

CSIR–Central Institute of Medicinal and Aromatic Plants, Lucknow

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Central Institute of Medicinal and Aromatic Plants, a national laboratory of Council of Scientific and Industrial Research (CSIR), is dedicated to high quality research in biological and chemical sciences and for extending technologies and services in the area of medicinal and aromatic plants for promoting industrial activities related to green technologies and aimed to improving quality of life of farmers.

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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). It is steering multidisciplinary research to develop and extend technologies and services to the farmers and entrepreneurs of medicinal and aromatic plants (MAPs). With its research headquarter at Lucknow (Uttar Pradesh), it has Research Centres at Bengaluru (Karnataka), Hyderabad (Andhra Pradesh), Pantnagar and Purara, Bageshwar (Uttarakhand) which are located in different agroclimatic regions.

CSIR–CIMAP has made outstanding contributions to Indian economy through its research and extension activities on MAPs. Mint varieties released and agro-packages developed and popularized by CSIR–CIMAP have made India a global leader in the production and export of menthol mint. CSIR–CIMAP has developed several varieties of MAPs, their complete agro-technology and post harvest packages which have revolutionized MAPs cultivation and business scenario in the country. Some of the research highlights of 2014 are given below.

Methyl jasmonate-elicited transcriptional responses and pentacyclic triterpene biosynthesis

SWEET basil (*Ocimum basilicum*) has been widely used in traditional systems of medicine for the treatment of various ailments and is well recognized for the pharmacological activities of its diverse secondary metabolites. Transcriptional changes in sweet basil after methyl jasmonate (MeJA) treatment have been studied and several candi-

date MeJA-responsive unique transcripts, including those of the secondary metabolic pathways, such as terpenoids and phenylpropanoids/flavonoids have been identified. Integrated transcript and metabolite analysis revealed MeJA-induced biosynthesis of the medicinally important ursane-type and oleanane-type pentacyclic triterpenes in sweet basil. Two MeJA-responsive oxidosqualene cyclases (ObAS1 and ObAS2) that encode for 761- and 765-amino acid proteins respectively, have been identified and functionally characterized. Functional expressions of ObAS1 and ObAS2 in yeast (*Saccharomyces cerevisiae*) led to the production of β -amyrin and α -amyrin, the direct precursors of oleanane-type and ursane-type pentacyclic triterpenes respectively. ObAS1 was identified as a β -amyrin synthase, whereas ObAS2 was a mixed amyirin synthase that produced both α -amyrin and β -amyrin but had a product preference for α -amyrin. The outcome of this research will be helpful in developing metabolic engineering strategies for enhanced production of medicinally important ursane-type and oleanane-type pentacyclic triterpenes¹.

Biodiversity acts as insurance of ecosystem functioning

In a study on bacterial model communities it was found that biodiversity plays an important role in the stability of ecosystem functioning under environmental disturbance. Bacterial communities varying in species richness were grown in media containing high concentration of salts, heavy metals and high temperature. Diverse communities tolerated different types of disturbances more efficiently than less diverse ones, because they contain more tolerant species which uphold the ecosystem functioning under abiotic perturbations. Bacterial diversity stabilized the biomass across the treatments, and differential response of bacterial species to different perturbations was the key reason behind these effects. The results suggest that biodiversity is crucial for maintaining the stability of ecosystem functioning and acts as ecological insurance under abiotic perturbations. The work is timely due to serious concerns regarding the loss of biodiversity and associated ecosystem services. These results demonstrate the importance of biodiversity in natural ecosystems, which can maintain the ecosystem functioning under frequent anthropogenic and climatic disturbance².

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Development of non-dormant seeds in cleistogamous strains

Cleistogamous strains were developed in *C. roseus* (periwinkle) to facilitate maintenance of genetic purity and seed production in the absence of pollinators. These strains did not exhibit any seed dormancy, with seeds germinating on the second day after their harvest. Low seed dormancy would be useful in reducing the occurrence of volunteer plants in periwinkle fields. Cleistogamy coupled with low seed dormancy would be ideal for the development of transgenics in periwinkle.

Increase in stress resistance, ROS scavenging activity and lifespan

The discovery of a wide range of chemical modulators of ageing in model organisms encourages development of new strategies for combating age-associated diseases. The compounds which could have similar effect would prove a boon to mankind. Different pharmacological doses of *O. sanctum* extracts were used to determine their impact on lifespan, thermotolerance, brood size and ROS scavenging activities in the model organism *C. elegans*. The extracts significantly extended lifespan and increased resistance to thermal stress. It is suggested that the protective and lifespan prolonging action of the aqueous extracts are not only due to their antioxidant capacity, but may also be mediated by the modulation of signalling pathways in *C. elegans*.

‘CIM-Kranti’ – a cold-tolerant variety of *Mentha arvensis*

A new improved variety of *Mentha arvensis* named CIM-Kranti has been developed through half-sib selection in



Figure 1. High-yielding and cold-tolerant variety ‘CIM-Kranti’ of *Mentha arvensis*.

the variety ‘Gomti’. The new variety is high-yielding and cold tolerant (Figure 1) and yields more than 100 kg/ha oil with 80% menthol during winter sucker producing crop along with 250–300 q suckers/ha, whereas the main summer crop also yields 10–12% more oil than the best available check variety CIM-Saryu. It has erect growth behaviour, is hardy, hairy and has a green stem. Its suckers are white in colour, soft and fibrous in nature.

Development of a citral-rich essential oil yielding variety ‘CIM-Jyoti’

The variety ‘CIM-Jyoti’ of *Ocimum* (Figure 2) has been developed through intensive breeding efforts for high yield of herb and essential oil with desirable quality of higher citral content (68–75%). The variety CIM-Jyoti consistently shows higher herbage, oil content and citral in the field evaluation trials. The average herb yield and oil yield in CIM-Jyoti is 200 q/ha and 150 kg/ha respectively. The essential oil having good amount of citral is in high demand. The lemongrass crop is the only source of essential oil for the extraction of citral. However, lemongrass is a 4–5 year crop and farmers hesitate to cultivate the lemongrass crop for such a long time in their fields. Farmers would like to take this type of oil from a short-duration crop without disturbing their traditional cereal and other crops. This variety will produce citral in a short duration of 70–80 days. It also fits in crop rotation/intercropping between wheat and paddy and with other vegetable crops of small farmers. Leaves of this variety can also be used in lemon tea.

Early mint technology

Early mint technology involves improved method of production of planting material (suckers/roots) by raising



Figure 2. Lemon-scented variety ‘CIM-Jyoti’ of *Ocimum*.

seedlings from suckers in winter season in poly-houses/polytunnels/polycovers using modified method of transplanting/planting on ridges, withdrawing irrigation for about 10–15 days before harvest, and using improved method of distillation. This technology has been adopted well by the farmers. The technology is responsible for bringing earliness of about 20–30 days and minimizes expenditure on land, labour, water and fuel by about 20–25% with 15–20% increase in productivity.

Pain relieving topical formulation

An aroma therapy-based herbal formulation was developed in the form of oil to provide soothing relief from pain, resulting from daily tiredness and fatigue. It utilizes a unique combination of plant extracts and medicinally proven aromatic oils which are useful for relieving pain resulting from exhaustion and reduce inflammation and swelling.

Herbal formulation for management of diabetes

A scientifically validated and safe herbal formulation called NBRMAP-DB has been developed for the management of diabetes jointly by CSIR-CIMAP and CSIR-NBRI, Lucknow. This formulation has since been licensed to a leading pharma company for manufacturing and marketing.

Introduction of palmarosa and basil

Two training programmes on cultivation and processing of aromatic plants were organized at Bamur, Angul district, Odisha. Through these programmes more than 100 farmers of the backward areas of Angul and Sambhalpur were trained on cultivation aspect of drought-resistant aromatic crops like palmarosa and basil (tulsi). A distillation unit was also installed at village Sahajbhali, Angul

for the processing of aromatic crops. About 20 demonstrations of palmarosa and 10 demonstrations of tulsi as a rainfed crop were organized in the farmer's field.

Generation of livelihood opportunities for tribal farmers

CSIR-CIMAP cultivation and processing technology of palmarosa is transforming the daily life of the Sahariya tribes in Lalitpur district, Uttar Pradesh, where tribes are dependent on forest for fuelwood and collection of herbs for their livelihood. CIMAP has introduced palmarosa crop under rainfed condition, which is providing better returns than the conventional maize crop. A distillation unit of 500 kg has also been setup amongst the farmers' groups. Under another project activity undertaken near Dudhwa Tiger Reserve, four training programmes were organized on cultivation and processing of menthol mint, *Artemisia annua*, lemongrass, khus, tulsi, kalmegh, sataver and sarpagandha for tribal farmers of the area. Several (50) demonstrations of the above crops were also organized in the farmer's field in seven villages of the area. More than 150 kg of menthol mint oil was produced by the farmers valued at about Rs 1.15 lakhs through small demonstrations, which has instilled confidence among tribal farmers towards cultivation and distillation of aromatic crops, and the area under MAPs is poised to increase further in the coming season.

1. Misra, R. C., Maiti, P., Chanotiya, C. S., Shankar, K. and Ghosh, S., Methyl jasmonate-elicited transcriptional responses and pentacyclic triterpene biosynthesis in sweet basil. *Plant Physiol.*, 2014, **164**, 1028–1044.
2. Awasthi, A., Singh, M., Soni, S. K., Singh, R. and Kalra, A., Biodiversity acts as insurance of productivity of bacterial communities under abiotic perturbations. *ISME J.*, 2014, **8**, 2445–2452.

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