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PACKAGE OF SUSTAINABLE PRODUCTION PRACTICES FOR FCV TOBACCO IN KARNATAKA LIGHT SOILS REGION

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Flue-Cured Virginia (FCV) tobacco is an important commercial crop in Karnataka. It is grown in Southern Transitional Zone (STZ) of the state comprising Mysore, Hassan, Chikkamagalore and Shivamogga districts. The tobacco is grown during *kharif* as rainfed crop predominantly on red sandy loam soils. The FCV tobacco cultivated in Karnataka Light Soils is known as 'Mysore style tobacco' and classified as superior quality filler in the International market.

Seed bed preparation and seedlings selection

Traditional Raised Bed Nursery

- Raised nursery beds are to be prepared with 15 cm height, 1m width, 10 m length with 30 cm channels in between beds
- Apply 40 kg FYM, 200 g ammonium sulphate, 300 g single super phosphate and 50 g of SOP or 110 g DAP, 100 g AS and 50 g SOP per 10 sq.m. bed along with 40 g of magnesium sulphate
- Ideal seedlings for transplanting should be of pencil thickness with 15cm length and 50-60 days old

Polytray Nursery

- A tray nursery technique was developed to produce healthy tobacco seedlings to overcome soil borne disease problems and to preclude transplantation shock
- The technique is simple and entails sowing tiny tobacco seeds on coir pith compost and transferring the young seedlings of about 20-25 days to poly-trays for raising them on the growth media with standard nutrient and watering schedules
- The tray nursery seedlings take about 60-65 days from sowing to transplanting
- Tray nursery seedlings offer the unique advantage of ensuring crop uniformity with minimum gap fills and consequently increased cured leaf yield and quality as against the seedlings grown under conventional raised soil-bed nursery

Varieties/hybrids

- Kanchan, FCH 222 and CH 3

Site selection and land preparation

- Select well drained red loam to sandy loam soils with good water holding capacity having pH of 5.5 to 7.5
- Deep plough the field in November-December months followed by harrowing or ploughing twice in the month of April-May
- Apply 8-10 tons FYM/6 tons of pressmud/2 tons of Vermicompost per hectare or adopt *in situ* green manuring with *sunhemp* (seeding @ 50 kg/ ha)
- Incorporate organic manures into the soil at least 2-3 weeks before planting

Time and method of planting (Main field)

- Early planting in the month of May is ideal
- Optimum plant spacing is 100 x 55 cm with a population of 18,181 plants/ha
- Ridge planting is best for high rainfall areas, while flatbed planting is ideal in low rainfall situations
- Adopting high density planting with a population of 22,222 plants/ ha will reduce evaporation losses and enhances leaf productivity under low rainfall situations
- Gap filling should be completed within 7-10 days after planting

Interculture

- Four to Five intercultural operations at 8-10 days' intervals are to be carried out during the crop growth period
- Initially shallow interculture is to be done using tyned harrows (2 times) followed by passing country plough 2 times and final ridging at 45-50 days using ridger
- Manual weeding should be done two times at 15 -20 and at 35-45 days after planting

Fertilizer application

- The fertilizer doses recommended for Karnataka Light Soils is 60-40-120 ($N-P_2O_5-K_2O$/ha). Fertilisers are to be applied in two splits at 10 and 30-35 days after transplanting

Fertiliser schedule for KLS			$N-P_2O_5-K_2O$-Ca (kg/ha)
1st split (30:40:60) 10 days after planting	DAP	100 kg	18-46-0-0
	AS	60 kg	12-0-0-0
	SOP	120 kg	0-0-60-0
2nd split (30:0:60) 30-35 days after planting	AS	150 kg	30-0-0-0
	SOP	120 kg	0-0-60-0
	Total		60-46-120-0

- For calcium nutrient supply, either dolomite @75 kg/ha or calcium nitrate @75 kg/ha can be applied in light textured acidic soils. If calcium nitrate is opted, other fertilizer nitrogen doses are to be adjusted accordingly
- A starter dose of calcium nitrate @ 25 kg N/ha and foliar nutrition with N and K through potassium nitrate @2.5% at 45 and 55 days after transplanting improves productivity during moisture stress condition

Leaching Adjustment

- Possible leaching losses of nitrogen in the event of heavy rainfall occurring shortly after fertilizer application can be compensated by applying additional 5-10kg N/ha

Pest Management

1. Ground beetle (*Mesomorphus villiger*)

- Spray chlorantraniliprole 18.5 SC @ 3 ml/10 l water one day before transplanting on the nursery bed or trays
- Apply 5 g of pongamia cake or neem cake powder (mixed in handful of sand) at the base of the seedling immediately after transplanting
- If seedlings are not treated before transplanting, apply imidacloprid 200 SL @ 2.5 ml or chlorantraniliprole 18.5 SC @ 3 ml/10 L in transplant water
- In the newly planted field, keep grass heaps 6-7 m distance apart between rows on a moist soil and destroy them next day

2. Leaf eating caterpillar (*Spodoptera litura*)

- Install 10 pheromone traps per hectare 20 days after planting
- Spray the hot spots thoroughly with 0.5% neem seed kernel suspension
- Spodoptera NPV (Nuclear Polyhedrosis Virus) can be sprayed @ 250 LE (prepared by mixing 250 infected larvae in 1000 litres of water per ha by mixing with 2.5 kg jaggery)

- If the infestation is severe, spray emamectin benzoate 5 SG @ 5 g in 10 litres of water (or) novaluron 10 EC @ 10 ml in 10 litres of water

3. Stem borer (*Scobipalpa heliopa*)

- Avoid use of infested seedlings for planting, open the bulged portion of the stem with needle
- Spray chlorantraniliprole 18.5 SC @ 3 ml (or) Flubendiamide @ 2.5 ml l/10 L in water

4. Whitefly (*Bemisia tabaci*)

- Install 10 yellow sticky traps (12 x 15 cm size with 2 mm thickness) per hectare to monitor the whitefly population
- If the population of whitefly is 100 per each sticky trap, give the following spray schedule of insecticides
- 1st spray-thiamethoxam 25 WG @ 2 g (or) pymetrozine 50 WG @ 4 g (or) flonicamid 50 SG @ 4g (or) imidacloprid 200 SL @ 2.5 ml in 10 litres of water
- 2nd spray -15 days after 1st spray and 3rd spray -15 days after 2nd spray with any one of the above insecticides

5. Tobacco aphid (*Myzus nicotianae*)

- When 2% of the plants are infested, use any one of the following insecticides viz., imidacloprid 200 SL @ 2.5 ml (or) thiamethoxam 25 WG @ 2 g (or) flonicamid 50 SG @ 4 g (or) pymetrozine 50 WG @ 4 g in 10 litres of water

6. Budworm / Capsule borer (*Helicoverpa armigera*)

- Plant marigold as trap crop in two rows around the field to attract ovipositing female moths; this helps in easy destruction of eggs and larvae
- One month after planting install 10 *Helicoverpa* pheromone traps per hectare
- Arrange 10 bird perches per hectare in un-topped fields, spray *Helicoverpa* Nuclear Polyhedrosis Virus (HaNPV) @ 250 LE/ha (prepared with 250 infected larvae in 1000 litres of water, add 2.5 kg jaggery)
- Apply *Bacillus thuringiensis* var. *kurstaki* (Bt) @ 10 g in 10 litres of water
- Spray Bt and NPV in the evening hours
- When the infestation is above 10 %, spray flubendiamide 480 SC @ 2.5 ml (or) chlorantraniliprole 18.5 SC @ 3 ml in 10 litres of water

Disease management

1. Damping-off (*Pythium aphanidermatum* (Edson) Fitz, *P. and myriotylum*) Leaf Blight (*Phyotophthora parasitica* var. *Nicotianae* (Breda de Haan) Tucker: (in Nursery)

- Metalaxyl + mancozeb combination (72 WP) @ 0.1% @ 500ml/ sq.m as pre-sowing drench
- Spray copperoxychloride (50 WP) @ 0.2% (20 g/10 L of water) or
- Fenamidone + mancozeb (60 WG) @ 0.3% (30 g/10 L of water) or metalaxyl + mancozeb (72 WP) @ 0.2% (20 g/10 L of water) twice at 30 & 45 DAS to control damping-off and blight

2. Soreshin (*Rhizoctoniasolani* Kuhn (Frank) Donk) and Anthracnose (*Colletotrichum tabacum* (Beining):(in Nursery)

- Two to three foliar sprays with carbendazim 50% WP @ 0.05 to 0.1% at an interval of 10 days starting from 20 DAS
- Propiconazol 25% EC (Tilt) @ 0.05% spray after 30 DAS for the control of both Soreshin & Anthracnose in conventional nursery
- Drench carbendazim 50% WP @ 0.05 to 0.1% at an interval of 10 days in tray system

3. Root-knot (*Meloidogyne* spp): (in Nursery)

- Avoid nursery sites previously grown with Tomato, Chillies, Brinjal, Bhendi, Potato and Pulses etc.
- Soil-solarisation of nursery beds, changing the nursery sites every year, application of vermicompost @ 2 kg/m^2
- Raising seedlings in tray medium enriched with *Trichodermaviride* (2 x10^7CFUs/g) + *Paecilomyceslilacinus* (2 x10^7CFUs/g) each @ 20 g/tray
- Spray drench of seedlings with carbosulfan 25 EC @ 0.2% at 25 days after planting

4. Brown spot (*Alternaria alternate* Fries Keissler)

- Do not allow matured leaf to over ripe by delayed harvest
- Keep the fields weed free and destroy the affected crop residues
- Follow the recommended potash fertilizer dose
- Potassium nutrition through foliar sprays of SOP @ 2.5% is advised in the endemic areas
- Spray propiconazole @ 0.1% (10 ml/10 L water) covering entire surface of leaf

5. Black shank (*Phytophthora parasitica* var *nicotianae* (Breda de Haan) Tucker): (in main field)

- Crop rotation is to be followed in frequently infected fields
- Soil application of well decomposed Neem cake enriched with Trichoderma viride (2 x 10^7 CFUs/g) @ 30g/m^2
- Apply 75-100 ml of 0.4% Bordeaux mixture/ plant (40 g of Copper sulphate + 40 g of lime in 10 L of water)
- Spray copper oxychloride @ 0.2% concentration (20 g/10 L of water) around the plant base (or) fenamidone + Mancozeb 60 WG (30 g in 10 L of water) (or)
- Spray metalaxyl + mancozeb combination (72 WP) @ 0.2% (20 g/ 10 L of water) but it must be restricted to two sprays

6. Root-knot (main field)

- Periodical deep ploughing in summer, crop rotation with less susceptible crops like Ragi, Maize, Castor, Gingely, Cotton, Groundnut
- *In situ* green manuring with Sunhemp in *rabi*
- Planting root-knot free seedlings from tray medium enriched with *Trichoderma viride*(2 x10^7 CFUs/g)+ *Paecilomyceslilacinus* (2x10^7 CFUs/g)
- Spot application of *T. Viride*+ *P.lilacinus*each @ 1 g/plant

7. Fusarium wilt (Fusarium oxysporum (Schlecht) Wr.f.sp. *nicotianae* Johnson)

- Growing wilt tolerant variety FCH 222 in sick fields
- Apply *Trichoderma viride* (2 x10^7CFUs/g) along with neem cake 30 g/m^2
- Crop rotation with sorghum/ maize for at least two years is beneficial
- Application of bio-agent enriched vermi-compost, pressmud, FYM green manuring with sun hemp will go a long way in reducing the incidence

8. Cucumber mosaic virus (CMV)

- Aphid, vector of this virus has to be controlled to prevent the spread of this disease
- For management of aphids, spray imidacloprid 200 SL @ 2.5 ml (or) thiamethoxam 25 WG @ 2 g (or) flonicamid 50 SG @ 4 g (or) pymetrozine 50 WG @ 4 g in 10 litres of water
- Remove and destroy severely infected tobacco plants

9. Tobacco mosaic virus (TMV) (*Marmor tabaci*)

- Strictly follow the sanitary measures and should not touch the infected plants
- Workers should wash their hands with soap water before and after entering infected fields
- Prophylactic sprays of plant extract like *Basella* or *Bougainvillea* or *neem* @ 1% or 0.5% skimmed milk on 30th, 40th and 50th DAP to prevent spread of the disease to some extent

10. Leaf curl virus (TLCV) (*Ruga tabaci*)

- Whitefly, vector of this virus has to be controlled to prevent the spread of TLCV disease
- Install yellow sticky traps of 12 x 15 cm size @ 12/ha for monitoring the vector whitefly
- Spray imidacloprid 200 SL @ 2.5 ml (or) thiamethoxam 25 WG @ 2 g (or) fonicamid 50 SG @ 4 g (or) pymetrozine 50 WG @ 4 g/ 10 litres of water on ten days seedlings before pulling in the nursery
- Spray the above chemicals 3-4 times 10 days after transplanting in the field at 15 days interval
- Remove and destroy severely infected plants

11. Broomrape (*Orobanche cernua*)

- Deep summer ploughing is recommended
- Instead of growing tobacco continuously, grow non-host or trap crops (Jowar, sesamum, Blackgram & Greengram) in rotation
- Dollop method of neem cake application @ 100 kg/acre on both sides of plants (30-35 days)
- Careful removal of spikes before flowering or seed setting reduces the orobanche seed load
- Above said measures if followed in integrated manner, orobanche infestation can be reduced

Topping and sucker control

- Topping at extended bud stage (20-22) depending upon the variety and crop growth
- Apply 10 ml of Decanol @ 4% or Power 10 @ 4% or Suckerout @ 3.5% per plant in the top 5-6 axils to control the suckers

Harvesting

- Harvest 2-3 mature leaves each time
- Bottom leaves (1&2 primings) are to be harvested on slightly greener side, middle leaves (3-6 primings) when they are ripe and top leaves (7 and above pickings) when they are fully ripe
- Harvest before 9.00 am and do not expose the harvested leaves to hot sun and soil
- Delay the harvesting for 3-4 days, if there is a rain
- Green leaves are to be graded into immature, mature and over matured leaves and are tied to the sticks separately
- Tie the leaves @ 2-3 leaves / bunch and 16-18 bunches in a stick on either side and should not exceed 100-120 leaves per stick

Flue-Curing

- Curing is slow and steady removal of moisture from green leaf in specialized structures called barns (simplex barn 13x 13x13 ft. or duplex barns: 16x16x16 ft.) as per the specified schedule

Stage	Temperature (Dry bulb)	Wet bulb	Ventilators	Duration (in hrs)
Yellowing	90-105^{0}F	80-94^{0}F	2" opening	36-48
Colour fixing	105-120^{0}F	94-98^{0}F	3-5" opening of both bottom and top ventilators	5-11
Leaf drying	120-145^{0}F	98-110^{0}F	Close ventilators gradually	25-40
Midrib drying	145-160^{0}F	110-114^{0}F	Close all ventilators	24-36

- Fixing of turbofan on barn top will result in energy saving by 10%
- Integrated barn technology with low profile barn, barn insulation with paddy straw, Modified flue system and ventury furnace will reduce the fuel requirement by 51%

Fuel for flue-curing

In general, wood is used as fuel. Other alternative fuels suggested are coconut fronds/husk, hulled maize cobs, discarded coffee stems, coffee husk, agri-biomass briquettes and solar energy

Problems in Flue-curing and their management

1. Barn rot

- Occurs when moist leaves are harvested and loaded in the barn. It can be managed by avoiding leaf harvesting when they are moist

2. Sponging

- Avoid rapid drying at high temperatures during yellowing and overloading of barn

3. Barn scald

- Avoid increasing the temperature by not more than 1 to 2^{0}F per hour

4. Dark Green grades

- Avoid curing of immature leaves and raising temperatures beyond 105^{0}F before yellowing is completed.

5. Cooked / caramelized leaf

- Avoid increasing temperature beyond 160^{0}F during midrib drying and loading of leaf nearer to flue pipes

6. Run back

- Maintain the required temperature during midrib drying stage

Grading, Baling and NTRM

- Bulk the cured leaf sticks for 3 – 4 days followed by unstringing and bulking
- Prepare a thick paddy straw bed on the floor and cover the bed with clean tarpaulin
- Pick wise bulking is to be done to facilitate plant position grading
- Leaf Moisture is to be verified periodically and rebulk at regular intervals
- Cured leaf should be graded based on the position of the leaves on the tobacco plant (Plant position grading) and further classification based on the quality and colour

Non-tobacco related matter (NTRM)

- Avoid non-tobacco related materials (NTRM) like sand, weeds, plastics, hessian cloth / gunny pieces, paper bits, broomstick pieces, feathers, bird droppings etc. in bales

NOTE: Cultivation of tobacco as per the crop size and area fixed by Tobacco Board will ensure fair price to the farmers

For further details please contact **Director, ICAR-CTRI, Rajahmundry**