

## **Salient achievement of ICAR-NRCSS, Ajmer for last five years**

### **Seed spice improvement and germplasm collection, conservation and utilization**

At present about 7000 germplasm lines of seed spices conserved and maintained in India (with ICAR-NRCSS, Ajmer and AICRP centres). Being a national active germplasm site (NAGS) for seed spices, ICAR-NRCSS, Ajmer is repository of 2250 germplasm lines (2017-18). In past five years ICAR-NRCSS, Ajmer have developed 10 varieties (Ajmer Coriander-1, Ajmer Coriander-2, Ajmer Fenugreek-3, Ajmer Fenugreek-4 & Ajmer Fenugreek-5, Ajmer Fennel-2 & Ajmer Fennel-3, Ajmer Dill-2, Ajmer Nigella-20 & Ajmer Ajwain-93) of seed spice crops and identified unique promising genotypes by non-traditional breeding methods having desirable traits. Minimal descriptors has been developed and published for all the seed spices by the centre. DUS guidelines has also been finalized for fenugreek and coriander

- Molecular characterization of released varieties of cumin, coriander, fennel and fenugreek has been done using random and ITS primers.
- Sixteen gene sequences of fenugreek and cumin have been submitted to NCBI, USA data base (Gene Accession numbers HM 176640-176649 for fenugreek and HM176650-HM176655 for cumin).

### **Technological developed/standardized in crop production**

- Line sowing of seed spices
- Raised bed technology with drip fertigation
- Nursery raising technology
- Crop geometry for efficient resource utilization
- Off season production of seed spices under shed net covered walk in tunnels
- Double storey (bower)cropping system/vertical farming
- Intercropping of vegetables and fruits with seed spices for increasing cropping intensity
- Pollination management in seed spices
- Crop sequence of Cluster bean-cumin-summer solarization has been found most
- Protected cultivation technology with low pressure drip irrigation has been standardized for protection of crop against frost
- The total nutrient requirements of coriander, cumin, fennel, fenugreek have been assessed
- Weed management techniques have been standardized for coriander, fennel, cumin and fenugreek
- Organic module with vermi-compost, *Azotobacter*, PSB, *Trichoderma*, Neem Cake and foliar spray of Onion/Garlic extract have been developed in coriander and fenugreek
- Soil solarisation for biological control

### **Technological developed/standardized in crop protection**

- Resource optimisation through bio fertilizers : New bacterium *Bacillus aerophilus* (king's b-15/ cor-20) for enhancing coriander growth and yield
- Bio-formulation for enhanced survival and effective application of Plant Growth Promoting *Rhizobacteria* on coriander seeds as well as soil application
- Phosphate solubilizing bacteria (*Bacillus subtilis*), and bio-agenets (*Trichoderma*, *Paecilomyces lilacinus*, *Pseudomonas fluorescens*)
- Monitoring/evaluation of agrochemical residue in cumin: Metham sodium, 15 days prior to sowing followed by foliar spray with dimethoate and difenoconazole molecule were found below detection limit.
- Plant protection schedule for cumin cultivation, eco-friendly management of cumin wilt and spray scheduling for management of cumin blight
- Botanical products identified and standardized for safe production of seed spices (Kareel (*Capparis decidua*) plant extract, Tumba (*Citrullus colocynthis*) fruit extract, Allyl iso thiocyanate for botanical management of insect-pests , *Pongamia* spp. seeds sulphur extract for botanical management of insect-pests, Liquid insecticide soap and cake for aphid management
- Unit for mass production of bio-control agents and a plant health clinic has been established

### **Technologies developed/standardized in post harvest management**

- Seed spice waste utilization: Cumin crop residues produces 1% essential oil and in ajwain 2% essential oil.
- Management of storage pests, microbial population and quality parameters through modified atmospheric packaging (MAP).
- Drying of Kasuri methi and other seed spices
- Cryogenic grinding technology for seed spices
- Process technology for development of different value added products (Fennel squash & RTS, Dill squash & RTS, Coriander squash & RTS, Dill cider, Fennel cider, Dill Prash, Dill Parag, Dill-aonla capsules as functional food, Biscuits (QPM+Fenugreek flour), Methica (fenugreek) tea standardized and patent filled and published
- Packaging technology for cumin and fenugreek
- Complete value chain of seed spices helped to build Farmers' Producer Organization
- Maturity indices standardized for seed spices

### **Technological developed/standardized in basic science**

- Seed priming and pelleting for early germination
- Genotypes for higher essential oil and oleoresin in coriander and fenugreek (Coriander genotypes Sindhu, Sudha and RCr 41 with 0.32% essential oil and fenugreek genotypes RMt-351, RMt-303 and CO-1 with 11.62, 8.95 and 8.62% oleoresin).
- Effect of water stress on seed quality of coriander (irrigation at flowering stage can be avoided in coriander without much effect on yield and quality).
- Hydro priming (soaking seeds in DW for 6 hrs) hastening the germination in cumin by 7-8 days.
- Oil profiling has been done in fenugreek, fennel and coriander germplasm and grouped as per essential oil constituents
- Regeneration protocol for cumin, coriander, fennel and anise has been developed

- Water use efficiency models have been developed in seed spices
- Effect of exogenous application of plant growth regulators on cumin and coriander for membrane integrity and seed yield have been studied
- Comparative analyses of volatile oil loss in coriander and fenugreek during conventional and cryogenic grinding have been estimated
- Antioxidant activities of seed extracts of coriander, cumin, fennel, fenugreek, ajwain, nigella and anise have been done
- Phenolic and flavonoid compounds have been evaluated in seed extracts of coriander, cumin, fennel, fenugreek, ajwain, nigella and anise
- Registration of gene/ITS sequences (Twelve microbial 16S rDNA gene sequence have been submitted to NCBI and registered for identification of microbial strains. One bio-sample registered as PRJNA338090, 38 *Fusarium* isolates from cumin characterized for ITS sequences, sequence submitted in NCBI database

#### **Technology/modules/database developed in social science**

- Expert system (e-Learning/e-Agriculture) has been developed on seed spices and uploaded on the NRCSS website for stakeholders benefit and knowledge
- A database on traders, industrialist and exporters of seed spices with complete information has been developed and been uploaded on NRCSS website

#### **Impact of ICAR-NRCSS technologies**

- Area under seed spices expand from 8 lakh ha in 2007-8 to 18 lakh ha in 2018-19 (Area 2.25 times and production almost double) with a productivity touching to almost 10 Q/ha.
- Export of seed spices and their products increased from Rs. 700 Crore (2010-11) to Rs. 3837 Crores (2017-18).
- ACr-1: Yield enhancement from 2-6 q/ha, covers about 1.5 lakh hectare of coriander cultivation area.
- AFg-3: Area under fenugreek increased from 85000 ha in 2013 to 22500 ha in 2019 (10-12% area coverage under AFg-3).
- Line sowing in cumin (covering >50% area in Gujarat, Rajasthan) resulted in reducing drudgery, seed requirement and enhance yield by 15-20%.
- Value chain of seed spices helped to builds Farmers' Producer Organization under NAIP (KAMAYE and PRIYADARSHANI) with the help of Krishak Vikash Sansthan (KVS), Ajmer.