions for NE preparation by high energy emulsification method viz. surfactant concentration, co-surfactant concentration, and stirring speed. Antimicrobial evaluation of EG with same amount of TTO as conventional gel revealed broader zones of growth inhibition against all the selected microbial strains. Moreover, EG was also found to be nonirritant (PII 0.0833). (Drug Dev Ind Pharm., 42:9, 1434-1445).

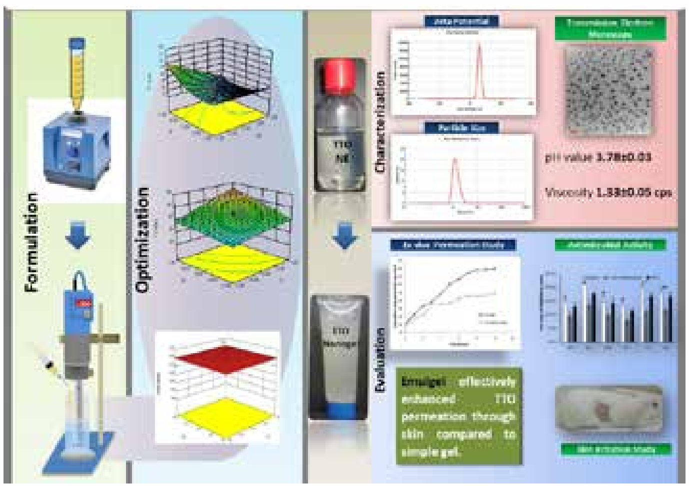


Fig: Tea tree oil nanogel preparation using response surface methodology

Inputs: NP Yadav and D Saikia

Development of single phyto-molecule based ACNE CURE GEL with defined biological, chemical and pharmaceutical standards

In the present formulation, a novel herbal lead in the form of pure phytomolecule with potent activity against *Propionibacterium acne* has been used. Combination of antimicrobial effect of phytomolecule and emollient effect of glycerin are casted in hydro-gel as an approach for the development of an herbal anti acne gel formulation. This formulation assures a natural and healthy acne free skin by inhibiting *P. acnes*.

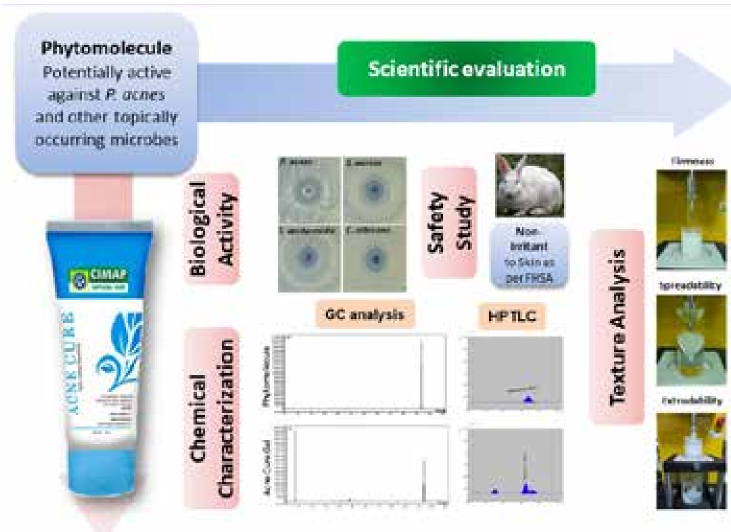
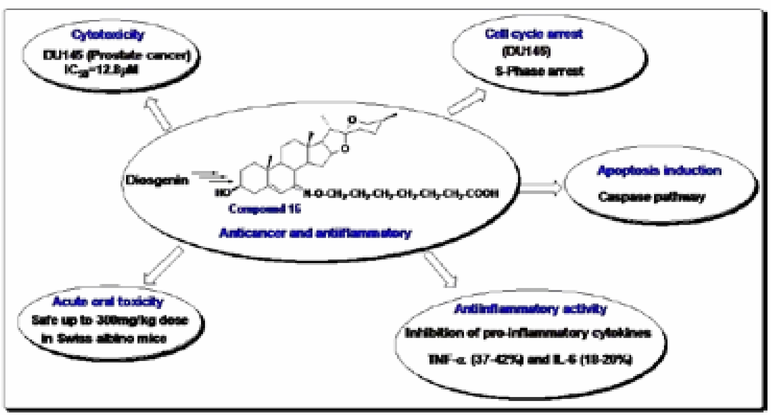


Fig: Acne Cure Gel

Input: Arvind Singh Negi, Debabrata Chanda, DU Bawankule, Feroz Khan, and Karuna Shanker

Value addition of diosgenin: (22β,25R)-3β-Hydroxy-spirost-5-en-7-iminoxy-heptanoic acid exhibits anti-prostate cancer activity through caspase pathway

Diosgenin has been modified into C7 long chain fatty acid/esters of 7-ketoxime as potential antiproliferative agents. Compound 16 exhibited potential anti-prostate cancer activity by inducing apoptosis in prostate cancer cells through caspase pathway. Compound 16 also exhibited antiinflammatory activity, simultaneously by inhibiting procytokines. Compound 16 was well tolerated and found safe up to 300 mg/kg dose in Swiss albino mice.



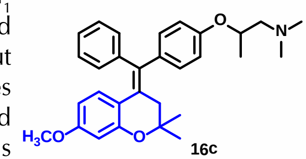
Steroids 2017, 119: 43-52

Input: Atul Gupta

Conformationally restricted benzopyran based triarylethylenes as growth inhibitors of carcinoma cells

A series of conformationally restricted benzopyran based triarylethylenes was characterized as potential growth inhibitors of breast carcinoma cells. The synthesized compounds (14a-b, 15a and 16a-e) presented significant growth inhibition of ER+ and ER- breast cancer cells within the range of IC_{50} 0.55-5.87 μM. Amongst other, 16c showed potent anticancer activity at IC_{50} 0.95 μM in MCF-7 cells with good selectivity (Selectivity Index 4.47) towards healthy cells. In cell cycle analysis, 16c significantly accumulated G2/M population with concurrent increase in sub G_1 populations (Figure). Further, 16c induced significant necrotic cell death without any apoptosis. The mechanistic studies performed for 16c showed that 16c elicited anticancer activity through necroptosis process.

a



b

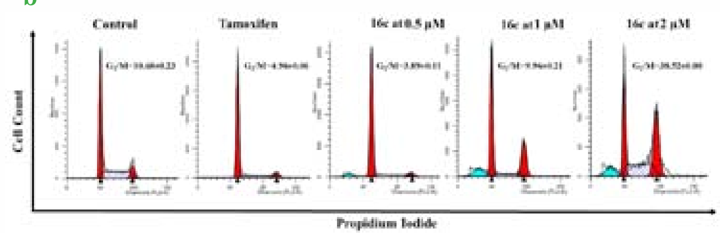


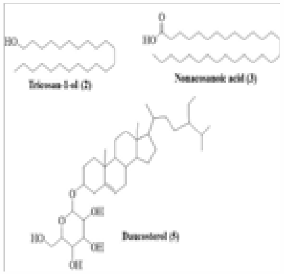
Fig: (a) Structure of 16c (b) Effect of 16c on cell division cycle (a) MCF-7 cells were treated with 16c at IC_{50} concentrations for 24 h and 48 h, stained with PI and were subjected to flow cytometry. (b) Histogram showing average population cells in various phases (G1, G2, S) of cell cycle (mean ± S.E. of three independent assays). A concentration dependent significant (***p<0.001) increase (in comparison to vehicle control) in G_2M phase cell cycle arrest was observed in all 16c treatment groups.

Input: KVN Satya Srinivas

Extraction and isolation of phytomolecules from *Cordia sebestena L*

Cordia sebestena L (Boraginaceae family) is also known as Geiger-Tree. The leaves of the plant possess anti hyperglycemic property against streptazotocin induced diabetes, and antihypolipidemic& potent antioxidant. The leaves were extracted hexane, acetone and methanol. The extracts were purified by column chromatography using silica gel yielded six compounds. The structure of the compound **2, 3** and **5** were elucidated based on NMR spectra and confirmed as tricosan-1-ol (2), nonacosanoic acid (3) and daucosterol (5)

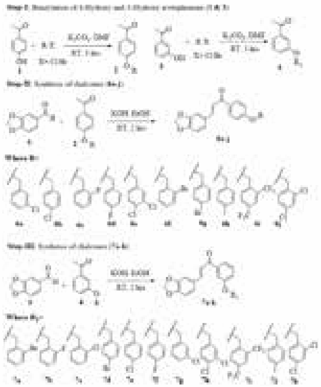

Cordia sebestena



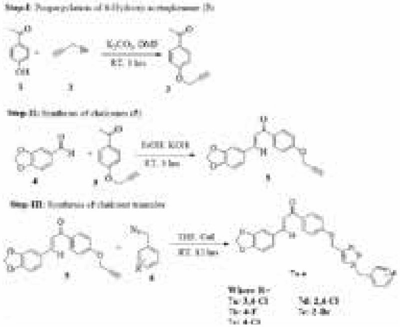
Synthesis and biological evaluation of novel piperonal chalcone and piperonal chalcone triazole derivatives

Taking into consideration the importance of piperonal, chalcones and 1,2,3-triazoles, we synthesized a series of piperonal chalcone derivatives and Piperonal chalcone 1,2,3-triazoles derivatives. In the first step 4 and 3 hydroxy acetophenones are coupled with different benzyl bromides in the presence of DMF and Potassium carbonate. Then brominated acetonphenones are condensation with piperonal in the presence of alcohol and KOH yielded novel twenty-one substituted piperonal chalcone derivatives (scheme-1).

Scheme-1



Scheme-2

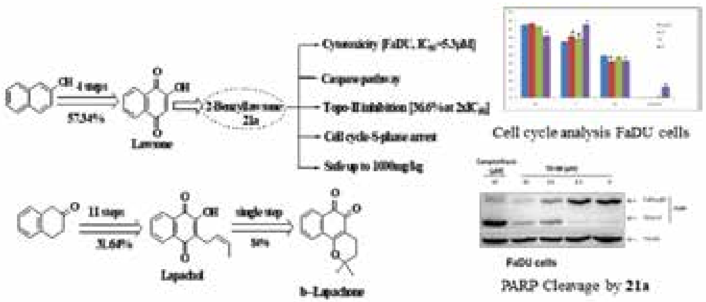


In the Scheme-2, the 4-hydroxy acetophenone is coupled with propargyl bromide in the presence of DMF and potassium carbonate. Then propargylated compound was condensed with piperonal in the presence of alcohol and KOH yielded (E)-3-(benzo[d][1,3]dioxol-5-yl)-1-(4-(prop-2-yn-1-yloxy) phenyl) prop-2-en-1-one. In the final step, compound **3** was coupled with different benzyl azidesunder click chemistry reaction conditions (Cu catalyzed 1,3-dipolar cycloaddition) in the presence of copper (I) iodide as catalyst in dry THF at room temperature for 12-14 hr yielded.

Input: Arvind Singh Negi, Suaib Luqman and Debabrata Chanda

Total synthesis of pharmacologically important naphthoquinones and anticancer activity of 2-Benzyllawsone through DNA topoisomerase-II inhibition

A simple and straight forward *de novo* synthesis of three naturally occurring naphthoquinones have been developed. Lawsone, lapachol and lapachone have been prepared from commercially available starting substrates. Further, 2-alkyl and 2-benzyl lawsone derivatives were also prepared as anticancer agents. Compound 21 exhibited potential antiproliferative activity against FaDU (hypopharynx cancer) cell line. It induced apoptosis through caspase pathway and exhibited topoisomerase-II inhibition activity. Compound 21 was safe in Swiss albino mice up to 1000mg/kg dose. [*Bioorganic Medicinal Chemistry* 2017, 25: 1364-1373.]



Input: CS Chanotiya

Scent from *Jasminum grandiflorum* flowers: Investigation of the change in linalool enantiomers

Jasminum species are among the most preferred fresh cut flowers in India since ancient times. The plant produces small and fragrant flowers, which are of great demand in several preparations and also in perfume industries. Floral volatiles of *Jasminum grandiflorum* L. were extracted using solid-phase microextraction and analyzed in enantioselective gas chromatography. The successive change in (*R*)- to (*S*)-linalool ratio from bud to mature flower was mainly due to the enantio- specific transformation and temporal decline of (*R*)-linalool producing gene. This enantiomeric change also leads to the difference in flower aroma.

Khusian-2-ol, vetiselinenol and ziza-6(13)-en-3α-ol were characterized in Vetiver variety CIM-Vriddhi.

Input: PK Rout

Production of glucose from spent aromatic biomass

The aromatic spent biomass is first de-lignified by using a novel process. Then after, the de-lignified biomass is used for the production of glucose using microbes i.e *Trichoderma* species. The schematic presentation of the process is given below.

The distillation aromatic biomass such as palmarosa, lemongrass,

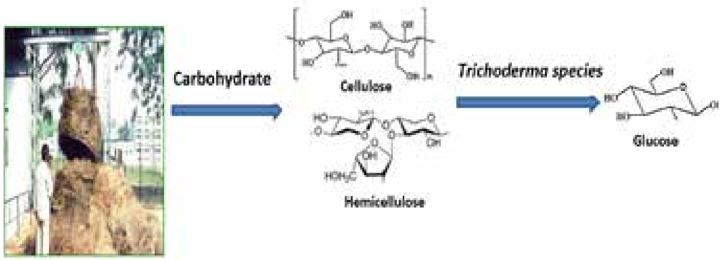


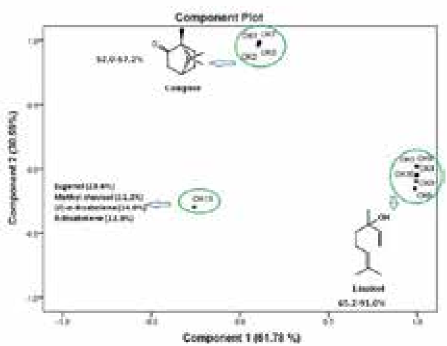
Fig : Production of glucose from spent aromatic biomass

citronella, mentha, ocimum, etc were de-lignified, and de-lignified biomass were used for the production of glucose through fungal saccharification process. The *Trichoderma* species such as *Trichoderma* *atroviride*, *Trichoderma harzianum* and *Trichoderma reesei* were used for the above saccharification reaction.

Input: Ram Swaroop Verma

Chemical composition, genetic diversity and biological activity of *Ocimum kilimandscharicum* Guerke

This study investigates the variations in the chemical, genetic, and biological activity (antibacterial, antifungal, and antioxidant) profiles of thirteen populations of *Ocimum kilimandscharicum* Guerke (OK1-OK13) from India. Correlations between chemical composition and the biological activities of *O. kilimandscharicum* were assessed. The essential oil (EO) content varied significantly among the studied populations (0.15– 0.93%). The EO analysis, and subsequent cluster and principal component analyses classified the populations in three distinct chemotypes, namely camphor (52.0–57.2%), linalool (65.2–91.0%), and phenylpropanoid/sesquiterpene. Amplification of genomic DNA using 20 inter simple sequence repeat (ISSR) primers yielded a total of 224 loci, out of which 210 loci were polymorphic in nature, representing 93.75% polymorphism. Pearson coefficient correlation (r = 0.32) suggesting low correlation between the distances obtained by molecular markers and EO compositions. The EO of population OK12 showed significant activity against *Staphylococcus epidermidis*, *Enterococcus faecalis*, and *Staphylococcus aureus*. However, EOs of populations OK11 and OK13 showed significant activity against *Candida albicans* (clinical isolate) and *Candida albicans* (ATCC), respectively. The EO of OK13 exhibited significant antioxidant activity. *In-vitro* safety evaluation study revealed that the EOs of most of the populations showed no significant toxicity against peritoneal macrophages cells. It is concluded that chemical and genetic profiles of *O. kilimandscharicum* varied considerably and these variations determined changes in its biological activities.



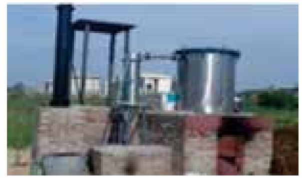
Input: Sudeep Tandon

Designing, fabrication and installation of distiilation units in various part of India

- Three Mobile SS distillation units of 500-600 kg / batch capacity and three CIM Asvika portable electric distillation units of 20-30 kg / batch for lemongrass, palmarosa and other aromatic grasses were designed, fabricated and installed up for ICAR Research Complex for NEH region, Meghalaya.The units have been successfully tested and commercialized at VillUnian, Meghalaya, Ukhrul, Manipal and Dimapur, Nagaland.

- 500kg / batch capacity MS directly fired type field distillation unit based on CIMAP know how and design was prepared, fabricated and successfully installed at Shillong, Meghalaya.

- SS distillation unit of 250-300 kg /batch capacity for distillation of lemongrass, palmarosa and other aromatic grasses was installed at Mohali, Punjab.



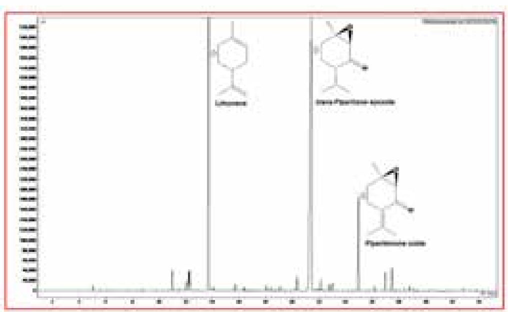
Input: Ashween D Nannaware

Designing and development of new process intensification solar distillation technology for essential oil extraction

In order to reduce the biomass consumption during the distillation of aromatic plants, a solar energy based distillation units was designed for the extraction of essential oil.

Input: RC Padalia

Characterization of *trans*-Piperitone epoxide and limonene rich chemotype of *Mentha arvensis* L.



Compounds	Content (%)
Limonene	32.62
***trans*-Piperitone epoxide**	43.74
Piperitenone oxide	6.97
β-Caryophyllene	1.38
α-Humulene	1.65

Mentha arvensis L. commonly known as menthol-mint is commercially cultivated in Indo-Gangetic plains and North West India for essential oil production. In present research, a new chemotype of *M.arvensis* is analysed by using gas chromatography and mass spectrometry method. Altogether, 34 constituents comprising 96.23% of the composition were identified. The essential oil was mainly composed of *trans*-piperitone epoxide (43.74%), limonene (32.62%), and piperitenone oxide (6.97%) as major constituents. The essential oil rich in *trans*-piperitone epoxide/ limonene was found to possess excellent antifungal activity (ZI: 27-42 mm; MIC: 0.03-8.33 μL/mL; MFC: 0.52-8.33 μL/mL) against tested eight pathogenic fungal strain viz. *Candida albicans, Candida albicans* (clinical isolate), *Candida albicans* (clinical isolate, KGMU), *Candida kefyr*; *Candida krusei, Candida glabrata*, *Candida tropicalis, and Candida albicans* (clinical isolate, in-vivo). Antioxidant activity of the essential oil evaluated by DPPH radical scavenging assay (%inhibition: 53.9-74.5%), nitric oxide scavenging assay (%inhibition: 36.9-72.1%) and ferric reducing antioxidant power (61.2 $\pm$ 3.75 μm/g).

Input: GD Kiran Babu

Effect of drying technique on quality of *Cassia angustifolia Vahl.* leaves and pods

Experiments were conducted for optimizing the drying techniques for leaves and pods of *Cassia angustifolia* Vahl. As the appearance and quality of the leaf and pods play important role in fetching high price in the international market. Pods and leaves were dried under shade, the Sun and at different temperatures in the oven. The drying kinetics followed a first order model and the rate of drying is very high in the case of Sun drying followed by shade and oven dryings.Preliminary HPLC analysis revealed that the oven dried leaf contained higher content of Sennoside-A and B compared to the Sun and shade drying method. Among oven dried samples, leaves dried at 50°C pods dried at 40°C possessed high content of Sennosides.

Table: Dring of Senna leaves and pods

Drying Method	Leaves		Pods	
	Sennoside A (%)	Sennoside B (%)	Sennoside A(%)	Sennoside B (%)
Shade dry	0.081	0.238	0.504	0.739
Sun dry	0.115	0.280	0.889	1.115
Oven dry at 40°C	0.129	0.362	1.346	1.861
Oven dry at 50°C	0.203	0.381	0.820	1.072
Oven dry at 60°C	0.144	0.427	0.496	0.810

Input: Jonnala K Kumar

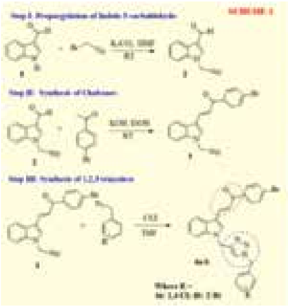
Novel synthesis and biological evaluation of Indole triazole chalcone derivatives

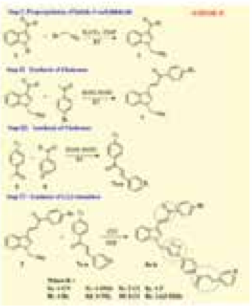
Indole 3-carbaldehye an Indole-derived alkaloid, isolated from marine sponge *Smenospongia* sp. Indole-3-carboxaldehyde was used to prepare analogs of the indole phytoalexiancyclobrassinin with NR_1R_2 group instead of SCH_3 group

Chalcones have been reported to possess many useful properties, including antiinflammatory, antimicrobial, antifungal, antioxidant, cytotoxic, antuitumor and anticancer activities

On the other hand, 1,2,3-triazoles have occupied an important role not only in organic chemistry, but also in medicinal chemistry due to their easy synthesis by click chemistry and attractive feature as well as numerous biological activities. 1,2,3-triazole is one of the key structural units found in a large variety of bioactive molecules as antifungal, antibacterial, antiallergic, anti-HIV, antitubercular and anti-inflammatory agents.

Considering the importance of Indole 3-carbaldehye, chalcones and 1,2,3-triazoles, the series of Indole 3-carbaldehye-chalcones-1,2,3-triazole (Scheme I) and Indole 3-carbaldehye-di chalcones-1,2,3-triazole (Scheme II) derivatives were synthesised.





Mission Programes

CSIR - AROMA MISSION

CSIR has launched an Aroma Mission, which endeavors to boost the cultivation as well as value-addition of aromatic crops for making our country not only self-reliant but also as emerging global leader in the production and supply of essential oils. This will enhance the income of farmers and ensure sustainable supply of fragrant raw material of high quality to the industry. With an aim to increase the income of the farmers considerably, the mission will help in limiting the migration of youths from rural to urban areas in search of job opportunities due to falling productivity and profitability in agriculture. CSIR Aroma Mission aims to develop, disseminate and deploy the aroma related S & T developments in CSIR labs to the end users including farmers, industry and society, to enhance income of farmers, quality of their life, business opportunities and rural development.

Since availability of quality planting material of aromatic crops is a major limitation for expansion in area under cultivation, productivity and profitability of aromatic crops, a huge amount of planting material of high-yielding varieties of commercially important aromatic crops (most significant being Lemongrass – 50 Lakh slips, Citronella – 10 Lakh slips, Vetiver – 20 Lakh slips, Palmarosa – 660 kg seeds, Menthol Mint – 200 kg suckers, Geranium – 0.25 Lakh slips, Chamomile – 2 kg seeds and Patchouli – 0.08 Lakh slips) was generated at the farms of the CSIR-CIMAP which will serve as nucleus material for the spread/distribution to a large number of interested farmers.

An additional area of more than 300 hectares was brought under cultivation with aromatic crops (the important ones being lemongrass ~ 140 ha, palmarosa ~ 90 ha, vetiver ~ 65 ha, citronella ~ 8 ha and ocimum ~ 1 ha). Most of the crops selected under the Mission can tolerate high levels of stresses like drought, floods, salinity, shade etc. Many of the drought-tolerant crops like lemongrass, rosagrass and palmarosa were introduced in around 300 ha area in Vidarbha, Bundelkhand, Odisha, Gujarat and Rajasthan which are frequently affected by insufficient rainfall. Crops like vetiver and palmarosa, which are able to tolerate extended periods of flood and salinity, were introduced in the cyclone- and Tsunami- affected coastal areas of Gujarat and Tamil Nadu. Presently, around 100 ha area is under cultivation of Vetiver in Cuddalore district of Tamil Nadu and of Palmarosa in the Kutch area of Gujarat providing handsome profits to the farmers. Efforts were also made to introduce high-value aroma crops in the North-East region where high-yielding varieties of Citronella were introduced to revive cultivation of this important crop, the oil of which is in high demand and is imported in huge amounts. Another significant intervention in North-East was the successful cultivation of vetiver in the Brahmaputra basin, which remains saturated with water for a long period.

To make farmers aware about the benefits of aromatic crops 42 one-day awareness programs were organized across the country benefiting around 2450 farmers. Also, one 3-day training program was organized for imparting training to the farmers and the entrepreneurs on cultivation and processing of aromatic crops.

Since the conceptualization of the mission, one high-yielding variety of aromatic crops was developed and released for commercial cultivation which may lead to considerable enhancement in the area under cultivation of aromatic grasses. In addition, already identified six high yielding genotypes/chemotypes were evaluated under field conditions under different environments targeting higher yields and aroma molecules in high demand.

In order to enlarge the impact of the proposed activities of the CSIR-Aroma Mission efforts were made to bring other stakeholders and line ministries on board which include aroma industries, MSME, DONER, DBT, state agriculture/ horticulture/ forest departments/universities and farmer organizations. Efforts are on to involve stakeholders in providing additional resources to install improved primary processing/distillation units in the farmers' field for efficient on-site processing of raw material and to build mechanisms to link aroma industry with farmers for procuring essential oils at fair prices.

It is expeted that this mission will pave the way for achieving self-sufficiency as well as global leadership in the production of essential oils like vetiver, palmarosa, lemongrass so as to export these oils to other countries. The selected crops under CSIR-Aroma Mission aim to utilise marginal/under-utilised lands to enhance income of small and marginal farmers at least by Rs 25,000-75,000 per hectare annually besides generating rural employment. The opportunities of value-addition to these oils would generate opportunities for entrepreneurs to venture into start-ups in the areas of perfumery, high-value aroma molecules and aroma-based products.

Progress at a glance

Total Area Covered (ha)	310
Total Manpower Trained (number)	2490
Total Awareness Programs (number)	43
Varieties Developed	1

Palmarosa plantations at Dhenkanal

Vetiver plantations in Cuddalore

Women training programme

Awareness programme

CSIR Phyto-pharmaceutical Mission

CSIR-CIMAP is also participating in the ambitious phytopharmaceutical mission of CSIR (launched in 2017 and led by CSIR-IIIM, Jammu) which aims to catalyze phyto-pharmaceutical drug discovery as per global standards for unmet medical needs from indigenous medicinal plants under captive cultivation. Other participating laboratories are, CSIR-CDRI Lucknow, CSIR-IHBT Palampur, CSIR-IICB Kolkata, CSIR-NEIST Jorhat, CSIR-NBRI Lucknow, and CSIR-URDIP Pune. CSIR-CIMAP is contributing in the following programme of the mission.

- Captive cultivation of selected medicinal plants including high value rare endangered and threatened (RET) ones
- Technology packages for production of GMP grade medicinal plant extracts
- Phyto-pharmaceutical drug development from important medicinal plants as per regulatory guidelines of DCG(I)
- Making public aware of mission activities and achievements using appropriate interface

Science & Technology

Input: Manoj Semwal & Bhaskar Shukla

Activities carried out by the ICT Department

- Development of CSIR-Aroma Mission online registration forms for the beneficiary registration along with workflow for the submission of the vertical wise reports by the participating institutions for monitoring the progress of the mission.
- Development of e-portal for central facility sample requisition and tracking for the users registered in the portal.
- A joint project initiative with Indian Space Research Organization on "Indian Biodiversity Information System - IBIN" wherein, the rare and endangered medicinal plants of Uttarakhand are to be digitized into along with chemical structure, pharmacognostical, geolocation and herbaria information
- Trainings programs, beneficiary selection and planting material distribution was conductedin Maharashtra, Uttarakhand and West Bengal states as a part of the CSIR-Aroma mission.
- In the National Mission for Clean Ganga project, GIS survey was conducted for identification of sites for vetiver plantation in Kanpur and Varanasi.
- Precision agriculture studies using Remote Sensing satellites, Drones and Geoinformatics on Mentha crop undertaken for micro level specific agro advisories.

Input: D Saikia

Installation of New Gamma Chamber at Lucknow campus

New **Gamma Irradiation Chamber** (GIC) was installed at CSIR-CIMAP, Lucknow campus in August 2017. This will provide vast opportunities of developing high-value medicinal and aromatic plants by scientists through mutation breeding at CIMAP.

Gamma Irradiation Chamber

Variety released

CIM-Snigdha: A methyl cinnamate rich and high essential oil yielding variety of basil

(Ocimum basilicum)

Basil belongs to the family "Lamiaceae". The essential oil of basil is extensively used in flavour, fragrance, food, oral health and traditional medicines. Methyl cinnamate – one of the important constituent of essential oil of *O. basilicum* is widely used in aroma, pharmaceutical and cosmetic industries. The new strain of *O. basilicum* (OBH-3 now christened as CIM-Snigdha) has been developed by CSIR-CIMAP through intensive breeding efforts for improved herb and essential oil yield coupled with high methyl cinnamate content (78.7%). The variety has consistently recorded a higher biomass and oil yield with high methyl cinnamate content in the oil in the field evaluation trials. The potential herb yield of this new variety is 221 q/ha and oil yield is 190 kg/ha. The variety matures in a short duration of 80-90 days and hence fits very well into crop rotation/intercropping cycle between wheat and paddy along with other vegetable crops. The distinct leaf morphology and high tolerance to cold conditions are the two important economic features of this variety to satisfy DUS criteria.

Fig: Field view of basil variety CIM-Snigdha

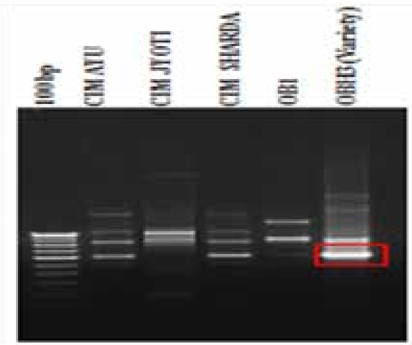


Fig: Molecular profiling by SCoT markers

Skill Development Programmes

SIDBI Sponsored Skill-cum-Technology Up-gradation Programmes

Sl. No.	Date	Place	No. of partici-pants
1	27-28 Feb. & 01 March, 2017	IGIB, New Delhi	81
2	16-18 May, 2017	Lucknow	126
3	28-30 June, 2017	Jaipur	57
4	27-29 July, 2017	Bangalore	44
5	29-31 August, 2017	Lucknow	105
		Total	**413**

View of classroom of training programme during 05-07 December, 2017 at Lucknow

Group photo of the participants in the training programme during 28-30 June, 2017 at Jaipur

Skill Development Programmes under Aroma Mission

Sl. No.	Date	Place	No. of partici-pants
1	01-02 May, 2017	Gorakhpur (PGSS)	97
2	04-06 October, 2017	Lucknow	40
3	11-13 October, 2017	Lucknow	25
4	27-30 November, 2017	Lucknow (MANAGE)	22
5	05-07 December, 2017	Lucknow	70
6	13-15 December, 2017	NCL, Pune	79
7	19-21 December, 2017	Lucknow (TERI)	27
8	11-13 October, 2017	Lucknow (JSLPS)	25
		Total	**385**

Training programmes at Lucknow

International Training Programme

Six days international training programme on "Cultivation, Processing and Marketing of Economically Important Medicinal and Aromatic Plants suitable for Nepal" was organised for the officers of Department of Plant Resources, Ministry of Forests and Soil Conservation, Government of Nepal from 10-16 July, 2017 at CSIR-CIMAP, Lucknow. Ten Officers from the Govt. of Nepal participated in this programme.

International Training programme for the Nepal Govt. Officers

Training on utilization of floral bioresource

A step towards making unemployed and poor women self-sustainable by preparing incense sticks using discarded or used flowers, CSIR-CIMAP organised 11 training courses during this year benefitting 424 women. The dates of such trainings along with number of participants are given in the table below. Based on the feedback received after training, it is estimated that about 30% women who took part in these trainings have started work for making of incense sticks and selling in the local market.

Entrepreneurial training to women for making incense sticks using floral bio-resource

Sl. No.	Date	Place	No. of participants
1	31.01.2017	CSIR-CIMAP, Lucknow	82
2	16.02.2017	Samodha, Dalelnagar, Hardoi, UP	65
3	26.08.2017	WETF, Lucknow	23
4	16.09.2017	WETF, Lucknow	27
5	26.10.2017	Barabanki	15
6	15.11.2017	Sahibabad, Ghaziabad	80
7	24.11.2017	Sirdi Sai Dham	30
8	20.09.2017	Maa Vaishno Devi Temple, Katra, J&K	22
9	11.12.2017	Maa Vaishno Devi Temple, Katra, J&K	23
10	07.04.2017	Shaktinagar, Lucknow	30
11	04.12.2017	WETF, Lucknow	27
		Total	**424**

Training Programme at CRPF Camp, Lucknow

Training Programme at Shri Maa Vaishno Devi Temple, Katra, J&K

Awareness programme on cultivation and processing of medicinal and aromatic plants

Sl. No.	Date	Place	No. of participants
1	10.01.2017	Deurbut, Bastar, Chattisgarh	50
2	14.01.2017	FFDC Kannauj	12
3	15.01.2017	CIMAP, Lucknow for SBI Officers	15
4	18.01.2017	Neelgaon, Sidhauli, Distt. Sitapur	161
5	18.01.2017	Masauli, Barabanki	62
6	20.01.2017	Fatehpur, Barabanki	120
7	27.02.2017	Awareness programme at Masauli with INSA Lucknow Chapter	100
8	23.03.2017	Bhojdih, Kanchi, Ranchi, Jharkhand	100
9	07.04.2017	Mathura, Uttar Pradesh	80
10	19.04.2017	VRTI, Mandavi, Kutch, Gujarat	38
11	20.04.2017	Guntala, Mundra, Kutch, Gujarat	80
12	10.01.2017	KVK, RS Pura, Jammu	62
13	12.01.2017	Bagta, Reasi, Jammu	83
		Total	**963**

Awareness programme at Kondagaon, Bastar, Chhattisgarh

Awareness programme at RS Pura, J&K

Awareness programme at Reasi, J&K

Awareness programme on improved cultivation practices and market discovery of Mentha Oil

Sl. No.	Date	Place	No. of participants
1	18.01.2017	Masauli, Barabanki, U.P.	62
2	24.05.2017	Barabanki, U.P.	94
3	03.06.2017	Sitapur, U.P.	86
4	19.06.2017	Gosaiganj, U.P.	72
5	20.06.2017	Ambedkarnagar, U.P.	90
6	21.06.2017	Kotwa Sadak, U.P.	99
7	22.06.2017	Faizabad, U.P.	116
8	23.06.2017	Lakhimpur, U.P.	65
9	24.06.2017	Dudhwa National Park, U.P.	67
10	25.07.2017	Badaun, U.P.	97
11	26.07.2017	Moradabad, U.P.	125
12	27.07.2017	Bareilly, U.P.	111
13	28.07.2017	Rampur, U.P.	113
14	06.08.2017	Lakhisarai, Bihar	48
15	09.08.2017	Begusarai, Bihar	91
16	10.08.2017	Buxer, Bihar	93
17	11.08.2017	Patna Rural, Bihar	92
18	06.09.2017	Bhopal Rural, M.P.	107
19	04.09.2017	Harda, M.P.	85
20	05.09.2017	Khandwa, M.P.	72
21	30.11.2017	Lucknow (MANAGE), U.P.	32
22	14.12.2017	Pune (Aroma Mission), Maharashtra	68
23	21.12.2017	Lucknow (TERI), U.P.	40
24	28.12.2017	Sultanpur, U.P.	61
25	29.12.2017	Shravashti, U.P.	97
26	30.12.2017	Unnao, U.P.	51
		Total	**2134**

Training programme at Bihar

Training programme at Barabanki

Awareness programme on cultivation and processing of aromatic crops

Sl. No.	Date	Place	No. of participants
1	23.03.2017	Bhojdih, Ranchi, Jharkhand	100
2	26.05.2017	NEDFi, Guwahati, Assam	30
3	21.08.2017	Pataunda Village, Kota, Rajasthan	10
4	21.08.2017	Dhobi Kaun, Jaspur, Vadodara, Gujarat	75
5	21.08.2017	Kothiya Kunjan, Vadodara, Gujarat	60
6	22.08.2017	Sarol, Anand, Gujarat	80
7	22.08.2017	Sahkari Seva Kendra, Baniyani Village, Bundi, Rajasthan	20
8	22.08.2017	Natoda Bhopat, Baran, Rajasthan	25
9	23.08.2017	Vill. Karju, Chhoti Sadri, Pratapgarh, Rajasthan	45
10	07.09.2017	KVK Madhepura, Bihar	110
11	07.09.2017	Vill. Karhara, Madhepura, Bihar	45
12	12.09.2017	Vill. Bhojideeh, Kanchi, Ranchi	85
13	13.09.2017	Khunti, Jharkhand	65
14	11.10.2017	Distt. Karvi Anglong, Assam	29
15	12.10.2017	Distt. Tejpur, Assam	22
16	13.10.2017	Distt. Birwa, Meghalaya	15
17	14.10.2017	Distt. Nalbari. Assam	44
18	15.10.2017	Boko, distt. Kamroop, Assam	22
19	28.10.2017	Vill. Ratanpura, Distt. Mau, UP	112
20	25.11.2017	Asta Gaon, Rahata distt. Ahmadnagar, Maharashtra	83
21	22.12.2017	Ghanghata, Sant Kabir Nagar, UP	73
		Total	**1150**

Awareness programme at Sant Kabir Nagar

Awareness programme at Ratanpura, Mau

Awareness Programme at Bihar

Awareness Programme at Ranchi

Awareness Programme on cultivation of palmarosa was conducted in Narayanakuppam village, Tiruvannamalai District, Tamil Nadu on 20 June 2017. Eighty one farmers from surrounding villages participated in the programme. Introduced the CIM-Harsh in the palmarosa growing areas of Tiruvannamalai District, Tamil Nadu. 80 kg of palmarosa seeds was distributed to beneficiary farmers.

Narayanakuppam, Tiruvannamalai Dist., Tamil Nadu

One-day awareness workshop on medicinal and aromatic plants and pepper was organised in Melina Onikeri village, Sirsi Taluk, North Kannada Dist., Karnataka on 17 June 2017 jointly by Kadamba Foundation, Sirsi, Thatisar Group Seva Sahakari Sangha, Melina Onikeri, Sirsi and CSIR-Central Institute of Medicinal and Aromatic Plants, Bengaluru. About 30 kg of palmarosa seeds were distributed to beneficiary farmers.

Sirsi, Uttara Kannada Dist., Karnataka

A one-day Awareness Programme on Aromatic Crops was organised in Dhalavaipuram, Rajapalayam Taluk, Virudhunagar District, Tamil Nadu on 6 December 2017. About 25 farmers from nearby villages attended the Awareness Programme.

Dhalavaipuram, Virudhunagar District,Tamil Nadu

A one-day awareness programme on aromatic crops was organised in Gandhigram Trust, Dindigul District, Tamil Nadu on 7 December 2017. Forty six farmers from nearby villages attended the awareness programme.

Gandhigram Trust, Dindigul District, Karnataka

dissemination of agrotechnologies related to Vetiver, Palmarosa, lemon grass, etc. in Bundelkhand areas under Aroma Mission. CSIR-CIMAP has initiated cultivation of aromatic crops to provide alternative source of income to farmers of this areas e.g. Hamirpur, Banda, Chitrakoot, Orai, etc. under the Aroma Mission.

Demonstration of planting methods to farmers in Bundelkhand

Outreach programme of INSA Chapter (Lucknow) at village Masauli, Barabanki

Interaction of Eminent scientists with students and farmers

National Technology Day

On the occasion of National Technology Day Aroma Industries Business Meet was organized on 11 May, 2017. About 20 aroma industries/ representatives participated in this event.

Visit of students in CIMAP during National Technology Day 11 May, 2017

Demonstration of Medicinal and Aromatic Plants in various parts of India

Demonstration of Palmarosa in salt affected area of Kutch, Gujarat

Demonstration of Vetiver in catchment area of river Bramhaputra in Assam

Field view of Lemongrass at Jharkhand river Bramhaputra in Assam

Demonstration of vetiver in Vadodara district

Demonstration of lemongrass at Jharkhand

Economics of cultivation of important medicinal plants grown at farmers' field

Data collection on socio-economic aspects, profitability and yield etc. of Ashwagandha, Tulsi, Kalmegh, Artemisia, Isabgol and Senna for more than 700 farmers from various parts of country, where these crops cultivated like, Telangana, Andhra Pradesh, Madhya Pradesh, Gujarat , Rajasthan and Uttar Pradesh from farmers field. Analysis of data on Artemisia, Ashwagandha has been made. The results showing very positive and promising aspects of these crops on the farmers field as profitable venture for doubling the income of farmers by using less input and management.

Survey of Ashwagandha field at Karnool, Andhra Pradesh

Field view of Satavar at Rampur

Data collection of Aloe-vera at Lucknow

Consultancy and technical guidance for cultivation, primary processing and marketing of aromatic and medicinal crops suitable for Jharkhand

A MoU agreement between CSIR-CIMAP and Jharkhand State Livelihood Promotion Society (JSLPS), Department of Rural Development, Govt. of Jharkhand, was signed on 31st August, 2017 for promotion of medicinal and aromatic plants in different districts of Jharkhand for livelihood promotion of the farmers. Under this collaboration, CSIR-CIMAP promoted the cultivation of newly developed high yielding varieties of medicinal and aromatic plants in rainfed and other wild animal affected areas of the state. One awareness-cum-demonstration programme and one skill development programme on cultivation, processing and

Signing of MoU with JSLPS

Releasing of training manual

Demonstration of lemongrass at Jharkhand marketing of economically important medicinal and aromatic plants between 11-13 October, 2017 was organised. In this programme 25 professionals from Jharkhand State Livelihood Promotion Society (JSLPS) were trained.

Impact study of menthol mint and Artemisia technologies for income enhancment of rural population

Third party impact study was conducted by National Productivity Council, Ministry of Commerce and Industry, Govt. of India on Assessment of Impacts of R&D Technologies on Society with reference to menthol mint (*Mentha arvensis*) and anti-malarial drug plant (*Artemisia annua*) among the farmers for income enhancement. In this study NPC was found and reported that the mentha growers adopted the CSIR-CIMAP's technologies and verities and gained total increases in their income is 57.82%. However, in case of *Artemisia*, farmers who have adopted the CSIR-CIMAP's verities and technologies had enhanced their income as compared to their regular agriculture income by 67.96%.

Khus cultivation in Bundelkhand region

CSIR-CIMAP developed hub for khus and Palmarosa cultivation in village Patyora, Ingota and Modaha (all in U.P.) sponsored by NABARD. Demonstrated was given to the farmers. Unit of 500 kg capacity have been established for collective utilization.

DDM,Hamirpur Visited farmer field

Farmer demonstrating khus rooted plant

Designing, fabrication and commissioning of essential oil distillation units

Six direct fired essential oil field distillation units having 500kg/batch capacity were designed and got fabricated under Project entitled 'Empowering of Tribal Families in the Cultivation and Processing of Aromatic Grasses Citronella and Vetiver in High Altitude Hill Tribal Areas of Andhra Pradesh'' These units consist of 'MS' distillation tank, SS-304 condenser tubes and vapour line, SS-304 receiver-cum-separators. Three units were installed at the tribal areas of Visakhapatnam District, Andhra Pradesh viz. villages Chintapaka, Koraparthi and Pinakota for the distillation of lemongrass and palmarosa oils. Awareness programs were conducted in these sites on distillation of essential oils.

Commissioning of distillation units at Chintapaka Village, Visakhapatnam District

Distillation Unit Installed at Koraparthy Village, Visakhapatnam District

Distillation Unit after installation at Pinakota Village, Ananthagiri Mandal, Visakhapatnam District

Popularization of CSIR-CIMAP Technologies

Displayed and demonstrated CIMAP's technologies and products to the students, entrepreneurs, farmers, academicians, and industrialist in CSIR Exhibition during 1st week of September 2017.

Awareness program on essential oil distillation at Pinakota Village, Ananthagiri Mandal, Visakhapatnam

(ii) Awareness program under Aroma Mission (CSIR-CIMAP HCP-007) was organized at Tadwai Mandal, Bhupalapalli District, Telangana on 13th October 2017. About 50 farmers attended the program. They were sensitized on cultivation and distillation of lemongrass and palmarosa oil production, through lecture and demonstration.

Awareness Programs conducted by CIMAP RC Hyderabad

Plants Distributed: 25,000 numbes of Lemongrass slips distributed to 5 farmers with each 5000 slips. Additional 30,000 Lemongrass slips will be given to these farmers after the material received from CRC Pantnagar

Rajyanayak Tanda, Dist. Nalgonda, Participants: 50 Farmers

Banjara Ellapur, Dist. Jaishnaker Bhupalapalli; Particpants: 28 Farmers

Edullapur, Dist. Yadadri, Participants- 15 Farmers

Bember, Dist. Nirmal, Participants: 54 Farmers

Tree Plantation Drive in CIMAP


Tree Plantation program was organized as a part of UPPFMA Project and inaugrated by Dr Prabhaker Dubey, Project Director (A&F)/ APPCF

Independence Day Celebrations


CSIR-KVS Jigyasa program


Student freom various KVS visited to CIMAP under Student Scientist Connetc programme CSIR-KVS Jigyasa which started

हिंदी सप्ताह

प्रो. गिरीष चंद्र त्रिपाठी, कुलपति, काशी हिन्दू विश्वविद्यालय

CSIR Platinum Jubilee Foundation Day Celebrations

CSIR-CIMAP Swacchata Pakhwada 2017

Special Lecture on Dr APJ Abdul Kalam by Prof. Arun Tiwari, a former Scientist of DRDO and a long time companion of Dr Kalam

"Dr A.P.J. Abdul Kalam: An Epitome of Inspiration"

Technology licensing

M/S Apex India Pvt Ltd., Lucknow

M/S Naturoveda Organics Pvt Ltd., Kolkata

CSIR-CIMAP and KGMU (MoU) on 113th Foundation Day of KGMU

MoU for clinical efficacy of herbal formulations

Women Empowerment

Shirdi, Pune

Mata Vaishno Devi Shrine

Central Reserve Police Force

Skill Development Initiatives under AROMA Mission

Programme on Cultivation and Primary Processing of Economically Important Aromatic and Medicinal Plants under Aroma Mission

14 States
79 participants

Early Mint Technology Demonstration in various districts of U.P

Fairs and Exhibitions

Awareness programme in Tobacco cultivation areas of Karnataka

Saraguru village in Hassan District.

Periyapatna village in Mysuru District.

AROMA Mission Awareness program at Astanagar, Maharashtra

Vill: Asta gaon Taluka Rahata district Ahmednagar, Maharashtra. Total 83 progressive farmers attended this event

About 500 acres area under Cultivation of this species in this Taluka.

Awareness program under Aroma mission

Village Kolwagoan, block Trivediganj Dt: Barabanki for Farmers Producer Organization.

Total 120 farmers participated and gained their knowledge about nursery preparation, cultivation, processing and marketing of menthol mint oil.

AROMA Mission at Cuddalore district, Tamil Nadu

2.5 lakhs of vetiver slips distributed in March 2017 to cover an area of 12 acres, monitored for their growth and harvest followed by quality evaluation. 1.5-2% oil content observed.

AROMA Mission at Vidarbh region

Aroma Mission in North East

Vetiver plantation in flood banks of Brahmaputra

Stall at Udyam-2017

Citronella plantation

Aroma Mission in Bundelkhand

'Nibughaas' ready for next harvesting. Mango orchard + Lemongrass. Economical co-cultivation Dist. Banda

Simauni Mela

CSIR vice president take a look at khus plant in Simauni Mela

Visit of HE Mr Anurag Srivastava, Indian Ambassador to Ethiopia

Visit of Secretary, MSME Dr. Arun Kumar Panda

Discussion towards joint collaboration among CIMAP and FFDC

Complementing efforts towards nation building though entrepreneurship development.

Visit to Dev Sanskriti Vishwavidyalaya, Haridwar

With Dr Pranav Pandya, Vice Chancellor

Association for Rural Development and Academic activities

Visit of students in Manav Upvan

Visit of farmers in Manav Upvan

About four thousand five hundred visitors including students, farmers, entrepreneurs, government officials and others common people from society visited CSIR-CIMAP and were apprised about different activities of the institute.

Review meeting on "Draft of National Policy of Medicinal and Aromatic Plants (MAPs) of India"

Skill development program at NCL, Pune

79 participants participated in the 3 days programme

TERI sponsored CSR program

Three days training programme for the farmers of Purulia, West Bengal

India International Science Festival, Chennai

CSIR Platinum Jubilee Technofest, CSIR-NAL, 25-27

Totagarike Mela, UHS, Bagalkot,

List of Technology Transfer to Various Firms

S. No.	Name of the technology (Agrements)	Date of Transfer	Name of Industry
1.	Making of anti-dandruff shampoo	19th April, 2017	M/s. Sujatha Bio Tech, Kashipur-244713 Uttarakhand
2.	Making of Herbal Shampoo	19th April, 2017	M/s. Sujatha Bio Tech, Kashipur-244713 Uttarakhand
3.	Transfer of seed material and promotion of cultivation of *Curcuma longa* (Var. CIM-Pitamber	2nd May, 2017	Shri M.V. Madhusudan, Dy. Director & Horticulture, Commissioner of Horticulture, govt. of Telangana
4.	Making of Pain reliving oil	4th May, 2017	M/s. Sujatha Bio Tech, Kashipur-244713 Uttarakhand
5.	Making of Pain balm	4th May, 2017	M/s. Sujatha Bio Tech, Kashipur-244713 Uttarakhand
6.	Making of Sanitary Pad	10th May, 2017	M/s. Apex India Consortium Pvt. Ltd, Lucknow-226010
7.	Making of Mosquito Repellent Spray	10th May, 2017	M/s. Apex India Consortium Pvt. Ltd, Lucknow-226010
8.	Making of Pain relieving oil	22nd May, 2017	M/s. Deltas Pharma, Haridwar-249401 Uttarakhand
9.	Making of Geranium Active	22nd June, 2017	M/s. Naturoveda Organics Pvt. Ltd, Kolkata-700073
10.	Making of Stress Relieving Oil	22nd June, 2017	M/s. Naturoveda Organics Pvt. Ltd, Kolkata-700073
11.	Making of Acne Face Wash	22nd June, 2017	M/s. Naturoveda Organics Pvt. Ltd, Kolkata-700073
12.	Making of poly herbal tooth paste	28thSeptember, 2017	M/s. Herbal Ayurveda & Presearch Centre, Noida
13.	Making of poly herbal tooth paste	5th October, 2017	M/s. Medas Consultancy Services, M.P. Nagar, Bhopal
14.	Making of flower based Agarbatti	25th October, 2017	M/s. Eckonirmitee Infrastructure and Services Pvt. Ltd Aurangabad (MH)

List of MOU's signed with other Institutes

1.	Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra	2017
2.	Mount Carmel College, Bengaluru, Karnataka	2017
3.	CIMAP & KGMU signed MOU on 113th Foundation Day of KGMU to work jointly on clinical efficacy of herbal formulations	2017

Others

Externally Funded Projects

S. No.	Funding Agency	Project No.	Project title	PI	Start date	Total cost (₹)	End date
1	DBT	GAP-364	Understanding etiology for optimization of high value agarwood oil production from *Aquilaria*	Dr. Alok Kalra	01.04.2017	40,36,000	31.03.2020
2	APMAPB	GAP-366	Development of model nursery for production and supply of quality seeds of Ashwagandha in Andhra Pradesh	Dr. Kotesh Kumar	01.04.2017	6,25,000	31.03.2018
3	ICAR for NEH	CNP-367	Providing consultancy for designing, fabrication and setting up of stainless steel directly fired type field mobile Distillation Unit of 500 kg and Asvika Portable Distillation units of 20 to 30 kg capacities for essential oils based on CSIR-CIMAP know how & design	Dr. Sudeep Tandon	01.04.2017	27,81,700	31.03.2018
4	NMPB	GAP-368	Inventorization of medicinal and medicinally important aromatic plants (M&MIAP) and its conservation in selected four Ganga Gram of Kanpur Nagar district of Uttar Pradesh	Dr. Birendra Kumar	11.05.2017	23,62,800	10.05.2020
5	NMPB	GAP-369	Dissemination of Vetiver (*Chrysopogon zizanoides*) agro-technology in flood prone and contaminated area of Ganga river of Uttar Pradesh	Dr. Rajesh Verma	11.05.2017	55,50,600	10.05.2021
6	MCX, Mumbai	SSP-370	Awareness programme on improved cultivation practices and primary processing of Menthol Mint	Dr. RK Srivastava	25.05.2017	4,00,000	24.05.2019
7	DHR	GAP-371	Plant lead based controlled release preparations for the treatment of Oral Submucous Fibrosis (OSF)	Dr. NP Yadav	16.05.2017	30,00,000	15.05.2020
8	SERB	GAP-372	Identification of functionally active domain/motif for insecticidal activity in a fern protein by progressive terminal deletions	Dr. Sharad Saurabh	05.04.2017	19,20,000	04.04.2019
9	DBT	GAP-373	Functional metagenomics based profiling of soils collected from selected medicinal and aromatic plants (MAPs) cultivated regions of India, towards identification of novel antibiotic resistance genes (ARGs)	Dr. Premalatha Kandasamy	01.04.2017	48,18,085	31.03.2020
10	SERB	GAP-374	Development of cost-effective and user friendly diagnostic for the early detection of CMV associated with commercially important plants.	Dr. Karmveer Kumar Gautam	03.04.2017	19,20,000	02.04.2019

11	SERB	GAP-375	Development of quantitative real time PCR(qRT-PCR) based multiplex diagnostic assay for rapid detection of viruses infecting banana plants	Dr. Kishore Babu Bandamaravuri	20.12.2016	6,57,394	31.12.2017
12	SERB	GAP-376	In planta characterization combined with metabolomics and biochemical approach to understand withanolides biosynthetic pathway in Ashwagandha (Withania somnifera)	Dr. Dinesh A. Nagegowda	08.06.2017	40,71,600	07.06.2020
13	SERB	GAP-377	Production of Patchoulol, a natural sesquiterpene, using genetically engineered Saccharomyces cerevisiae	Dr. Ramanjaneyulu Golla	20.04.2017	19,20,000	19.04.2019
14	DBT	GAP-378	Surface modified nanocarrier formulations of kaempferol Co-loaded with paclitaxel for enhanced anti-cancer effect	Ms. Nidhi Mishra Mentor: Dr. N.P Yadav	11.07.2017	48,40,518	10.07.2020
15	DST	GAP-379	Screening of isochorismate synthease (ICS) alleles in Cassia angustifolia Vah. By TILLING	Dr. Soni Gupta	17.07.2017	28,30,000	16.07.2020
16	M/S J.J Pharmacy Pvt. Ltd.	CNP-380	To develop a plant based formulation for Pancreatic Lipase inhibition in the form of capsule/tablet (New)	Dr. Dinesh Kumar	21.07.2017	12,00,000	20.07.2018
17	SERB	GAP-381	Metabolic engineering of secondary phytochemicals in Withania somnifera (Ashwagandha): Aided through identified heterologous nuclear scaffold attachment region driven efficient expression of WRKY transcription factor.	Dr. Rani Singh	01.05.2017	19,20,000	31.04.2019
18	DBT	GAP-382	Development of indigenous yeast expression platform for the production of high value triterpene-squalene.	Dr. DK Venkata Rao	03.08.2017	50,00,000	02.08.2020
19	DST	GAP-383	Chemical investigation of bioactive molecules of Cuscuta species and its anti-proliferative activity against human cancer cells lines	Mrs. Zulfa Nooreen Mentor: Dr.Ateeq Ahmad	25.08.2017	22,05,000	24.08.2020
20	Jharkhand State Livelihood Promotion Society, Jharkhand	CNP-384	Providing consultancy and technical guidance for cultivation, primary processing/distillation and guidance for marketing and medicinal crop suitable for Jharkhand	Dr. Ram Suresh Sharma	14.09.2017	65,30,100	13.09.2019

21	Meghalaya Basin Development Authority, Shillong	CNP-385	Providing consultancy for designing, fabrication and setting up of MS directly fired type field Distillation Unit of 500 kg capacity for essential oils based on CSIR-CIMAP knowhow & design	Er. Sudeep Tandon	26.09.2017	4,13,135	25.09.2018
22	M/s Catalysts Biotechno-logies Pvt. Ltd, New Delhi	CNP-386	Providing consultancy in natural antibacterial agent for the replacement of antibiotic and food grade cleaning agent for brewery industries.	Dr. MP Darokar	01.11.2017	16,92,651	31.05.2019
23	DST	GAP-387	Integrated approach of bio-inoculants for yield enhancement and disease management in menthol mint (*Mentha arvensis* L.)	Dr. Shruti Charturvedi	03.11.2017	28,29,000	02.11.2020
24	Directorate of Agriculture (Govt. of Uttarakhand) Krishi Bhawan	GAP-388	Introduction and popularization of newly developed cold tolerant menthol-mint variety CIM-Kranti among the farmers of Uttarakhand for income generation and agriculture intensification of research centre Pantnagar PO-Dairy farm Nagla Distt-US Nagar	Dr. Rakesh Kumar Upadhyay	22.12.2017	24,00,000	21.12.2020
25	SK University of Agricultural Sciences & Technology of Kasmir, Benhama, Ganderbal (J&K)	CNP-389	Designing, fabrication and setting up of SS Cohobation type Distillation Unit of 50 kg for demonstration of lavender, rose & essential oils under CSIR-CIMAP guidance.	Er. Sudeep Tandon	02.11.2017	1,44,000	01.05.2018

DBT- Department of Biotechnology, DST- Department of Science and Technology, NMPB- National Medicinal Plants Board, DHR- Department of Health Research, ICAR- Indian Council of Agricultural Research, SERB- Science and Engineering Research Board, MCX- Multi Commodity Exchange

Staff Members (as on 31 Dec 2017)

Prof.Anil Kumar Tripathi
Director

Chief Scientist
Dr. Ashok Sharma
Dr. RS Sangwan
Dr. Alok Kalra
Dr. Abdul Samad
Shri Rakesh Tiwari
Shri PV Ajaya Kumar

Senior Principal Scientist
Dr. (Mrs) Neelam Singh Sangwan
Dr. AK Shasany
Dr. Saudan Singh
Dr. Alok Kumar Krishna
Dr. Ved Ram Singh
Dr. RS Bhakuni
Er. Sudeep Tandon
Dr. MP Darokar
Dr. Arvind Singh Negi
Er. G. D. Kiranbabu
Dr. Birendra Kumar
Dr. AK Gupta

Principal Scientist
Dr. Laiq-Ur-Rahman
Dr. Dharmendra Saikia
Dr. Vikrant Gupta
Dr. Rakesh Pandey
Dr. Anirban Pal
Dr. Dinesh A. Nagegowda
Dr. J Kotesh Kumar
Dr. (Mrs) Sunita Singh Dhawan

Sr. Scientist
Dr. Dayanandan Mani
Dr. Karuna Shanker
Dr. Rajesh Kumar Verma
Dr. Sanjay Kumar
Er. Manoj Semwal
Dr. Dnyaneshwar Umrao Bawankule
Dr. Feroz Khan
Dr. Venkata Rao D.K.
Dr. CS Vivek Babu
Dr. Sumit Ghosh
Dr. (Mrs) Prema G. Vasudev
Dr. Ashutosh Kumar Shukla
Dr. Narayan Prasad Yadav
Mr. KVN. Satya Srinivas
Dr. Suaib Luqman
Dr. Rajendra Chandra Padalia
Dr. V. Sunderesan
Mr. Ram Swaroop Verma
Dr.(Smt) Puja Khare
Dr. Chandan Singh Chanotiya
Dr. Debabrata Chanda
Dr. Prasanta Kumar Rout
Dr. Pradipto Mukhopadhyay
Dr. Kishore Babu Bandamaravuri
Dr. Ramesh Kumar Srivastava
Dr. Mukti Nath Mishra

Scientist
Dr. Abha Meena
Dr. Rakesh K. Shukla
Dr. (Ms.) Tripta Jhang
Dr. Atul Gupta
Dr. Preeti Srivastava
Er. Bhaskar Shukla
Dr. Ram Suresh
Dr. Rakesh Kumar Upadhyay
Er. Ashween D. Nannaware
Dr. Narendra Kumar
Dr. Rakesh Kumar
Dr. Yogendra N.D.
Dr. Channayya Hiremath
Dr. Venkatesha K.T.
Dr. Jnanesha A.C.

Group-III

Principal Technical Officer
Dr. VK Agarwal
Dr. HP Singh
Dr. Mohd Zaim
Dr. Dinesh Kumar
Shri A M Khan

Sr. Technical Officer (3)
Shri Prem Singh
Dr. DK Rajput
Dr. Sukhmal Chand
Dr. Dasha Ram
Shri K Bhaskaran
Dr Ateeque Ahmad

Sr. Technical Officer (2)
Mrs. Sudha Agarwal
Shri Govind Ram

Sr. Technical Officer (1)
Smt Anju Kumari Yadav
Shri Shiv Prakash
Dr. (Mrs.) Manju Singh
Dr. Rajendra Prasad Patel
Dr. Rakshpal Singh
Dr. Anil Kumar Singh

Technical Officer (Gr. III (3))
Shri Ram Pravesh
Dr. Amit Chauhan
Dr. Anil Kumar Maurya
Shri Amit Mohan
Smt Namita Gupta
Shri A.K. Tiwari

Technical Assistant
Shri Sanjay Singh
Shri A. Niranjan Kumar
Mrs. Anju Kesarwani
Shri Balakishan Bhukya
Shri Amit Kumar Tiwari
Shri Manoj Kumar Yadav
Shri Ashish Kumar
Sh. Prawal Pratap Singh Verma
Shri Ashish Kumar Shukla
Shri Manish Arya
Shri Sanjeet Kumar Verma
Shri Deepak Kumar Verma
Miss Pooja Singh
Shri Prabhat Kumar
Shri Sonveer Singh

Group-II

Sr. Technician (3)
Shri SK Sharma

Sr. Technician (2)
Shri S. Selveraj
Shri Shyam Behari
Smt IV Rautela
Shri Ram Chandra
Shri Y Shiva Rao
Shri Salim Baig
Dr. Abdul Khaliq
Shri SK Pandey
Shri Raghubind Kumar
Shri Gopal Ram
Shri E Bhaskar
Smt S Sharda
Shri PN Gautam
Shri Joseph M Massey
Shri Ram Lakhan
Shri PK Tiwari
Shri Vinod Kumar
Shri Siva Kumar DC

Sr. Technician (1)
Smt Raj Kumari
Shri Dharam Pal Singh

Technician (2)
Shri V.K. Shukla
Shri Pankaj Kumar Shukla
Shri Kundan Narayan Wasnik
Shri Yalla VVS Swamy
Shri Basant Kumar Dubey
Shri Vijay Kumar Verma
Shri Harendra Nath Pathak
Shri Hemraj Sharma
Shri Jitendra Kumar Verma

Technician (1)
Shri Pramod Kumar

Group-I

Lab Assistant
Shri Mahesh Prasad
Shri VK Singh
Shri Abdul Mabood
Shri Ram Ujagir
Shri Subhash Kumar
Shri Bharat Singh Bisht
Shri Man Mohan
Shri Qasim Ali
Shri Sabhajit
Shri Mohd. Navi
Shri Munawar Ali
Shri Hari Pal
Shri Nurul Huda
Shri Surendra Nath
Shri Lal Chand Prasad
Smt Pushpa Semwal

Lab Attendant (2)
Shri TP Suresh

Administrative Staff

Group-A
Shri M.S. Mehra
Shri B.L. Meena
Shri Baljeet Singh
Shri Bhasker Jyoti Deuri
Smt. B. Mallikamba

Group-B (Gazetted)
Shri Hare Ram Kushwaha
Shri Ankeshwar Mishra
Shri Vikash Chand Mishra
Shri Sanjay Kumar Ram
Shri Girija Shankar Verma
Shri Shailendra Pratap Singh
Smt Kanchan Lata Thomas

Group-B (Non-Gazetted)
Smt Sufia Kirmani
Shri Muneshwar Prasad
Shri Sant Lal
Shri Parvez Nasir
Shri P Srinivas
Shri Rajesh Kumar
Shri Kaushal Kishore

Shri Siddharth Shukla
Shri Ravi Prakash
Shri KG Thomas
Ms. Sanyogita Sainger
Shri PK Chaturvedi

Asstt (F&A)
Smt Nisha Sharma
Shri Harish Chandra
Shri Shiv Kumar
Shri Suneel Kumar
Shri AL Sahoo
Shri Ayush Singhal
Shri Kanhaiya Lal
Smt KC Nagarathnamma

Asstt (S&P)
Shri Pankaj Kumar
Shri Shamiullah Khan
Shri Anees Ahmad
Shri SA Warsi

Senior Stenographer
Ms. Gaitry Sharda
Smt P Sabitha
Shri Srikar Ji Sinha
Ms. Suchita Gupta

Isolated Posts (Group-B)
Shri Yograj Singh
Shri Rohit Khanna
Smt Sangeeta Tanwar

Group-C Posts Asstt (S&P)
Shri Ajeet Verma

(Asstt Gen Grade-II)
Shri Manoj Swaroop Shukla
Mrs. Sheela Yadav
Shri Vijay Kumar Bhartey
Mrs. Preeti Gangwar

Asstt (F&A) Grade-II
Shri Pradeep Kumar
Smt Farzana Hafeez

Jr. Stenographer

Asstt (Gen.) Grade-III
Shri R Algarswamy
Shri. Ravi Prakash Mishra
Ms. Pratibha Maurya

Asstt (S&P) Grade-III

Asstt (F&A) Grade-III

Group C (Non –Tech)

Drivers PB-1
Shri Ajay Kumar Verma
Shri Sanjay Kr. Singh
Shri Sarwesh Yadav
Shri Chandrapal Verma
Shri Rajesh Kumar

Canteen Staff
Shri Victor Mukherjee

Multi-Tasking Staff
Shri Mata Prasad
Shri Kailash Chandra
Shri Tula Singh
Shri Ashok Kr. Pathak
Shri Kishan Lal
Shri P Bhikshapathi
Shri Ajay Kumar
Smt Nirmala Verma
Smt Tara Devi
Smt. Nargis Sufia Ansari
Smt Sunita Devi
Shri Santosh Kumar
Shri Sant Ram

PB-1
Shri Sudhir Kumar Bhattacharya
Shri Harihar
Shri Raja Ram
Shri Praveen Kumar
Shri Kishan Ram
Smt. Zarina Bano
Shri Ram Karan
Shri Dharam Pal Balmiki
Shri Abdul Nadir Khan
Shri Arvind Kumar
Smt. Raj Mati
Shri Harpal Valmiki
Shri. Kripa Ram
Shri. Mohd. Shameem
Shri. Mohd. Mohsin
Shri Raja Ram

CIMAP Welcomes New Staff Members

S No	Name	Designation	Date of Posting	Posting
1.	Shri.Deepak Kumar Verma	Technical Assistant	15-09-2017	CIMAP, Lucknow
2.	Shri. Sanjeet Kumar Verma	Technical Assistant	15-09-2017	CIMAP, Lucknow
3.	Ms. Pooja Singh	Technical Assistant	15-09-2017	CIMAP, Lucknow
4.	Shri Sonveer Singh	Technical Assistant	22-09-2017	CIMAP RC, Pantnagar
5.	Shri. Prabhat Kumar	Technical Assistant	26-09-2017	CIMAP, Lucknow

Staff Superannuated

Sl. No.	Name	Designation	Date of Retirement
1.	Shri. J. P. Tewari	Chief Scientist	30.06.2017
2.	Shri Kundan Singh	PTO	31.07.2017
3.	Shri Anil Kumar	Chief Scientist	31.07.2017
4.	Shri A. R. Kidwai	Sr. Tech (2)	31.08.2017
5.	Shri Raja Ram	Group D (NT)	31.12.2017

Publications

Research Articles & Review

1. Agrawal K, Singh DK, Jyotshna, Ahmad A, Shanker K, Tandon S, Luqman S. 2017. Antioxidative potential of two chemically characterized *Ocimum* (Tulsi) species extracts. *Biomedical Research & Therapy* 4 (9):1574-1589.

2. Ahmad IM, Dixit S, Konwar R, Prema G Vasdev, Yadav AK, Tripathi S, Gupta MM, Sharma A, Gupta A. 2017. Syntheses of conformationally restricted benzopyran based triarylethylenesas growth inhibitors of carcinoma cells. *Bioorganic and Medicinal Chemistry Letters* 27(22):5040-45. [IF = 2.44]

3. Alam S, Khan F. 2017. 3D-QSAR studies on Maslinic acid analogs for anticancer activity against breast cancer cell line MCF-7. *Scientific Reports* 7:1-13. [IF = 4.25]

4. Alam S, Khan F. 2017. QSAR, docking, ADMET, and system pharmacology studies on tormentic acid derivatives for anticancer activity. *Journal of Biomolecular Structure & Dynamics* 36(9):2373-2390. [IF = 3.12]

5. Augustin MM, Shukla AK, Starks CM, O'Neil-Jhnson M, Han L, Holland CK, Kutchan TM. 2017. Biosynthesis of *Veratrum californicum* speciality chemicals in *Camelina savita* seed. *Plant biotechnology report* 11:29-41 [IF = 1.422]

6. Azmi L, Shukla I, Gupta SS, Chaudhary A, Kant P, Yadav NP, Rao CV. 2018. Evaluation of chemoprotective effect of quercetinfrom *Argyreia speciosa* against N-methyl-N-Nitro-N-nitrosoguanidine and nacl-induced gastric carcinomas in wistar rats. *Pharmacognosy Journal*. 10(2):215-220.

7. Bansal S, Narnoliya LK, Mishra B**,** Chandra M, Yadav RK, Sangwan NS. 2017. HMG-CoA reductase from camphor tulsi (*Ocimum kilimandscharicum*) regulated MVA dependent biosynthesis of diverse terpenoids in homologous and heterologous plant systems. *Scientific Report* 8:3547. [IF = 4.25]

8. Bansal S, Sangwan NS. 2017. An insight into structural and functional characteristics of 3-*hydoxy* 3-*methylglutaryl* CoA reductase from *Ocimum* species. *Canadian Journal of Biotechnology* 1:47.

9. Barnawal D, Bharti N, Pandey SS, Chanotiya C, Kalra A. 2017. Plant growth-promoting rhizobacteria enhance wheat salt and drought stress tolerance by altering endogenous phytohormone levels and TaCTR1/TaDREB2 expression. *Physiologia Plantarum* 161:502-514. [IF = 3.33]

10. Barnawal D, Pandey SS, Bharti N, Pandey A, Ray T, Singh S, Chanotiya C, Kalra A. 2017. ACC deaminase-containing plant growth promoting rhizobacteria protect *Papaver somniferum* from downy mildew. *Journal of Applied Microbiology* 122:1286-1298. [IF = 2.09]

11. Bhakuni RS, Gupta M, Rout PK, Misra LN, Gupta P, Singh N, Darokar MP, Saikia D, Singh SC. 2017. Chemical composition and bioactivity of *Boswellia serrata* Roxb. essential oil in relation to geographical variation. *Plant Biosystems* 151:623-629. [IF = 1.25]

12. Bhakuni RS, Siddique AA, Mishra LN, Gupta P, Darokar MP. 2017. New triglycerides from antimicrobial extracts of *Nepeta hindostana* weed. *Indian Journal of Chemistry* 56B:542-550. [IF = 0.35]

13. Chandra M, Sangwan NS. 2017. Analyzing the structural aspects of isoprenoid biosynthesis pathway proteins in *Ocimum* species. *Canadian Journal of Biotechnology* 1:206.

14. Dhawan SS, Mishra A, Jain P, Lal RK. 2017. Trichomes and yield traits in *Mentha arvensis*: genotype performance and stability evaluation. *Journal of Herbs, Spices & Medicinal Plants* 24:1-14. [IF = 1.80]

15. Dhiman R, Markandeya M, Fatima F, Saxsena PN, Roy S, Rout PK, Patnaik S. 2017. Predictive modeling and validation of arsenite removal by a one pot synthesized bioceramic buttressed manganese doped iron oxide nanoplatform. *RSC Advances* 7:32866-32876. [IF = 3.10]

16. Dubey V and Luqman S. 2017. Cathepsin D as a promising target for the discovery of novel anticancer agents. *Current Cancer Drug Targets* 17:404-422. [IF = 3.41]

17. Gupta AK. 2017. 'CIMAP SIL-9': A dwarf and high silymarin yielding variety of milk thistle (*Silybum marianum*). *Journal of Medicinal and Aromatic Plant Sciences* 39:44-48.

18. Gupta AK. 2017. CIM-Sanjeevani: A high artemisinin yielding population of Artemisia (*Artemisia annua*). *Journal of Medicinal and Aromatic Plant Sciences* 38:78-83.

19. Gupta AK. 2017. Registration of a high rhizome and high curcuminoid yielding variety of turmeric (*Curcuma longa* L) CIM-Pitamber. *Journal of Medicinal and Aromatic Plant Sciences* 39:49-54.

20. Gupta P, Patel DK, Gupta VK, Pal A, Tandon S, Darokar MP. 2017. Citral, a monoterpenoid aldehyde interacts synergistically with norfloxacin against methicillin resistant *Staphylococcus aureus*. *Phytomedicine* 34:85-96. [IF = 3.52]

21. Gupta R, Singh A, Ajayakumar PV, Pandey R. 2017. Microbial interference mitigates *Meloidogyne incognita* mediated oxidative stress and augments bacoside content in *Bacopa monnieri* L. *Microbiological Research* 199:67-78. [IF = 2.77]

22. Gupta R, Singh A, Srivastava M, Singh V, Gupta MM, Pandey R. 2017. Microbial modulation of bacoside A biosynthetic pathway and systemic defense mechanism in *Bacopa monnieri* under *Meloidogyne incognita* stress. *Scientific Reports* 7:41867. [IF = 4.25]

23. Gupta R, Singh A, Pandey R. 2017. Chitinolytic microbes confer *Meloidogyne incognita* resistance and augment secondary metabolites in *Bacopa monnieri* (L.) Pennell. *Archives of Phytopathology and Plant Protection* 50:178-196.

24. Hamid AA, Tanu K, Ashraf R, Singh A, Gupta AC, Prakash O, Sarkar J, Chanda D, Bawankule DU, Khan F, Shanker K, OO Aiyelaagbe, Negi AS. 2017. (22β,25R)- 3β-Hydroxy-spirost-5-en-7-iminoxy-heptano acid exhibits anti-prostate cancer activity through caspase pathway. *Steroids* 119:43-52. [IF = 2.52]

25. Jadaun JS, Sangwan NS, Narnoliya LK, Singh N, Bansal S, Mishra B, Sangwan RS. 2017. Over-expression of DXS gene enhances terpenoidal secondary metabolite accumulation in rose-scented geranium and *Withania somnifera*: active involvement of plastid isoprenogenic pathway in their biosynthesis. *Physiologia Plantarum* 159:381-400. [IF = 2.58]

26. Jadaun JS, Sangwan NS, Narnoliya LK, Tripathi S, Sangwan RS. 2017. *Withania coagulans* tryptophan decarboxylase gene cloning, heterologous expression, and catalytic characteristics of the recombinant enzyme. *Protoplasma* 254:181-192. [IF = 2.87]

27. Jain S, Singh A, Khare P, Chanda D, Mishra D, Shanker K, Karak T. 2017. Toxicity assessment of *Bacopa monnieri* L. grown in biochar amended extremely acidic coal mine spoils. *Ecological Engineering* 108:211-219. [IF = 2.91]

28. Jyotshna, Gaur P, Singh DK, Luqman S, Shanker K. 2017. Validated method for quality assessment of henna (*Lawsonia inermis* L.) leaves after postharvest blanching and its cosmetic application. *Industrial Crops and Products* 95:33-42. [IF = 3.84]

29. Karaka T, Boraa K, Paul RK, Das S, Khare P, Dutta AK, Boruah RK. 2017. Paradigm shift of contamination risk of six heavy metals in tea (*Camellia sinensis* L.) growing soil: A new approach influenced by inorganic and organic amendments. *Journal of Hazardous Materials* 338:250–264. [IF = 6.06]

30. Khan S, Pandey SS, Jyotshna, Shanker K, Khan F, Rahman L. 2017. Cloning and functional characterization of quinolinic acid phosphoribosyl transferase (QPT) gene of *Nicotiana tabacum*. *Physiologia Plantarum* 160:253–265. [IF = 2.58]

31. Khan S, Upadhyay S, Khan F, Tandon S, Shukla RK, Ghosh S, Gupta V, Banerjee S, Rahman L. 2017. Comparative transcriptome analysis reveals candidate genes for the biosynthesis of natural insecticide in *Tanacetum Cinerariifolium*. *BMC Genomics* 18(1):54. [IF = 3.73]

32. Khare P, Dilshad U, Rout PK, Yadav V, Jain S. 2017. Plant refuses driven biochar: Application as metal adsorbent from acidic solutions. *Arabian Journal of Chemistry*10: S3054-S3063. [IF = 4.55]

33. Khare P, Mishra D, Singh DK, Luqman S, AjayaKumar PV, Yadav A, Das T, Saikia BK. 2017. Retention of antibacterial and antioxidant properties of lemongrass oil loaded on cellulose nanofibre-poly ethylene glycol composite. *Industrial Crops & Products* 114:68-80. [IF = 3.18]

34. Kumar A, Jnanesha AC. 2017. Potential species of aromatic plants for cultivation in semi-arid tropical (SAT) regions of Deccan region. *Journal of Medicinal Plants Studies* 5(3):269-272.

35. Kumar A, Agarwal K, Singh M, Saxena A, Yadav P, Maurya AK, Yadav A, Tandon S, Chanda D, Bawankule DU. 2018. Essential oil from waste leaves of *Curcuma longa* L. alleviates skin inflammation. *Inflammopharmacology* 26(5):1245-1255. [IF = 2.59]

36. Kumar A, Jnanesha AC. 2017. Cultivation, utilization and role of medicinal plants in tradition medicine in deccan eco-climate. *International Journal on Agricultural Sciences*8(1):98-103.

37. Kumar A, Jnanesha AC. 2017. Genetic diversity and conservation of medicinal plants in Deccan plateau region in India. *Journal of Medicinal Plants Studies* 5(3):27-30.

38. Lal RK, Singh S, Gupta P, Dhawan SS, Sarkar S, Verma RK. 2017. Quantification of ursolic acid, correlations and contribution by other traits towards accumulation of ursolic acid in six *Ocimum* species. *Trends in Phytochemical Research* 1:39-46. [IF = 1.00]

39. Maji D, Misra P, Singh S, Kalra A. 2017. Humic acid rich vermicompost promotes plant growth by improving microbial community structure of soil as well as root nodulation and mycorrhizal colonization in the roots of *Pisum sativum*. *Applied Soil Ecology* 110:97-108. [IF = 2.78]

40. Maurya AK, Mohanty S, Pal A, Chanotiya CS, Bawankule DU. 2017. The essential oil from *Citrus limetta* Risso peels alleviates skin inflammation: *In-vitro* and *in-vivo* study. *Journal of Ethnopharmacology* 212:86-94. [IF = 2.98]

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Book Chapters

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2. Ghosh S, Irfan M, Datta A. 2017. Application of RNA silencing in improving plant traits for industrial use in Dalmay T. (Eds). Plant gene silencing: mechanisms and applications, 128-146, Wallingford, UK

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4. Padalia RC, Verma RS, Chauhan A, KT V, Singh VR. 2017. Pharmaceutical Values and Essential Oils of Indian Ocimum taxa: A review in. (Eds). Indian Ethno medicinal Plants: Traditional Practices to Cure Diseases, 116-138, Jaipur (Rajasthan), India

5. Pandey R, Gupta R, Singh A. 2017. Potential use of microbes for root-knot nematode management in medicinal and aromatic plants and improve production of plant secondary metabolites. in Raj A. (Eds). IPS, 44-54

6. Pandey R, Gupta R, Singh A. 2017. Nematode diseases of major medicinal and aromatic crops and its biomanagement in Mishra DP. (Eds). Plant Systematic and Biotechnology: Challenges and Opportunities, 75-87

7. Patel A, Khare P, Patra DD. 2017. Biochar Mitigates Salinity Stress in Plants in Kumar N. (Eds). Plant Adaptation Strategies in Changing Environment, 153-182, Singapore, Singapore

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11. Singh B, Kumar N, Vyas D, Misra P, Gairola S, Gandhi S, Sangwan P L, Latoo S K. Plants for well-being and vigour Accepted for publication (final proof). In Chopra V L., National Publishing House, Dehradun, India

Patents Granted

1. α-yohimbine and its derivatives as antipsychotic agents and process of their preparation. Patent No. India 281936, 29.3.2017 (SK Srivastava,VK Khanna, Shikha Gupta, AK Agarwal, Chandishwar Nath, MM Gupta, R Kishore Verma)

The present invention relates to the development of a virtual screening model for predicting antipsychotic activity using quantitative structure activity relationship (QSAR), molecular docking, oral bioavailability, ADME and Toxicity studies. QSAR model showed activity-descriptors relationship correlating measure (r^2) 0.87 (87%) and predictive accuracy of 81% (rCV^2=0.81). The present invention specifically showed strong binding affinity of the untested (unknown) novel compounds against anti-psychotic targets viz., Dopamine D2 and Serotonin ($5HT_{2A}$) receptors through molecular docking approach. The present invention further showed compliance of Lipinski's rule of five for oral bioavailability and toxicity risk assessment for all the active Yohimbine derivatives.

2. Vetiver plant named `CIMAP-KHUSINOLIKA` Patent No. US PP28388, 12.9.2017 (HS Chauhan,HP Singh, C S Chanautia, AK Shasany, UC Lavania, VKS Tomar, Alok Kalra, Ashok Kr Singh)

The present invention relates to the development of a novel, morphologically and genetically distinct khusinol rich essential oil producing clone of vetiver [Vetiveria zizaniodes (L.) Nash. syn. Chrysopogon zizanioides (L.) Roberty; family Poacaeae] named 'CIMAP-Khusinolika'. The plant of this clone is characterized by spreading type clump canopy in the initial stage, white feathery stigma and capable of producing >1% (v/w) essential oil containing 45-50% Khusinol (v/v) obtained after hydro-distillation from fresh roots harvested from 06 month old plantations. This clone has unique ISSR profiles that serve as DNA-fingerprints. The clone was obtained through recurrent selection in polycrossed population generated from the bulk of wild collection, and can be propagated through vegetative slips (3 to 6 month old stem with few roots) for commercial plantation as a short duration crop.

Awards & Recognition

- Dr. Alok Kalra elected as Fellow of the National Academy of Sciences (FNAS)
- Dr. Ajit Kumar Shasany elected as National Academy of Agricultural Sciences (NAAS)
- Dr D.U. Bawankule elected as Fellow of Academy of Sciences for Animal Welfare (ASAW)
- Dr Alok Kalra visited Tokyo Japan on account of Multi-Country Observational Study Mission on Innovations in Value-added Agriculture
- Dr. N.S. Sangwan was invited to deliver a lecture at Jiangnan University, Wuxi, in an International Conference on Industrial Bioprocessing (IFIBiop 2017) where she also chaired a session on upstream and downstream processing processes.
- Dr A.S. Negi was awarded with DHR-Short Term Fellowship for six months to work on microtubule dynamics at University of California Santa Barbara, USA.
- Dr Ramesh Srivastava visited Thailand to attend Asian Forum on Smart Agriculture: Futuristic Technologies for Sustainable Farming during November 6-9
- Dr Ajit K Shanasy attended Third Meeting of Medicinal Plants Focal Points of IORA RCSTT, Jakarta, Indonesia, May 10-12
- Dr. Ashutosh K. Shukla has been awarded the prestigious Raman Research Fellowship for 2017-18 by CSIR for conducting advanced research in the area of Alkaloidomics and Synthetic Biology with Prof. (Dr.) Michael Müller at the Albert-Ludwigs-University Freiburg, Germany
- Dr. Rakesh Pandey was conferred with Plant Pathology Leadership Award-2017 by GBPUA&T, Pantnagar and Indian Phytopathological Society, New Delhi.
- Dr. Birendra Kumar received Distinguished Scientist award for outstanding contribution in the field of Genetics and Crop Breeding by S&T Society for Integrated Rural development, Warangal, Telangana
- Dr. Jnanesha A.C. received Junior Scientist of the year Award in the field of Agriculture by National Environmental Science Academy, New Delhi.
- Dr. Karuna Shanker and team were awarded with 12th Dr. P D Sethi Annual Awards for Best Paper in Pharma Analysis.

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Former Director, CSIR-IIIM,
Executive Villa, 522-A Block-C, Sushant
Lok-1 Gurgaon
Haryana – 122002

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P.O. Manauli, SAS Nagar Mohali
Punjab – 140306

Professor Ram Harsh Singh
Life Time Distinguished Professor
Institute of Medical Sciences
Banaras Hindu University
Department of Kayachikitsa
Varanasi, Uttar Pradesh – 221005

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Former Head, CSIR – URDIP, Pune
A-61, Virndavan Society Pandhavati,
Pashan Road, Pune
Maharashtra – 411008

Dr. Ramesh Sonti
Chief Scientist
CSIR-Centre for Cellular and Molecular
Biology, Uppal Road
Hyderabad, Telangana – 500007

Dr. Rajesh Kotecha
Special Secretary
Minister of AYUSH
Ayush Bhavan, Block GPO Complex, INA
New Delhi – 110023

Professor R.B. Singh
Professor, Department of Geography
University of Delhi
School of Economics
New Delhi – 110007

Dr. Ram A. Vishwakarma
Director
CSIR-Indian Institute of Integrative
Medicine, Canal Road
Jammu, J&K – 180001

DG's Nominee

Dr. Sanjay Kumar
Director
CSIR-Institute of Himalayan Bioresource
Technology
Palampur
Himachal Pradesh – 176061
E mail: director@ihbt.res.in

Director

Prof. Anil Kumar Tripathi
Director
CSIR-Central Institute of Medicinal &
Aromatic Plants
P.O. CIMAP, Near Kukrail Picnic Spot
Lucknow-226015

Permanent Invitee
Head or his Nominee

Planning & Performance Division
Council of Scientific & Industrial Research
Anusandhan Bhawan, 2 Rafi Nagar
New Delhi-110001

Management Council

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Director
CSIR-CIMAP, Lucknow

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Dr. V.K. Agarwal
Medical Officer
CSIR-CIMAP, Lucknow

Dr. Vikrant Gupta
Principal Scientist
CSIR-CIMAP, Lucknow

Controller of Finance and Account
Finance and Accounts Officer

Member Secretary
Controller of Administration /Administrative Officer

Right to Information Act

Following officials have been designated as per the requirement of the act:

Central Public Information Officer

Dr. Dharmendra Saikia

CSIR-CIMAP, Lucknow
E-mail: d.saikia@cimap.res.in
Phone: 91-522 - 2718650

Appellate Authority

Mr. P.V Ajayakumar

CSIR-CIMAP, Lucknow
E-mail: pv.ajayakumar@cimap.res.in
Phone: 91-522 - 2718665

Nodal Officer

Er. Bhaskar Shukla

CSIR-CIMAP, Lucknow
E-mail: bhaskar.shukla@cimap.res.in
Phone: 91-522 - 2718616

The summary of the cases during 2017 is:

Year 2017

(01 Jan 2017 - 31 Dec 2017)

Application Received	Rejected	Information Provided	1st Appeal	Referred to CIC, New Delhi
84 including Transfer cases	02	82	03	Nil

Budget at Glance (2017-18)

	Allocation (₹ in lakhs)	Expenditure (₹in lakhs)
Pay and Allowances	2983.980	2983.043
Contingency	357.380	357.380
HRD	0	0
Lab maintenance	203.900	203.900
Staff Qtrs. Maintenance	39.500	39.475
Chemicals /Consumables	423.500	423.500
Works and Services	165.500	164.852
Apparatus and Equipment	500.500	500.500
Office Equipment	0	0
Furniture and fitting	0	0
Library(P50)(Books& journal)	72.333	72.333
Staff Qtrs. (Construction)	140	139.809
CSIR Network Projects	1114.605	968.049
Total	6001.198	4884.792
Pension	2734.600	2734.600
External Budgetary Resources		
Lab Reserve Fund (LRF)		42.646
External Cash Flow (ECF)		703.27

(As on 31st March 2018)

List of the PhD thesis awarded

S. No	Name of the Student	Title of the Thesis	Year of Award	Name ofSupervisor	University
1	Furkan Ahmed	Phytochemical studies on *Saraca asoca* (Roxb.) de Wilde for bioactive compounds.	2017	Dr. R.S. Bhakuni	AcSIR
2	Yogita Deshmukh	Isolation and characterization of basmati aroma (2 acetyl- 1-pyrroline) synthesizing bacteria from the rhizosphere of basmati rice (*Oryza Sativa* L.)	2017	Dr. D.D Patra	JNU
3	Archana Prasad	"*In vivo* and *in vitro* strategies for improved production of bioactive sponins and sapogenins in *Centella asiatica* (L.) urban"	2017	Dr. Archana Mathur	JNU
4	Krishna Kumar	Geraniol syntheses and its involvement in monoterpenoid indole alkaloid biosynthesis in *Catharanthus roseus*	2017	Dr. Dinesh A. Nagegowda	JNU
5	Bashir Akhlaq Akhoon	"*In vivo* and *in silico* approaches to investigate anti-ageing activities of withanolide A in *Caenorhabditis elegans*"	2017	Dr.Rakesh Pandey	JNU
6	Ruby	"*In vitro* production of therapeutic molecules form normal and genetically engineered cultures of *Borehaavia diffusa* and *Mirabilis jalapa*"	2017	Dr.(Mrs.)Suchitra Banerjee	AcSIR
7	Arvind Saroj	"Isolation and characterization of *R. solani* isolates from selected important medicinal and aromatic plants using classical & molecular approaches"	2017	Dr. Abdul Samad	JNU
8	Ujjal J Phukan	Cloning and characterization of stress inducible *Apetala*2 homolog from *Mentha arvensis*	2017	Dr. Rakesh Kumar Shukla	JNU
9	Sajendra Kumar Verma	Identification and mechanism of action studies on phytomolecules for combating methicillin/vancomycin resistance in *Staphylococcus aureus*	2017	Dr.Mahendra P. Darokar	JNU
10	Dhananjay Kumar Singh	Development of chemical profiling and exploration of pharmacological activity in henna (*Lawsonia inermis* L.)	2017	Dr. Suaib Luqman	JNU
11	Rashmi Lahiri	Genetics and pattern of inheritane of economic, quantitative and qualitative traits in opium poppy (*Papver somniferum* L.)	2017	Dr. Raj Kishori Lal	JNU
12	Shilpa Mohanty	Therapeutic mechanism of selected plant derived leads against inflammatory mediators involved in malaria pathogenesis	2017	Dr. Dnyaneshwar U. Bawankule	AcSIR

13	Vigyasa Singh	Studies on drug resistance reversal potential of phytochimical(s) for combating *Staphylococcus aureus* infections	2017	Dr.MP.Darokar/ Dr. Anirban Pal	JNU
14	Ajay Kumar	Terpene biosynthesis pathway genes of *Pelagonium graveolens*	2017	Dr. Ajit Kumar Shasany	JNU
15	Shilpi Bansal	Functional genomics studies on the key genes of terpenoids biosynthesis from selected medicinal plants: *Ocimum kiimandscharicum and Withania somifera*	2017	Dr. (Mrs.) Neelam Singh Sangwan	AcSIR
16	Monika Singh	Therapeutic mechanism of diosgenin analogues on inflammatory response in sepsis, malaria and skin inflammation	2017	Dr. Dnyaneshwar U. Bawankule	JNU
17	Himanshu Tripathi	Genomic identification of potential targets unique to *Candida alblcans* and QSRA studies on active phytomolecules/derivatives for antifungal activity	2017	Dr. Feroz Khan	AcSIR
18	Tanya Biswas	Elucitation of *in vitro* secondary metabolite production and its transcript expression profiling in *Panax* species	2017	Dr.(Mrs.)Archana Mathur	JNU
19	Yashveer Gautam	Studies on design and synthesis of tetralone and indole type pharmacophores as anticancer agents	2017	Dr. Arvind Singh Negi	JNU
20	Mohammd Imran Ahmed	Synthesis of potential selective estrogen receptor modulators(serms)	2017	Dr. Atul Gupta	JNU
21	Archana Saxena	Mechanism(s) of selected diarylheptanoids on inflammatory response in sepsis and malaria	2017	Dr. Dnyaneshwar U. Bawankule	JNU
22	Rupali Gupta	Studies of potential rhizopheric chitinolytic bacterial communities for meloidogyne incognita management in *Bacopa monnieri* L. (Pennell)	2017	Dr. Rakesh Pandey	AcSIR
23	Pallavi Pandey	Genetic manipulations through "hairy roots" in selected medicinal plants for biotransformation mediated value addition & bioactive metabolite production.	2017	Dr.(Mrs.)Suchitra Banerjee	AcSIR
24	Sanjeet Kumar Verma	Study of the allelpathic potential of *Ocimum* species on weeds, agricultural crops and soil properties.	2017	Dr. Rajesh Kumar Verma	AcSIR
25	Umesh Pankaj	Study of the mycorrhizal symbiosis with palmarosa (*Cymbopogon martinil*) under salt affected soil and its influence on growth, yield, quality and soil properties	2017	Dr. Rajesh Kumar Verma	JNU

*AcSIR- Academy of Scientific and Innovative Research
*JNU- Jawaharlal Nehru University, New Delhi

हिन्दी प्रभाग

कर्मचारी सदस्य (31 दिसंबर 2017)

निदेशक
प्रो. अनिल कुमार त्रिपाठी

मुख्य वैज्ञानिक
डॉ. अशोक शर्मा
डॉ. आर.एस. सांगवान
डॉ. आलोक कालरा
डॉ. अब्दुल समद
श्री राकेश तिवारी
श्री पी.वी. अजया कुमार

वरिष्ठ प्रधान वैज्ञानिक
डॉ. (श्रीमती) नीलम सिंह सांगवान
डॉ. ए.के. शासनी
डॉ. सौदान सिंह
डॉ. आलोक कुमार कृष्णा
डॉ. वेदराम सिंह
डॉ. आर.एस .भाकुनी
इं. सुदीप टंडन
डॉ. एम.पी. दारोकार
डॉ. अरविंद सिंह नेगी
इं. डी. किरण बाबू
डॉ. बिरेन्द्र कुमार
डॉ. ए.के. गुप्ता

प्रधान वैज्ञानिक
डॉ. लाईक–उर–रहमान
डॉ. धर्मेंद्र सैकिया
डॉ. विक्रांत गुप्ता
डॉ. राकेश पांडे
डॉ. अनिर्बन पाल
डॉ. दिनेश ए. नागेगोडा
डॉ. जे. कोटेश कुमार
डॉ. (श्रीमती) सुनीता सिंह धवन

वरिष्ठ वैज्ञानिक
डॉ. दयानंदन मनी
डॉ. करुणा शंकर
डॉ. राजेश कुमार वर्मा
डॉ. संजय कुमार
इं. मनोज सेमवाल
डॉ. डी.यू. बावनकूले
डॉ. फिरोज़ खान
डॉ. वेंकट राव डी.के.
डॉ. सी.एस. विवेकबाबू
डॉ. सुमित घोष
डॉ. (श्रीमती) प्रेमाजी वासुदेव
डॉ. आशुतोष कुमार शुक्ला
डॉ. नारायण प्रसाद यादव
श्री के.वी.एन. सत्य श्रीनिवास
डॉ. शोएब लुक़मान
डॉ. राजेंद्र चंद्र पडालिया
डॉ. वी. सुंदरेसन
श्री राम स्वरुप वर्मा
डॉ. (श्रीमती) पूजा खरे
डॉ. चंदन सिंह चनोटिया
डॉ. देबब्रता चंदा
डॉ. प्रशांत कुमार राऊत
डॉ. प्रदिप्तो मुखोपाध्याय
डॉ. किशोर बाबू बंदामारावुरी
डॉ. रमेश कुमार श्रीवास्तव
डॉ. मुक्तिनाथ मिश्रा

वैज्ञानिक
डॉ. आभा मीना
डॉ. राकेश के. शुक्ला
डॉ. (सुश्री) त्रिप्ता झांग
डॉ. अतुल गुप्ता
डॉ. प्रीती श्रीवास्तव
इं. भास्कर शुक्ला
डॉ. राम सुरेश
डॉ. राकेश कुमार उपाध्याय
इं. अशविन डी. नन्नावरे
डॉ. नरेंद्र कुमार
डॉ. राकेश कुमार
डॉ. योगेंद्र एन.डी.
डॉ. चन्नेया हिरेमाथ
डॉ. वेंकटेश केटी
डॉ. जनानेश ए.सी.

समूह–III
प्रधान तकनीकी अधिकारी
डॉ. वी.के.अग्रवाल
डॉ. एच.पी.सिंह
डॉ. मोहम्मद जैम

डॉ. दिनेश कुमार
श्री ए.म. खान

वरिष्ठ तकनीकी अधिकारी (3)

श्री प्रेम सिंह
डॉ. डी.के. राजपूत
डॉ. सुखमल चंद
डॉ. दशा राम
श्री के. भास्करन
डॉ. अतीक अहमद

वरिष्ठ तकनीकी अधिकारी (2)

श्रीमती सुधा अग्रवाल
श्री गोविंदराम

वरिष्ठ तकनीकी अधिकारी (1)

श्रीमती अंजू कुमारी यादव
श्री शिव प्रकाश
डॉ. (श्रीमती) मंजू सिंह
डॉ. राजेंद्र प्रसाद पटेल
डॉ. रक्षपाल सिंह
श्री अनिल कुमार सिंह

तकनीकी अधिकारी (जीआर III (3))

श्री राम प्रवेश
डॉ. अमित चौहान
श्री अनिल कुमार मौर्य
श्री अमित मोहन
श्रीमती नमिता गुप्ता
श्री ए.के. तिवारी

तकनीकी सहायक

श्री संजय सिंह
श्री ए निरंजन कुमार
श्रीमती अंजू केसरवानी
श्री बाला किशन भुक्या
श्री अमित कुमार तिवारी
श्री मनोज कुमार यादव
श्री आशीष कुमार
श्री प्रवल प्रताप सिंह वर्मा
श्री आशीष कुमार शुक्ला
श्री मनीष आर्य
श्री संजीत कुमार वर्मा
श्री दीपक कुमार वर्मा
सुश्री पूजा सिंह
श्री प्रभात कुमार वर्मा
श्री सोनवीर सिंह

समूह II

वरिष्ठ तकनीशियन (3)

श्री एस.के. शर्मा

वरिष्ठ तकनीशियन (2)

श्री एस. सेल्वराज
श्री श्याम बिहारी
श्रीमती आई.वी रौतेला
श्री राम चन्द्र
श्री वाई. शिवाराव
श्री सलीम बेग
डॉ. अब्दुल खालिक
श्री एस.के. पांडे
श्री आर.डी. राम
श्री रघुबिंद कुमार
श्री गोपाल राम
श्री ई. भास्कर
श्रीमती एस. शारदा
श्री पी.एन. गौतम
श्री जोसेफ एम. मैसी
श्री राम लखन
श्री पी.के. तिवारी
श्री विनोद कुमार
श्री शिवा कुमार डी.सी

वरिष्ठ तकनीशियन (1)

श्रीमती राज कुमारी
श्री धर्मपाल सिंह

तकनीशियन (2)

श्री वी. के. शुक्ला
श्री पंकज कुमार शुक्ला
श्री कुंदन नारायण वासनिक
श्री यल्ला वी.वी.एस. स्वामी
श्री बसंत कुमार दुबे
श्री विजय कुमार वर्मा
श्री हरेंद्र नाथ पाठक
श्री हेमराज शर्मा
श्री जितेंद्र कुमार वर्मा

तकनीशियन (1)

श्री प्रमोद कुमार

समूह–क

प्रयोगशाला सहायक

श्री महेश प्रसाद
श्री वी.के. सिंह
श्री अब्दुल मबूद
श्री राम उजागिर
श्री सुभाष कुमार
श्री भरत सिंह बिष्ट
श्री मन मोहन
श्री कासिम अली
श्री सभाजीत
श्री मोहम्मद नवी
श्री मुन्नवर अली
श्री हरि पाल
श्री नूरुल हुदा
श्री सुरेंद्रनाथ
श्री लाल चंद प्रसाद
श्रीमती पुष्पा सेमवाल

लैब अटैन्डेंट (2)

श्री टी.पी. सुरेश

प्रशासनिक स्टाफ

समूह ए

श्री एम.एस. मेहरा
श्री बी.एल. मीना
श्री बलजीत सिंह
श्री भास्कर ज्योति देवरी
श्रीमती बी. मल्लिकाम्बा

ग्रुप–बी (राजपत्रित)

श्री हरे राम कुशवाहा
श्री अंकेश्वर मिश्रा
श्री विकास चंद मिश्रा
श्री संजय कुमार राम
श्री गिरिजा शंकर वर्मा
श्री शैलेंद्र प्रताप सिंह
श्रीमती कंचन लता थॉमस

ग्रुप–बी (गैर राजपत्रित)

श्रीमती सूफ़िया किर्मानी
श्री मुनेश्वर प्रसाद
श्री संत लाल
श्री परवेज नासीर
श्री पी. श्रीनिवास
श्री राजेश कुमार
श्री कौशल किशोर
श्री सिद्धार्थ शुक्ला
श्री रवि प्रकाश
श्री के.जी. थॉमस
मिस सन्योगिता सैंगर
श्री पी.के. चतुर्वेदी

सहायक (एफ एंड ए)

श्रीमती निशा शर्मा
श्री हरीश चंद्र
श्री शिव कुमार
श्री सुनील कुमार
श्री ए.एल. साहू
श्री आयुशा सिंघल
श्री कन्हैया लाल
श्रीमती के.सी. नगरनाथम्मा

सहायक (एस एंड पी)

श्री पंकज कुमार
श्री शमी–उल्लाह खान
श्री अनीस अहमद
श्री एस. एवारसी

वरिष्ठ आशुलिपिक

सुश्री गायत्री शारदा
श्रीमती पी सबिता
श्री श्रीकरजी सिन्हा
सुश्री सुचिता गुप्ता

पृथक पद (समूह–बी)

श्री योगराज सिंह
श्री रोहित खन्ना
श्रीमती संगीता तनवर

ग्रुप–सी पोस्ट सहायक (एस एंड पी)

श्री अजीत वर्मा

(सहायक जनरल ग्रेड –2)

श्री मनोज स्वरुप शुक्ला
श्रीमती शीला यादव
श्री विजय कुमार भारती
श्रीमती प्रीती गंगवार

सहायक (एफ एंड ए) ग्रेड –2

श्री प्रदीप कुमार
श्रीमती फरज़ाना हफ़ीज़

जूनियर आशुलिपिक

सहायक (जनरल) ग्रेड –3

श्री आर. अलगरस्वामी
श्री रवि प्रकाश मिश्रा
सुश्री प्रतिभा मौर्य

सहायक (एस एंड पी) ग्रेड –3

सहायक (एफ एंड ए) ग्रेड –3

ग्रुप–सी (गैर–टेक)

ड्राइवर्स पीबी –1
श्री अजय कुमार वर्मा
श्री संजय कुमार सिंह
श्री सर्वेश यादव
श्री चंद्रपाल वर्मा
श्री राजेश कुमार

कैंटीन स्टाफ

श्री विक्टर मुखर्जी

मल्टी टास्किंग स्टाफ

श्री माता प्रसाद
श्री कैलाशचंद्र
श्री तुला सिंह
श्री अशोक कुमार पाठक
श्री किशन लाल
श्री पी. भिक्षापति
श्री अजय कुमार
श्रीमती निर्मला वर्मा
श्रीमती तारादेवी
श्रीमती नर्गिस सूफिया अंसारी
श्रीमती सुनीता देवी
श्री संतोश कुमार
श्री संतराम

पीबी–1

श्री सुधीर कुमार भट्टाचार्य
श्री हरिहर
श्री प्रवीण कुमार
श्री किशनराम
श्रीमती ज़ारिना बानो
श्री रामकरण
श्री धर्मपाल बाल्मीकि
श्री अब्दुल नादिर खान
श्री अरविंद कुमार
श्रीमती राज मती
श्री हरपाल वाल्मीकि
श्री कृपा राम
श्री मोहम्मद शमीम
श्री मोहम्मद मोहसिन
श्री राजा राम

सीमैप नए स्टाफ सदस्यों का स्वागत करता है

क्र.सं.	नाम	पद	पोस्टिंगकीतारीख	प्रविष्टि
1	श्री दीपक कुमार वर्मा	तकनीकी सहायक 15.09.2017	15.09.2017	सीमैप, लखनऊ
2	श्री संजीत कुमार वर्मा	तकनीकी सहायक 15.09.2017	15.09.2017	सीमैप, लखनऊ
3	सुश्री पूजा सिंह	तकनीकी सहायक 15.09.2017	15.09.2017	सीमैप, लखनऊ
4	श्री सोनवीर सिंह	तकनीकी सहायक 22.09.2017	22.09.2017	सीमैप आर सी, पंतनगर
5	श्री प्रभात कुमार	तकनीकी सहायक 26.09.2017	26.09.2017	सीमैप, लखनऊ

सेवानिवृत्त कर्मचारी

क्र. सं.	नाम	पद	सेवानिवृत्ति की तारीख
1	श्री जे.पी. तिवारी	मुख्य वैज्ञानिक	30.06.2017
2	श्री कुंदन सिंह	पी टी ओ	31.07.2017
3	श्री अनिल कुमार	मुख्य वैज्ञानिक	31.07.2017
4	श्री ए.आर. किदवई	सीनियर टेक (2)	31.08.2017
5	श्री राजा राम	ग्रुप डी (एन टी)	31.12.2017

सूचना का अधिकार अधिनियम

निम्नलिखित अधिकारियों को अधिनियम की आवश्यकता के अनुसार नामित किया गया है:

केंद्रीय लोक सूचना अधिकारी

डॉ धर्मेंद्र सैकिया
सीएसआईआर–सीमैप
ई–मेलः d.saikia@cimap.res.in
फोनः 91–522–2718650

अपीलीय प्राधिकरण

श्री पी.वी. अजया कुमार
सीएसआईआर–सीमैप
ई–मेलः pv.ajayakumar@cimap.res.in
फोनः 91–522–2718665

नोडल अधिकारी

श्री भास्कर शुक्ला
सीएसआईआर–सीमैप
ई–मेलः bhaskar.shukla@cimap.res.in
फोनः 91–522–2718616

वर्ष 2017 के दौरान मामलों का सारांश है:

वर्ष 2017 (01 जनवरी 2017 – 31 दिसंबर 2017)				
आवेदन प्राप्त हुआ	अस्वीकृत	सूचना प्रदान की गई	पहली अपील	सीआईसी, नई दिल्ली को संदर्भित किया गया
84 स्थानांतरण मामलों सहित	02	82	03	शून्य

अनुसंधान परिषद

अध्यक्ष

प्रोफेसर एस.एस. हांडा

पूर्व निदेशक, सीएसआईआर–आईआईआईएम,
कार्यकारी विला, 522–एब्लॉक–सी, सुशांतलोक–1
गुड़गांव
हरियाणा–122002

सदस्य

डॉ. टी.आर. शर्मा

राष्ट्रीय कृषि–खाद्य जैव प्रौद्योगिकी संस्थान (एनएबी.आई)
जेसी बोस नेशनल फेलो और एक्जीक्यूटिव डायरेक्टर
राष्ट्रीय कृषि–खाद्य जैवप्रौद्योगि की संस्थान (एनएबी.आई)
सेक्टर–81, नॉलेजसिटी, पीओ–मनौली, एसएएस नगर
मोहाली पंजाब–140306

प्रोफेसर राम हर्ष सिंह

लाइफटाइम प्रतिष्ठित प्रोफेसर
चिकित्सा विज्ञान संस्थान, काय चिकित्सा विभाग
वाराणसी, उत्तर प्रदेश–221005

डॉ आर आर हिरवानी

पूर्व प्रमुख, सीएसआईआर–यूआरडीआईपी, पुणे
ए–61, वृंदावन सोसाइटी पंढवती,
पाशन रोड, पुणे, महाराष्ट्र–411008

डाव रमेश वी. सोंटी

मुख्य वैज्ञानिक
सीएसआईआर–कोशिकीय एवं आणविक जीव विज्ञान केन्द्र उप्पल रोड, हैदराबाद–500007

डॉ राजेश कोटेचा

विशेष सचिव, आयुश मंत्रालय
आयुश भवन, बी–ब्लॉक जीपीओ कॉम्प्लेक्स,
आईएनए, नई दिल्ली–110023

प्रोफेसर आर.बी. सिंह

प्रोफेसर, भूगोल विभाग
दिल्ली विश्वविद्यालय अर्थशास्त्र विभाग
नई दिल्ली–110007

डॉ राम ए विश्वकर्मा

निदेशक
सीएसआईआर–भारतीय समवेत औषध संस्थान (आई.आई.आई.एम.) जम्मू
नहर रोड जम्मू, जम्मू और कश्मीर – 180001

महानिदेशक नामित

डॉ संजय कुमार

निदेशक
सीएसआईआर–हिमालय जैव संपदा प्रौद्योगिकी संस्थान,पोस्ट बॉक्स नंबर 6 भारत
पालमपुर (हि.प्र.) 176061

निदेशक

प्रो. अनिल कुमार त्रिपाठी

निदेशक
सीएसआईआर–केन्द्रीय औषधीय एवं सगंध पौध संस्थान (सीमैप)
पी. ओ–सीमैप, निकट कुक्रैल पिकनिक स्पॉट
लखनऊ–226015

स्थायी आमंत्रित

प्रमुख या उसके नामित
योजना एवं निष्पादन विभाग
वैज्ञानिक एवं औद्योगिक अनुसंधान परिषद
अनुसन्धान भवन, 2 रफी मार्ग
नई दिल्ली–110001

प्रबंधन परिषद

अध्यक्ष

प्रोफेसर अनिल कुमार त्रिपाठी
निदेशक
सीएसआईआर–सीमैप, लखनऊ

विशेष आमंत्रित

डॉ संजय कुमार
निदेशक
सीएसआईआर–आईएचबीटी पालमपुर

सदस्य

डॉ मधु दीक्षित
निदेशक
सीएसआईआर–सीडीआरआई, लखनऊ

डॉ अशोक शर्मा
मुख्य वैज्ञानिक
सीएसआईआर–सीमैप, लखनऊ

डॉ एम.पी. दारोकार
वरिष्ठ प्रधान वैज्ञानिक
सीएसआईआर–सीमैप, लखनऊ

डॉ धर्मेंद्र सैकिया
प्रधान वैज्ञानिक
सीएसआईआर–सीमैप, लखनऊ

डॉ आभा मीना
वैज्ञानिक
सीएसआईआर–सीमैप, लखनऊ

डॉ वी.के. अग्रवाल
चिकित्सा अधिकारी
सीएसआईआर–सीमैप, लखनऊ

डॉ विक्रांत गुप्ता
प्रधान वैज्ञानिक
सीएसआईआर–सीमैप, लखनऊ

वित्त और खाते के नियंत्रक
वित्त और लेखाधिकारी

सदस्य सचिव
प्रशासन के नियंत्रक/प्रशासनिक अधिकारी

NOTES

Glimpses from the history

Central Institute of Medicinal and Aromatic Plants, popularly known as CIMAP, is a frontier plant research laboratory of Council of Scientific and Industrial Research (CSIR). Established originally as Central Indian Medicinal Plants Organization (CIMPO) in 1959, CIMAP is steering multidisciplinary high quality research in biological and chemical sciences and extending technologies and services to the farmers and entrepreneurs of medicinal and aromatic plants (MAPs) with its research headquarter at Lucknow and Research Centers at Bangalore, Hyderabad, Pantnagar and Purara. CIMAP Research Centers are aptly situated in different agro-climatic zones of the country to facilitate multi-location field trials and research. A little more than 50 years since its inception, today, CIMAP has extended its wings overseas with scientific collaboration agreements with Malaysia. CSIR-CIMAP has signed two agreements to promote bilateral cooperation between India and Malaysia in research, development and commercialization of MAP related technologies. CIMAP's contribution to the Indian economy through its MAPs research is well known. Mint varieties released and agro-packages developed and popularized by CIMAP has made India the global leader in mints and related industrial products. CIMAP has released several varieties of the MAPs, their complete agro-technology and post-harvest packages which have revolutionized MAPs cultivation and business scenario of the country.Recognizing the urgent need for stimulating research on medicinal plants in the country and for coordinating and consolidating some work already done by organizations like the Indian council of Agricultural Research, Indian Council of Medical Research, Tropical School of Medicine of Calcutta and various States Governments and Individual workers, the Council Scientific and Industrial Research approved in 1957 the establishment of the Central Indian Medicinal Plants Organization (CIMPO) with the following objectives : to co-ordinate and channelize the present activities in the field of medicinal plants carried out by the various agencies : to develop the already existing medicinal plants resources of India : to bring under cultivation some of the important medicinal plants in great demand and also to introduce the cultivation into the country of exotic medicinal plants of high yielding active principal content. It was further decide that as the work on all aspects of cultivation of aromatics plants was identical with all the cultivation of medicinal plants, the aromatic plants should also be covered within the scope of CIMPO. The Essential Oils Research Committee functioning under the Council of Scientific & Industrial Research was then dissolve and its activities taken over by CIMPO. The Organization started functioning with effect from 26 March 1959 with the appointment of late Shri P.M. Nabar its first Officer In-charge.

*Scope & Functions

- To pursue developmental, promotional and related work on cultivation, production, processing, utilization and marketing of medicinal and aromatic plants with specific reference to their practical application and utility.
- To cultivate medicinal and aromatic plants, either in its own farms or through other agencies, and to process wherever necessary, the plant materials for obtaining their end products.
- To carry out, in collaboration with other agencies, introduction, acclimatization (including measures for prevention and control of pests and diseases) of exotic-species and also production of authentic high-yielding seeds, leaves and other propagating materials of medicinal and aromatic plants of economic importance.
- To encourage cultivation of medicinal and aromatic plants in suitable regions of the country by giving grants-in-aid or loans and other incentives, wherever necessary.
- To carry out surveys of resources of medicinal and aromatic plants and to maintain economic statistics of the raw materials as well as finished products.
- To setup and maintain a specialized herbarium and museum of medicinal and aromatic plants of economic importance as well as of products derived therefrom.
- To undertake research and to encourage the same in established research institution, e.g. university laboratories, technological institutions, national laboratories, etc. for schemes relating to improvement, processing and utilization of medicinal and aromatic plants.
- To act as a 'clearing house' for collecting techno-economic data relating to medicinal and aromatic plants and products derived therefrom, by scientific ledgering and documentation and to disseminate information through publications of monographs, brochures, books, and all other effective means.

* cited from the 1977 brochure of the Central Indian Medicinal Plants Organization(CIMPO)

Salient Contributions of CSIR-CIMAP

- Catalysed transformation of India from menthol importing country to the largest global producer and exporter of menthol mint oil by spreading *Mentha* cultivation in more than 300,000 hectares, developing short-duration and high yielding varieties, and superior agro and processing technologies which enhanced the income of nearly 600,000 farmers.

- Ensured 'Make in India' of the anti-malarial drug artemisinin by developing high yielding varieties of *Artemesia annua,* chemical process for extraction and derivatization of artemisinin and promoting cultivation of improved varieties in farmers field.

- Profitable utilization of salt-affected and flood-prone coastal and river bank areas by developing and deploying short duration and high yielding varieties of Vetiver (Khus).

- Development and deployment of improved varieties of lemon grass, palmarosa, ashwagandha, and tulsi cultivation in under-utilized rain deficit areas like Bundelkhand, Vidharbha, Kutch and Marathwada.

- Developed one of the most successful herbal formulation for the management of diabetes type 2 (With CSIR-NBRI) using medicinal plants mentioned in Ayurveda and ensuring clinical efficacy and safety.

- Leading CSIR Aroma Mission to empower Indian farmers and aroma industries by cultivation, processing, value addition and marketing of aromatic crops.

- Coordinating promotion of exchange of knowledge and trade of medicinal plants among IORA member states of Indian-Ocean Rim Association.

Head Quarter Lucknow

Research Center Bengaluru

Research Center Hyderabad

Research Center Pantnagar

Research Center Purara

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CSIR-CIMAP

CSIR-Central Institute of Medicinal and Aromatic Plants

(Council of Scientific and Industrial Research)

Kukrail Picninc Spot Road, Lucknow-226015 (INDIA)

Ph: +91-522-2718639, 2718641, 2718505; E-mail: director@cimap.res.in, Website : www.cimap.res.in

army printing press
www.armyprintingpress.com
Lucknow (0522) 6565333