

RESEARCH HIGHLIGHTS

Tobacco Cultivar Improvement

Tobacco Varieties released/ identified: Three varieties (2 FCV and 1 *Bidi*)

- **FCJ-11 (NLCR 6-10):** A high yielding (3300 kg/ha) FCV tobacco variety was identified for release in FCV tobacco growing areas of Northern Light Soils.
- **FCR-15:** A high yielding (2400 kg/ha) and TMV resistant FCV tobacco variety was identified for release in FCV tobacco growing areas of Southern Light Soils.
- **ABD-132:** A high yielding (2300 kg/ha) *bidi* tobacco variety with low level of smoke constituents was identified for release in *bidi* tobacco growing areas of Andhra Pradesh under rainfed conditions.

Development of tobacco varieties / hybrids

FCV tobacco

- The entries, FCR-4 (2388 kg/ha) and FCR-17 (2408 kg/ha) were found promising with respect to cured leaf yield and grade index under Traditional Black soils.
- Two entries viz., V-5127 and V-5130 were found to be better yielders among the twelve entries tested (2016-19) with significantly higher mean yields (2759 & 2560 kg/ha) over check Siri in black soils.
- Six drought tolerant lines viz., KDB-11, KDB-10, KDB-9, KDB-8, KDB-6 and KDB-3 with 14-23% improvement in cured leaf yield over check Siri were identified to be promising in SLS region.
- Based on last three years performance, four advanced breeding lines viz., FCH 245, FCH 246, FCH 247 and FCH 248 were found to be superior over checks with 12-17% improvement in cured leaf yield in KLS region of Karnataka.
- Breeders seed of seven FCV tobacco varieties viz., Siri, VT-1158, Hema, Kanchan, LT Kanchan, Rathna, FCH 222 and CTRI Sulakshana; and 14 Non-FCV tobacco varieties viz., Abirami, I-64 (Monnai), Bhagyalakshmi, Meenakshi, PV-7, Vairam, VR-2, Kaveri, I737, KV-1, Abirami CR, Sangami, Banket A-1, Jati and Motihari were collected.

Non-FCV tobacco

- Burley entries, YB-19 (2540 kg/ha) and YB-22 (2260 kg/ha) were found to perform better over the popular variety Banket A1.
- A selection (F6-2-2) derived from a cross A-145 × Bhagyalakshmi recorded the highest seed yield of 1167 kg/ha.

Germplasm Resource management

- As a National Active germplasm (NAG) site, ICAR-CTRI is maintaining 3381 accessions including the thirteen newly added accessions.
- A core collection was constituted with 305 accessions. Observations on 25 characters identified for characterization were recorded and analyzed in 2100 germplasm lines.
- A total number of 257 core collection entries and 470 FCV exotic accessions were analyzed for leaf K content. It varied from 0.53-4.14% in core collections and 0.57-4.53% in FCV exotic collections. FCV exotic accessions viz., EC-14091 (4.53%), Bori Bargana (4.14%) and R90-1 (4.09%) recorded highest K content.
- Seed of 175 chewing tobacco germplasm accessions along with passport data were forwarded to ICAR-National Bureau of Plant Genetic Resources, New Delhi for conservation and assigning IC numbers. Passport data of all the germplasm accessions was digitized.
- National identity Number was obtained for rustica cultivar, ArR-27 (IC 630579).

Biotechnology for Tobacco Improvement

- Linkage analysis of solanesol mapping population indicated the presence of two linkage groups viz., first (PT52937, PT52831, PT53418, PT51706 and TM1106) and second (PT10163, PT52816, TBM12 and TM10375).
- In the nicotine mapping population, primers TBM12, PT52816 and TM11062 were found to be linked with each other.
- Solanesol expression analysis showed high transcript accumulation of dxs (1-deoxy-D-xylulose-5-phosphate synthase) and dxr (1-de-oxy-D-xylulose-5-phosphate reductase) enzymes involved in the solanesol biosynthetic pathway in stem and root samples of HDBRG (high solanesol line) and dxr in Siri (low solanesol line) roots only.
- Transcript analysis also indicated that the genes dxs and dxr were involved in solanesol biosynthesis and that their high transcript levels indicate high solanesol.
- Two Low Converter (LC) plants were identified in Banket A1 population using a standardized LC protocol.
- ITS characterization of eight *Orobanche* isolates collected from five FCV tobacco areas (SLS, NLS and BS areas) and one each from Burley and *bidi* tobacco growing regions in Andhra Pradesh indicated that they belong to *Orobanche cernua* with 98-100% sequence match.

Tobacco seed supply

- A total quantity of about 10,395 kg truthfully labelled seed of different cultivated varieties was supplied to farmers through ICAR-CTRI, Rajahmundry and its Research Stations to meet entire seed requirement (>90%) of tobacco farmers in Andhra Pradesh, Karnataka, Tamil Nadu and West Bengal.

Crop Production

- Permanent manurial experiments conducted on Motihari tobacco at CTTRI-RS, Dinahata, West Bengal since 1965 showed that significantly higher productivity was achieved by the application of major nutrients (112 kg N + 112 kg P₂O₅ + 112 kg K₂O ha⁻¹) as compared to the omission of one or more nutrients in the fertilizer schedule. Among the major nutrients, nitrogen continues to be the essential nutrient for obtaining optimum yield in *motihari* tobacco.
- Integration of soil solarization and white polythene sheet mulching reduced the *Orobanche* infestation by 53 and 49% (with and without neem cake respectively) while in non-solarized plots, mulching sheet reduced the infestation by 42 and 39% respectively.
- Best bet technologies including (1) Tray seedlings (2) Drip fertigation etc., recorded higher FCV tobacco green leaf yield (GLY), cured leaf yield (CLY), grade index (GI), GL/CL and GI/CL ratio under Northern Light Soils.
- Among the different cropping systems, maize-tobacco system recorded higher system productivity (2380 kg/ha) followed by sorghum-tobacco (2155 kg/ha) compared to fallow-tobacco (1724 kg/ha).
- Starter dose of N through calcium nitrate @ 5, 15 and 30 kg/ha increased the cured leaf productivity and top grade production by 9-15% and 7-10% in dry and semi-dry zones of KLS respectively.
- Foliar application of N and K through potassium nitrate (2.5% concentration) at 45 & 60 DAT proved effective in maximizing the cured leaf yield by 9-11% in dry /semi-dry zones of KLS without altering the cured leaf quality parameters.
- Cured leaf productivity was enhanced by more than 12% by increasing the plant population to 22,222 plants/ha (90x50 cm) compared to the currently recommended 18,181 plants/ha (100 x 55 cm) in dry /semi-dry zones of KLS.
- Soil solarization significantly increased the FGLY and TCLY of chewing tobacco by 23 and 11% respectively over control. Tray seedlings + Furrow irrigation + 100% RDF increased the FGLY and TCLY of chewing tobacco by 5 and 7% respectively over the conventional nursery seedlings.

Agricultural Extension

- The mean adoption of identified technologies in SBS area (72.60) was higher compared to Southern Light Soils (64.20).
- Asia is the largest producer of tobacco in the world accounting for about 63% of production and about 61% of area and embraces 24% of tobacco exports in the world.

- Cooperative marketing, logistics, fish by-product utilization units are recommended through supply chain management for the socio-economic empowerment of fishing community as a strategy to mitigate climate change impact.
- Training programmes were conducted for tenant and small farmers during 14-15th November for SBS region; 18-20th November for SLS region at CTRI-RS, Kandukur; 27-29th November at ICAR-CTRI, Rajahmundry and CTRI-RS, Jeelugumilli for NLS and NBS regions.
- A training programme was organized on “Basics of FCV tobacco production” during 30th September-05th October, 2019 at ICAR-CTRI, Rajahmundry for the newly recruited field officers of Tobacco Board.
- Short term hands on training programme was conducted to Executives/Supervisors of M/s GPI Ltd., on ‘Leaf Quality and Smoke Analysis’ at ICAR-CTRI, Rajahmundry during 26-27th June, 2019.

Mobile App on tobacco

- An android based mobile app on Good Agricultural Practices for FCV tobacco was developed. The App is a user friendly, menu driven application for easy and instant accessibility of FCV tobacco information.

Management of resource constraints for production efficiency and produce quality

- Oil Palm frond biomass (50%) + coir pith (50%) and oil palm trunk biomass (50%) + coir pith (50%) showed positive response on the growth of tobacco tray seedlings.
- Application of oil palm biochar (oil palm empty fruit bunch, oil palm trunk and oil palm frond) + 100% RDF significantly improved the cured leaf yield. Maximum available soil potassium was also recorded with their application.
- Copper nanoparticles prepared from the tobacco leaf at 300ppm inhibited the fungal pathogen *Pythium aphanidermatum* by 42% and *F.oxysporum* by 18%.
- Neophytadiene, thunberganoids and cembrenoids were in high proportion among the Neutral Volatile Aroma Compounds (NVACs) in cured leaf of SLS and SBS regions. Duvatrienediol were high in SBS and SLS when compared to NLS and KLS regions.
- Mulching, soil application of hydrogel and biochar, foliar application of gibberellic acid during grand growth period; dense planting during delayed monsoon are found to be effective management strategies for climate resilient FCV tobacco production in SLS domain of Andhra Pradesh.
- Among the different tobacco based cropping systems, tobacco yields were higher in sunnhemp-tobacco cropping system. Among *kharif* crops, foxtail millet (*Korra*) was found to give promising (500 kg/ha) yield under rainfed conditions in SLS.
- Among the different methods of irrigation, drip method was found to be effective in terms of yield and water use efficiency in Southern Light Soils.

- FCV tobacco grown in Southern Light Soils in Prakasam and Nellore districts was delineated and spatial maps of soil fertility were prepared.
- Soil Test Crop Response based prescription equations were developed for different targeted yields and online fertilizer recommendation software was developed for FCV tobacco in Northern Light Soils.
- The vDIA-based screening method was developed in collaboration with ICAR-National Research Centre for Grapes (NRCG) which facilitates selective and sensitive multiresidue analysis of pesticides in tobacco.
- GC MS based simple, precise, semi-quantitative method was developed for estimation of minor alkaloids viz., nornicotine, anabasine, cotinine, myosmine in burley tobacco.

Energy Conservation

- Solar thermal interventions viz., solar hot air circulation and solar water circulation inside the barn, along with Poly Carbonate Roof Chamber (PCRC) over the barn top, barn wall ceiling with thermocol, barn floor cementing resulted in saving of wood fuel to an extent of 26 to 39%.
- Oil palm Empty Fruit Bunch (OEFB) biomass can be effectively utilized as a fuel for curing FCV tobacco in the form of briquettes. The equivalent weight of fuel wood for curing of FCV tobacco is 1.4 kg.

Integrated Management of Biotic Stress

- Pest surveillance showed that the average infestation of tobacco caterpillar and whitefly within the infested nurseries of SBS was 15% and 3% respectively.
- In FCV planted crop, whitefly population commenced from second week of January (1 per trap) and showed peak catches during fourth week of February (15). In burley tobacco, whitefly population commenced from third week of October (1) and showed peak catches during first week of December (25.5), thereafter declined.
- In Northern Black Soils, Leaf Curl Virus (LCV) incidence in FCV tobacco ranged from 3-11% and Cucumber Mosaic Virus (CMV) incidence was <4%. In NLS, LCV (11-19%) and CMV (6-11%) incidence was high. In SLS and SBS, LCV and CMV incidence was less (3-6%). In KLS, incidence of LCV ranged from 6-12% and CMV was <6%.
- Whitefly population and LCV disease incidence was least (0.36 -0.67/ plant) with chemical control module (thiamethoxam - pymetrozine - flonicamid-imidacloprid), followed by IPM plot with sorghum barrier-NSKS-pymetrozine-flonicamid (0.41-1.12/ plant) compared to sorghum bordered FCV tobacco.
- Flupyradifurone recorded the lowest aphid population at 2 DAS (2.76) and highest cured leaf yield (2440 kg/ha), followed by flonicamid (3.06, 2420 kg/ha) and sulfoxaflor (3.28, 2410 kg/ha) and were superior to control.

- The period of persistency was longest (28 days) for afidopyropen 0.05%, where as it was 26 days for afidopyropen 0.0375%, sulfoxaflor, flupyradifurone and flonicamid, and it was 24 days for pymetrozine.
- LC₅₀ of various insecticides in *Spodoptera litura* larval population of Rajahmundry ranged from 8.6 to 206.7 ppm. Emamectin benzoate was the most toxic insecticide (8.6 ppm) followed by chlorantraniliprole (36.9 ppm), chlorfenapyr (36.9 ppm) and flubendiamide (41.7 ppm).
- Species diversity indices and pest defender ratios were calculated for arthropods sampled from various crop ecosystems. Shannon-Weiner and McIntosh evenness indices indicated that chickpea and mustard crops (0.6) have a more even ecosystem with balanced presence of different arthropod taxa; implying them to be promising companion crops in tobacco for improving natural pest control.
- Root-knot nematode population decreased by 59% with sunnhemp green-manuring whereas in weeded and un-weeded fallow plots it increased by 28 and 9% respectively.

Krishi Vigyan Kendra

Kalavacharla

- A total of 9 technologies on performance of rice varieties MTU-1172 and MTU-1190, Cassava mosaic resistant tapioca varieties-PDPCMR1, Sree Raksha-1 and SreeRaksha-2, photoinsensitive Dolichos variety 'ArkaPrasidhi', multiple disease resistant tomato hybrids 'ArkaSamrat' & 'ArkaAbhed', estrous synchronization with double PGF2 alpha protocol, balanced feed and fodder lucerne were assessed in the farmers' fields.
- A total no of 19 front line demonstrations were conducted for paddy, pulses, horticulture, plant protection, animal husbandry, wealth from waste, nutrition etc.
- Training cum awareness programmes were conducted on- Improved production technologies in cashew and mango, management of fall army worm by chemical method, weed management in field crops, integrated pest management in rice, terrace gardening and kitchen gardening.

Kandukur

- On farm trials (OFTs) viz., Evaluation of FCV tobacco line FCR-15, fox tail millet (korra) as *pre-rabi* crop in rainfed areas, evaluation of improved chilli variety LCA - 616, assessment of the performance of triple layer hermetic storage bags, assessment of millet based Nutri-bar were conducted.
- Front Line Demonstrations (FLD's) viz., ICM in FCV tobacco, improved chilli hybrids: Arka Khyathi, Arka Swetha, Arka Haritha and Arka Meghana, ICM in chilli, improved tomato hybrid Arka Abhed and Arka Samrat, use of mango harvester to reduce fruit damage, introduction of three pronged wheel hoes to reduce drudgery were carried out during 2019.
- Organized training programmes on Farm machinery for rainfed agriculture, vermicomposting, waste decomposition, azolla cultivation, soil sampling in field and

vegetable crops, milky mushroom production, value addition to fruits and green leafy vegetables and income generation activities to SC farm women under SC sub plan.

All India Network Project on Tobacco

- Workshop of All India Network Project on Tobacco was conducted at BTRS, Anand Agricultural University, Anand during 27-28th December, 2019. Workshop was inaugurated by Hon'ble DDG (CS) Dr. A. K. Singh. Other dignitaries were Dr. R. K. Singh, ADG (CC), Associate Director of Research Dr. M. K. Jhala and Director, ICAR-DMAPR, Dr. S. Roy.
- Variety Identification Committee meeting was held on 28th December, 2019. It was chaired by Dr. R. K. Singh ADG (CC). The committee identified two FCV tobacco varieties viz., FCJ 11, FCR 15 and a *bidi* tobacco variety ABD 132 for release.

Tobacco lines evaluated in multi-location trials

- IVT & IHT: 8 FCV and 11 Non-FCV lines
- AVT & AHT: 71 FCV and 31 Non-FCV lines
- Bulk Trials: 9 FCV and 4 Non-FCV lines
- On farm Trials: 4 FCV and Non-FCV lines

Technologies Identified

- *Bidi* tobacco growing farmers are advised to apply poultry manure as organic manure to raise their nursery for increasing the number of healthy seedlings with reduced root-knot index in Gujarat.
- Application of 100% RDN (110 kg) + PK (70 kg P +50 kg K) once in two years or 100% RDN (110 kg) + P (70 kg) every year is recommended instead of applying 100% RDF (110 kg N + 70 kg P +50 kg K) every year without affecting leaf quality for *bidi* tobacco grown in Kurnool district of Andhra Pradesh.
- In a normal season topping up to 15th leaf at bud stage or early flowering stage and under rainfed conditions topping up to 12 leaves is recommended for *bidi* tobacco growing areas of Kurnool district, Andhra Pradesh.

Implementation of GOI's flagship programmes and developmental programmes

- **Swachhta Hi Sewa:** Swachhta Hi Sewa programme was implemented during 11.09.2019 to 02.10.2019. As a part of this programme, drive on plastic removal was carried out.
- **Vigilance Awareness Week:** Vigilance awareness week was observed during 29.10.2019 to 03.11.2019 with the theme 'Eradicate Corruption-Build a New India'.
- **Mahatma Gandhi Birthday celebrations:** Mahatma Gandhi's 150th Birthday Celebrations were organized at ICAR-CTRI, Rajahmundry on 2.10. 2019.
- **Constitution Day:** Indian Constitution Day was celebrated on 26.11.2019 at CTRI, Rajahmundry. Director, Dr. D. Damodar Reddy sensitised the staff about the Indian Constitution and staff took an oath to uphold the constitution.

- **International Yoga Day:** The 5th International Day of Yoga was celebrated at ICAR-CTRI, Rajahmundry on 21.06.2019.
- **SC SP Plan:** ICAR-CTRI has implemented the Scheduled Caste Sub-Plan at ICAR-CTRI, Rajahmundry and research stations. Farmers were provided with paddy and sunnhemp seed, cashew, mango seedlings, fertilizers, crop protection agents, poly trays, tarpaulins, minor field implements etc. A total no. of 800 farmers were benefitted through this programme.
- **Hindi Week:** Hindi Week was celebrated during 16-21st September, 2019 at headquarters and regional stations of ICAR-CTRI.
- **Pulse Seed Hub:** A total quantity of 1290 q of pulse seed (chickpea & redgram) was produced.