

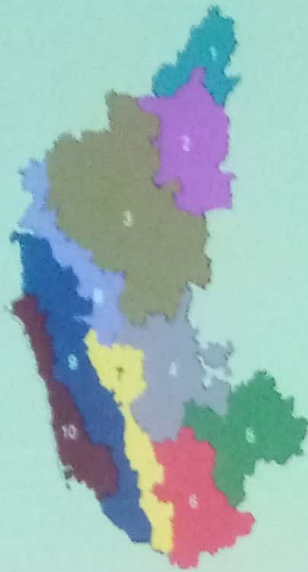
FCV Tobacco Production Technology and Good Agricultural Practices in Karnataka Light Soils (KLS)



**TOBACCO BOARD, GUNTUR
AND
CTRI RESEARCH STATION, HUNSUR
KARNATAKA**



Agro-climatic Zones of Karnataka*



1. North Eastern Transition Zone
 2. North Eastern Dry Zone
 3. Northern Dry Zone
 4. Central Dry Zone
 5. Eastern Dry Zone
 6. Southern Dry Zone
 7. Southern Transition Zone (STZ)*
 8. Northern Transition Zone
 9. Hill Zone
 10. Coastal Zone
- * FCV Tobacco growing belt

Source : Dept. of Agriculture, Govt. of Karnataka





PREFACE / CHAIRMAN MESSAGE

This comprehensive booklet on Good Agricultural Practices(GAP) exclusively for Karnataka light Soil(KLS) Tobacco, brings out all recent advances in research and is aimed to reorient to meet the changing need of the growers, exporters, global customers and traders keeping in view the quality requirements of International market.

This book will be a valuable source of information to the farmers and extension staff, which will also be a guide for any seen and unforeseen problems that come across in tobacco cultivation. The topics covered are very objective oriented to guide the farmer in adopting the timely Good Agricultural Practices from seed to sale of tobacco. The main focus areas of tobacco cultivation such as Integrated Nutrient Management, Improvement of Yield and quality, Integrated Pest Management, control of crop protection agents residues, elimination of NTRM, improved curing practices which lead to reduction in cost of cultivation and improve the yield and quality of tobacco has been explained in a very farmer friendly manner.

I am sure that all the stake holders will definitely contribute in building up and retaining the brand image of Karnataka FCV tobacco in the international market and make tobacco cultivation sustainable by following the recommended practices of tobacco cultivation

I congratulate all the concerned Scientists of CTRI for their sincere efforts in bringing out this highly beneficial booklet which can no doubt fulfil the objectives of producing good quality tobacco that meets the international standards.

(Dr. KOOTHATI GOPAL, L.A.S.)

CHAIRMAN

TOBACCO BOARD



GOOD AGRICULTURAL PRACTICES FOR SUSTAINABLE FCV TOBACCO PRODUCTION IN KLS

Introduction

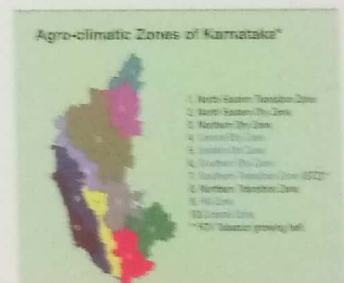
Flue Cured Virginia (FCV) tobacco is the main commercial crop grown in Southern transitional zone of Karnataka (STZ No. 7), which comes under Southern part of the state. The crop is grown during Kharif season as rainfed crop in about 1.00 Lakh ha each year in the light soil areas, popularly known as Karnataka Light Soils (KLS) with a production ranging from 100-120 m.kg. The cured leaf produced in this Zone is thin to medium bodied, rich lemon yellow to orange, light textured ripe & open grained with mild and smooth smoking properties ideal for international blends. The chlorides, tar content, carbon monoxide and heavy metals are low to very low with minimum pesticide residues and TSNA level below detectable level. The superior quality filler tobacco produced in KLS known as 'Mysore style' has great demand in the International market and more than 70-80% of the annual production is exported to several countries. Nearly 85% of the FCV tobacco area in Karnataka is mainly concentrated in four taluks (H.D.Kote, Hunsur, Periyapatna and K.R.Nagar) of Mysore district and remaining area of around 15% is in Arakalgud taluk of Hassan district and some scattered area in Chickmagalur, Shimoga as well as Davanagere districts.

Profile of the Southern transitional Zone :

The Southern Transitional Zone (Zone No.7) in Karnataka (comprising of mostly Mysore, Hassan, Chikmagalur and Shimoga districts) is characterized by dry sub humid to semi arid climate with an annual rainfall of 600-1000 mm. Nearly 70% of the area out of grossed cropped area 7.3 lakh ha is under rainfed farming in this zone. FCV tobacco is the major commercial crop (> 95% in Mysore and Hassan Districts) grown on red sandy loams commonly known as Karnataka Light Soils (KLS), followed by Cotton, Maize, Finger millet and pulses. In KLS region, majority of the soils are shallow to moderately deep, yellowish red to dark reddish brown in colour, sandy loam to sandy clay loam in texture, acidic to neutral in reaction, well drained and highly leached. The soils have low Water Holding Capacity and Cation Exchange Capacity. The clay content generally varies from 10 to 25% and Kaolinite and hydrous oxide of iron and aluminum dominate the clay complex. In general, the soils are low in nitrogen and medium to high in available phosphorous and medium to high in available potassium. The red sandy loam to sandy clay loam soil with slightly acidic to neutral PH and good drainage are quite conducive for quality FCV tobacco production. The length of the growing period (LGP) is around 190-200 days. In general, the farmers are mostly small and marginal with a land holding of 1-2 ha. The region has bimodal distribution of rainfall benefited by both south west (May-September) and North east (Oct-Dec) monsoons. The zone is under tropical monsoonic climate with an average annual rainfall varying from 650 -1000 mm and 80% received during the South west Monsoon period May – October which coincides with the FCV tobacco crop season.

The Southern Transitional zone is endowed with ideal climatic conditions like lower diurnal temperature, higher relative humidity and monsoonic rains during the crop growth period conducive for production of quality tobacco.

Crop profile : Flue Cured Virginia (FCV) cigarette tobacco is an important commercial crop grown under rain fed conditions in the STZ 7 of Karnataka. Cultivated in > 1.0 lakh ha in Karnataka (>1000 villages and 42,000 farmers).exported to >50 countries annually (Rs.25,000 crores to the national exchequer) known in the international market as "Mysore style", classified as 'superior quality filler' in the international market with excellent physical qualities (light to medium body, rich lemon to orange, ripe, pliable, open graininess) ideal chemistry (low - medium nicotine, high reducing sugars, low chlorides, very low pesticides level & low levels of heavy metals, TSNA below detectable level, besides less tar content and carbon monoxide.





FCV TOBACCO CROP CULTIVATION IN KLS

Nursery Management:

Production of sturdy and healthy transplantable seedlings is the first major step contributing to the success of the crop in the main field. As the crop is raised as rainfed crop in kharif season which



commence from March coincides with the pre- monsoonic period and hence the prevailing factors during the period influence the spread of several soil borne diseases affecting the quality seedlings production.

Important considerations:

Select Sandy loam and well drained soils and avoid water logged situations /heavy/clay soils. The nursery site should be rotated with crops like Finger millet, Hybrid Maize, Jowar, Cotton, Sesame, Sunhemp and Groundnut. Crops like Tomato, Brinjal, Chillies, Bhendi, Potato, Pulses should not be grown. The soil should be brought to fine tilth and raised beds (15 cm height, 1 m breadth, 15 m length, & 30 cm channel) are to be prepared.



Ideal nursery operations:

About 4.5 -5.0 g seeds mixed with fine sand should be sown in the prepared 15 m² bed followed by light planking with wooden plank for seed anchorage. High seed rate & sowing the seeds with water should be avoided. Cover the beds with thin layer of paddy straw up to 25 days and thinned gradually and exposed to the sun light daily in the morning hours to avoid etiolating of seedlings and drive out the moisture from the beds. Avoid mulching with paddy husk. Watering daily 2-3 times are to be given for about 15 days and later 2 watering are sufficient up to 35-40 days followed by gradual reduction in watering for hardening the seedlings. Excess watering, water logging in channels and watering late in the evening or during noon hours invite damping off etc.. About 30 days young seedlings can be taken from the overcrowded patches and reset in the fresh beds for further growth for getting hard seedlings which can withstand hot weather and low humidity. Clipping of the leaves should be done up at 45-50 days (without damaging the growing point) stage to avoid over-growth and to harden the seedlings.





TRAY NURSERY CONCEPT

In contrast to conventional nursery, raising tobacco seedlings in plastic trays commonly called as tray nursery using soil free organic media such as composted coir pith (coco-peat) is considered as promising technology for producing hard and disease free seedlings which are amenable for early planting in the month of May. The methodology involves growing tobacco seedlings in plastic trays (98 cups/cells) by resetting about 25-30 days old seedlings obtained from the conventional nursery using soil free organic media for production of sturdy, disease free and uniform seedlings.

Advantages of tray nursery system:

It is an eco- friendly and farmer friendly technology and being considered as a good alternative to replace sick nursery soils. Seedlings can be raised under water scarce situations with minimum weeding and use of chemical fertilizers/pesticide as well as labour. The tray nursery results in 100% establishment in the main field avoiding gap filling by the farmers resulting in 7-8% increase in higher yield and quality leaf production. The technology greatly ensures uniform crop growth facilitating all the good agricultural practices to be followed in time.

Important considerations:

It is always advised to transplant 25-30 days old seedlings from the beds and avoid over aged seedlings. Keep the transplanted trays in shade for few days for initial establishment. Careful watering (once or twice in a day) needs to be done. Nutrient application in the form of 17:17:17 complex @ 15 g/30 trays to be done at 10-12 days. Top dress the seedling with CAN/AS 15-20 g/30 trays and wash the seedlings thoroughly. Need based plant protection measures with carbendazim @ 0.1% for the control of Anthracnose and Shoroshin. Clipping to be attended at 25 days after the seedlings attain sufficient height to harden the seedlings. Restrict watering at the later stage and before transplanting.



Criteria for Nursery Management

- To raise nursery in sandy loam, well drained soils having water with low chlorides.
- To adopt tray nursery concept – a technology to minimize use of water, fertilizer, pesticides, labour and can produce healthy disease free seedlings.
- Use only recommended varieties specified for the area.

Recommended varieties:

The growers are advised to use only pure certified seeds supplied from the recognized agencies to avoid mixtures in the field to achieve uniform crop without admixtures

Kanchan:

Exotic cultivar released in 1999 for cultivation in KLS. It is a green cast variety with semi-open plant habit with short internodes. Leaves are long and narrow with wavy lamina. Cured leaf is bright lemon to orange in color. Thick bodied, optimally spotted, pliable with superior aroma. It yields more than 2000 kg cured leaf/ha with around 70% bright grades and resistant to black shank disease and tolerant to root-knot. Responds to higher N dose, presently the ruling variety in KLS.

FCH 222:

It is the recent variety developed and released for Fusarium wilt sick soils of FCV tobacco growing areas of KLS during 2012. The plant has around 25 leaves with 20-22 curable leaves. The leaf spangling is medium at maturity. The cured leaf is characterized by neutral aroma with around 70% bright grades. It has got yield potential of around 2000 kg/ha with good cured leaf quality.

CH-3 Hybrid:

The hybrid line CH-3 jointly developed by CTRI and ITC is having high yield potential with hybrid vigour. Its performance in the selected areas in the on-farm trails has been found to be very promising.

FIELD CROP MANAGEMENT**Land Selection**

Well drained red loam to sandy loam soils with good water holding capacity having a PH of 5.5-7.5 is ideal for producing quality FCV tobacco. Avoid heavy/clay, waterlogged and saline affected soils.

Land preparation

Field should be deep ploughed by tractor drawn disc plough in Nov.-Dec. followed by harrowing or ploughing twice in the month of April to May to achieve fine soil tilth for planting.

Transplanting

Early planting in the month of May is the ideal time for planting FCV tobacco in KLS. Select disease free, sturdy and hard seedlings from the reset beds / tray nursery raised for planting for better establishment in the field. Recommended spacing of 100 x 55 cm with a population of 18,181/ha has to be maintained. Form ridges at 1 mt. apart and pass the markers across the ridges at 55 cm. Depending upon the rainfall ridge planting (in high rainfall area) and flat planting (in medium to low rainfall situation) is preferred. Adopting dry planting by pouring water in the planting hole and using tray nursery seedlings is ideal than wet planting after rains.

Nutrient management:

The application of organic manures such as FYM @ 8-10 t/ha, Press mud @ 6 t/ha or vermicompost @ 2 t/ha should be done. FYM or Press mud should be well incorporated into the soil 2-3 weeks before planting. Vermicompost should be applied in the planting hole at the time of planting @ 100g/plant. 30 kg N (in the form of Ammonium Sulphate), 40 Kg P₂O₅ (in the form of Single Super Phosphate) and 60 Kg of K₂O (in the form of Sulphate of Potash) has to be applied as a basal dressing by adopting dollop method (4-5 cm deep and 5-8 cm away from the plant on both sides of the plant along the ridge by using fertilizer cups) at 7-10 DAT. Top dress the crop with 30 kg N (in the form of Ammonium Sulphate), and 60 Kg of K₂O (in the form of Sulphate of Potash) at 25-30 DAT. The recommend quantity of individual fertilizers has to be thoroughly mixed and applied.





Fertilizers			
Basal Dressing	Quantity/ac	Quantity/ha	Quantity/plant
Ammonium Sulphate	60 Kg	150 Kg	8.25 g
Single Super Phosphate	100 Kg	250 Kg	13.75 g
Sulphate of Potash	48 Kg	120 Kg	6.6 g
Top Dressing			
Ammonium Sulphate	60 Kg	150 Kg	8.25 g
Sulphate fo Potash	48 Kg	120 Kg	6.6 g

A total mixture of fertilizers for basal dressing: 28.6 g /Plant;
Top dressing: 14.8 g/Plant

In case of heavy rainfall after application of fertilizers, apply about 5-10 Kg N (25-50 Kg Ammonium Sulphate/ha) to compensate for the possible leaching losses depending on the soil type and the intensity of rainfall.



Field Crop Management

- Select soils with well drained loamy soils having PH5.5 to 7.5 and good water holding capacity.
- Maintain good soil fertility and structure through integrated nutrient management (Green Manuring and balanced fertilization).
- Adopt ideal spacing for better interculture operations and crop growth.

Interculture & Weeding:

About 4-5 intercultural operations at 8-10 days interval should be taken up during the crop growth period. Initially shallow interculture using tined harrows 2-3 times followed by passing country plough 2 times and final ridging the crop at 45-50 days using ridger. Weeds should be removed manually at 15-20 days and at 35-40 days after planting to avoid competition for moisture and nutrients.



Topping & desuckering:

Topping and desuckering operations are essential for improving the yield and quality of FCV tobacco. The ideal time for topping is at the extended bud stage at 20-22 leaves depending upon the variety cultivated, soil type and condition of the crop. The desuckering can be done manually or using chemical suckericides like Deconol, Seeten, Sucker out etc. at 4% concentration (40 ml in 1 lit of water). Suckericide has to be applied 2-3 days after topping. Avoid application of the suckericide during cloudy/ rainy/ drizzling conditions.

PEST AND DISEASE MANAGEMENT

Tobacco is susceptible to several diseases and pests both in nursery phase and field crop. The major insect pests are stem borer, Tobacco aphids and leaf eating caterpillar while the major diseases are damping off, leaf blight and black shank, Soreshin, Anthracnose (in nursery phase), Fusarium wilt, Brown spot and root-knot (in field crop).

Pest/disease Management in Nursery

Damping-off - *Pythium aphanidermatum* (Edson) Fitz.; *Phytophthora* (Dreschler)

The disease may occur at pre-emergence or post-emergence stage. Conspicuous symptoms are sudden collapse of young seedlings in patches. Brown, watery soft rot of young seedlings, girdling of hypocotyle and wet rot are common symptoms.

Leaf Blight and black shank - *Phytophthora parasitica* var. *nicotianae* (Breda de Haan) Tucker

Leaf blight symptoms occur during mid-nursery period on the foliage due to rain splash of zoospores of the pathogen from soil, while black shank infection occurs by the soil-borne propagules such as chlamydospore and oospores.

The blight symptoms include large, circular, water soaked brown lesions on leaves which enlarge and coalesce leading to wet rot of leaf tissue and midribs. Whereas black shank infection is characterised by blackening of roots & stem at ground level and wilting & yellowing of leaves.

Chemical control: Application of Ridomil Gold @ 0.1% @ 500ml/sq.m as pre-sowing soil drench and 0.2% foliar spray drench @ 100 ml/sq.m twice at 30 & 45 DAS is suggested for the control of the diseases.



Soreshin - *Rhizoctonia solani* Kuhn -

The disease is observed at early stage of seedling growth. The first symptom is a small water soaked lesion on the stem close to soil line that rapidly becomes brown and sunken. Under high humidity and temperature lesions become very constricted and the stem breaks off at soil line the top portion of the seedlings easily pulls off from the root, however the root system is generally healthy.

Anthracnose - *Colletotrichum tabacum* (Boning)

The pathogen attacks at all stages of the seedlings. The disease is caused both on stem and leaf. The symptoms on leaf are characterized by small circular water soaked brownish spots in large numbers. While the disease on stem is seen as brown sunken, elongated, elliptical lesions at the basal portions as well as on petiole and mid-rib generally coalesce to form bigger lesions. The roots of the infected seedling are normal and leaves are green in colour.



Control measures: Two to three foliar sprays with carbendazim 50% WP (Bavistin) @ 0.05 to 0.1% at an interval of 10 days starting from 30 DAS and Propiconazol 25% EC (Tilt) @ 0.05% spray after 30 DAS for the control of both Soreshin and Anthracnose. Avoid severely stem infested anthracnose seedlings for planting.



Root-knot – *Meloidogyne incognita* (Kofoid & white) Chitwood; *M. javanica* (Treub) Chitwood; *M. arenaria* (Neal) Chitwood

The distinct symptoms of the disease are galling on roots, severe stunting, symptoms of nitrogen deficiency, yellowing and day wilting. Root-knot damage results in uneven distribution of affected plants within the bed.

Control measures: Avoid nursery sites previously grown with Tomato, Chillies, Brinjal, Bhendi, Potato and pulses etc., solarisation of nursery beds, changing the nursery sites every year, application of vermicompost @ 2 kg/m², incorporation of carbofuron (Furadon @ 20g/m² in 2 splits) at sowing and at 20 DAS). Tray nursery seedlings production is highly beneficial to effectively avoid root-knot infestation



Integrated Pest Management (IPM)

- Adopt IPM by use of Biopesticides, Cultural / Mechanical / Biological methods for control of CPAs residues.
- Use of Yellow Sticky Traps / Pheromone Traps for better pest monitoring.
- Use only recommended agrochemicals and avoid banned pesticides.
- Random leaf analysis for CPA residues and address the growers for corrective steps.
- To organise awareness camps to growers and extension staff on follow up action.

PESTS/DISEASE MANAGEMENT IN FIELD CROP

Stem borer (*Scrobipalpa heliopa*)

This is common insect pest both in nursery and main field. The larva causes damage by mining the leaves, midribs, leaf stalks and finally boring in the stem and inducing the stem galls. Also causes stunting of the plants and unusual branching of the infested seedlings. The adult is a small brown moth and lays 50-80 eggs. The fully grown larva is pale white in colour with head and thorax dark brown. The control measures include destroying the aged nursery beds, avoiding using infested seedlings for planting, open the bulged portion of the stem with the sharp needle and spraying twice Flubendamide 480SC @ 2.5 ml in 10 lt of water at 10 and 20 DAP.



Tobacco aphid (*Myzus nicotianae*) Blackman

This is a major and common insect pest in KLS in field crop. They are green or pinkish brown louse like insects. Generally, wingless forms are observed in large numbers, while winged forms are less frequent and migratory acting as vectors for some viruses like cucumber mosaic and rosette. Continuous cloudy and humid weather and low temperatures for a prolonged period followed by warm climate can cause outbreak of aphid infestation. The aphids suck plant sap and continuous sucking retard the growth of the young leaf. The secretions from the aphids cause sooty mold (*Fumago* sp.) in the effected leaf.

Severe sooty mold affected leaves become unfit for curing affecting the quality. The control measures when the 2% of the plants are infested include spraying of imidacloprid 200SL (Confidor @ 3 ml/10 lit of water) or thiomethoxon 25 WG (Actra @ 2 g/ 10 lit of water) alternatively. Care should be taken to spray the insecticides on the bottom surface of the infested leaf. Leave 1-2 weeks gap before harvesting the leaf to avoid excessive insecticide residues in cured leaf. The cultural methods like growing Bajra/ Jowar/ maize as barrier crop in 2-3 lines all around the tobacco field helps in reducing aphid incidence and usage of chemical sprays. Bio- agents like *Verticellium lecanii* can also be used in an

integrated approach.

Leaf eating caterpillar (*Spodoptera litura*)

It is a common pest both in nursery and main field. However at both stages of the crop it is comparatively a minor pest in KLS. However the damage can become severe during prolonged drought situations due to voracious feeding on the leaves during night time. The control measures includes collection of the caterpillars by hand picking, growing castor as border crop around the nursery as well as main field, spraying neem kernel suspension (NSKS @ 0.5-1.0%) and lastly resorting to spraying of Emamectin Benzoate 5 SG @ 5g in 10 lt of water or Novaluron 10EC @ 10 ml in 10lt of water.



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

This is becoming a major soil borne disease in some of the endemic areas of FCV tobacco growing areas in Karnataka. The most conspicuous symptoms are yellowing and drying of leaves, more pronounced on one side of the plant and one or two roots turning black. Leaves on the affected side usually stunted and distorted. The top of affected plant eventually wilts and gets drawn towards affected side and hence, the disease is also known as 'Draw stalk' or 'Crook-neck'. The disease is severe in sandy loams and favoured by warm weather and prolonged drought after rains/irrigation especially in early planted crops. The control measures include destruction of stalks/roots in the affected fields, strictly avoiding root knot affected seedlings, follow crop rotations with Sorghum, finger millet, Maize, Sudan grass and Sunhemp and strictly avoid crop rotation with sweet potato, tomato, potato, cotton etc., Under moderately infection level apply Tridemorph @ 0.05% (5g / 10 lt of water) or carbendazim @ 0.1%(10g / 10 lt of water) at root zone. (200 ml per plant) at plant hole and repeating the same once or twice as drench around eth plant at 25 and 40 DAT helps in reducing the losses due to the disease. Careful intercultural operations in wilt affected field should be done at the end. Application of vermicopost, Press mud, FYM and growing green manuring with sunhemp will go a long way in reducing the incidence. Growing wilt tolerant variety FCH 222 is recommended.



Root knot nematodes: *Meloidogyne incognita* (Kofoid & white) Chitwood; *M. javanica* (Treub)

The Root knot is a major problem both in the nursery and field crop. The distinct symptoms of the disease are galling on roots, severe stunting, symptoms of nitrogen deficiency, yellowing and day wilting. Root-knot damage results in uneven distribution of affected plants within the same field. Lower leaves of affected plants exhibit necrotic (Rim firing) symptom due to potash deficiency and the severely affected plants may die especially in dry spell or may show drought injury and K deficiency symptoms despite the presence of adequate moisture and fertilizers. The control measures include growing seedlings in the tray nursery system, enriching the tray media (coco peat) with bio agents like *Trichoderma viride*, *Paeecilomyces lilacinus* etc., @ 50g/tray medium, periodical deep ploughing in summer, crop rotation with less susceptible crops like Ragi, Maize, Castor, Gingely, Cotton, Groundnut, and taking up green manuring crops like Sun hemp after the harvest of the tobacco.





Brown spot: *Alternaria alternata* (Fries) Keissler –

It is basically a field crop disease. The severity of the disease varies from year to year depending on the favourable meteorological factors coinciding with crop growth and harvesting periods. The initial small water soaked spots become circular brown spots with typical concentric rings under favourable conditions. These spots eventually coalesce covering larger area of lamina rendering entire leaf ragged and worthless.

The central necrotic spot form 'shot-hole'. Spots increase at leaf ripening stage. The control measures include early planting,

application of potash in two splits and avoiding excess nitrogen, timely harvest (do not allow matured leaf to over ripe by delayed harvest), keeping the fields weed free and destroying the affected crop residues. Potassium nutrition through foliar sprays of SOP @ 2.5% is advised in the endemic areas.

Tobacco Mosaic- *Marmor tabaci*

The disease is characterized by vein-clearing, mottling of leaves with light and dark green areas. In early infection the plants are stunted with narrow and distorted leaves. The disease spreads mechanically. Unclean cultivation, use of tobacco products by farm workers and susceptible weeds are reasons for the disease occurrence.

The control measures include avoiding any form of usage of tobacco products in the vicinity of nursery, following phyto-sanitation measures, washing hands and the sickles/scissors in the soap solution while clipping seedlings. In the main field, roguing of the early affected plants before interculture, careful intercultural operations, washing of the hands and implements before and after various operations such as weeding, intercultural, topping and desuckering. Early topping and good sucker control are beneficial. Never use mosaic affected seedlings for planting.



Leaf-curl – *Ruga tabaci*

Diseased leaves show vein clearing, puckering, and downward curling of margins. Leaves become brittle with thickened veins and ear like out growths (enations) on the under surface of leaves resulting in stunted growth of the plant. Leaf curl is mainly transmitted through whitefly, *Bemisia tabaci*. Bushy vegetation and growing of Brinjal, Sunflower, Cotton around tobacco fields will encourage build up of whiteflies. The control measures include removal and destruction of infected plants and controlling the vector by spraying imidacloprid (Confidor @ 3 ml/10 lit of water)



Weather fleck

A non-parasitic disorder in field crop. Symptoms are first seen on mature basal leaves in the form of irregular, water soaked spots, closely aggregated, 1-3 mm in diameter on upper surface. These lesions turn brown to grey or white with necrotic centre surrounded by chlorotic tissues. Low temperature and rainfall with poor sunshine during growth period are responsible for weather fleck and ozone injury due to ozone in the atmosphere which is seen in open fields as small grey spots on exposed foliage.

BIOLOGICAL CONTROL:

- Apply *Paecilomyces lilacinus* @ 30g / sq.m enriched with FYM or Vermi compost preferably in solarized soil for the management of root-knot nematodes in FCV tobacco nursery.
- Apply *Paecilomyces lilacinus* (25g) + *Trichoderma viride* (25g) in tray media (1.2 Kg) to raise tray seedlings for the management of root-knot nematode and fusarium wilt complex in FCV tobacco crop.
- Apply *Trichoderma viride* @ 20g / m² at sowing and same @ 10 g/m² at 30DAS for control of damping off, blight and black shank in FCV tobacco nurseries.



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Tips for pest and pesticide residue management in FCV tobacco production in KLS:

- Use strictly the seed from authorized source.
- Raise nurseries early (1st fortnight of March) and take up early planting (by May end or by 1st week of June)
- Removal and destruction of tobacco stalks of previous crop.
- Avoid fields having previous history of nematode/ disease incidence.
- Practice crop rotation as far as possible with non-host crops like ragi, sorghum and maize.
- Deep summer ploughing for at least three to four times to expose disease causing agents like fungal propagules, nematodes and insects larvae to high temperatures to reduce the inoculum.
- Discard the left over nurseries after planting.
- Plant only healthy seedlings devoid of root- knot, stem borer and anthracnose infection.
- Use disease tolerant variety FCH 222 for controlling fusarium wilt disease in sick soils.
- Preferably plant tray nursery seedlings treated with *Paecilomyces lilacinus* and *Trichoderma viride* for the management of root- knot nematode and fusarium wilt disease complex in main field.
- Strictly follow sanitary measures to avoid viral diseases.
- Practice roguing of diseased plants early in the season to avoid disease spread.
- Avoid starting intercultural operations from disease infested portions/fields to avoid spread of soil-borne diseases like root knot nematode and fusarium wilt disease.
- Wash hands with soap water before and after entering infected fields.
- Destroy egg masses and tiny caterpillars by collecting them early in the morning every day.
- Avoid growing crops like field bean, tomato, brinjal, chilly as preceding rabi crop in fields infested with root knot and wilt.
- In planted crop, grow Tagetes (Marigold) around the field to attract *Heliothis* moth.

Addressing CPA issues in tobacco farming

- Use only recommended pesticides on tobacco.
- Avoid using banned pesticides.
- Avoid mixing of different pesticides for spraying.
- Use only recommended doses of pesticides.
- Avoid using pesticides in dust formulation in tobacco.
- Stop spraying 10 days before start of leaf harvest.
- Use protective clothing and devices while spray.
- Never eat, drink, smoke or rub your eyes/face while spraying.
- Wash hands /body thoroughly after spraying operations.
- In planted crop, grow Tagetes (Marigold) around the field to attract *Heliothis* moth.
- Follow integrated pest management (IPM) strictly.

HARVESTING:

Time of harvest and degree of leaf ripeness influence greatly the chemical and physical properties of cured tobacco. Harvesting of well matured and ripe leaves each time is essential for getting good grade out turn and better cured leaf quality. Harvesting in tobacco is done by priming matured leaves and generally starts after 2 months of planting. At each harvest about 2-3 matured leaves are to be harvested according to the ripeness from the bottom and should be carried out in the morning hours. Harvesting should be done at 7-8 days interval depending upon the maturity and weather conditions. Harvested leaves should be transported to shade without damaging and spread on a clean





tarpaulin. The green leaves are to be graded into immature, properly matured and over matured groups and tied to the sticks separately. Tie the leaves at the rate of 2-3 leaves / bunch and 16-18 bunches in a stick on either side and should not exceed 100-120 leaves per stick.

CURING:

Curing is a process of drying the leaves after yellowing under controlled conditions of humidity and temperature to get the desired leaf colour and aroma in the barns. It involves four stages namely yellowing, Color fixing, Lamina drying and mid rib drying. Proper temperature, humidity and hot air within the barn are achieved during curing process by manipulating heat through flue pipes and ventilation through bottom and top ventilators.

The harvested leaves should be loaded on the same day of the harvest. Load optimum sticks (350 in case of single barn, 600 in double and 900 in low profile barn) in the barn to get good curing and quality leaf. Under dry situations during harvesting period, provide artificial humidity in the barn by spreading wet gunny cloths on the barn floor. If wet weather persists during harvesting, necessary care should be taken before loading the sticks in the barn to remove excess moisture on the leaves. Required number of bottom ventilators as well as top ventilators of the recommended size should be provided in the barn for proper curing. Use the curometer compulsorily for regulating the temperatures regime during different stages of curing.



Post Harvest Product Management (PHPM)

- Care should be taken to ensure the inputs used are free from CPAs residues & NTRMs at all crop stages.
- Ripe leaf harvesting and adopt pickwise bulking to facilitate plant position grading.
- To adopt energy conservation methods like Roof Insulation – Ventury furnace technology.
- To avoid NTRMs through use of better storing, bulking and grading facility.

IMPORTANT CURING DEFECTS AND REMEDIES:

Green grades: Loading of the immature green leaves and insufficient yellowing before color fixing and drying the leaf. Follow Green leaf grading before loading. Avoid harvesting and loading immature leaves, provide sufficient yellowing time

Sponging: Result of overloading the barn, lack of proper ventilation, lower temperatures for too long during the early part of the curing process. Avoid overloading, provide proper aeration/ventilation and regulate the temperature through curometer

Run back: Formation of brown /dark areas along the mid rib and large lateral veins due to sudden drop in the temperature after leaf drying process and during the mid rib drying stage. Take care to maintain the required temperature (145-160°F) during mid rib drying using curometer.

Caramalization: It is caused by excessive temperature/heat during mid rib drying. Raising temperature above 160°F produces abnormal reddish color on leaf lamina and alters normal aroma and flavor of the leaves. Do not rise temperature above 160°F during mid rib drying stage.

ENERGY SAVING TECHNOLOGIES:

Adoption of energy saving methods for curing minimizes the use of fuel material and will go a long way in conserving the natural resources. It also reduces the production expenditure for the farmers, as curing alone accounts for more than 30% of the total cost of cultivation.

Low profile barn: Adopting low profile barn design (24 x16 x13') proved to be energy efficient with an average fuel saving of 16% compared to the conventional barn.

Ventury furnace: This is an improved furnace system which ensures better combustion of fuel due to adequate air supply and saves about 15% wood fuel consumption over the control barn with conventional furnace.

Paddy straw insulation: Insulating the ceiling with paddy straw to a thickness of 4" below the roof supported by GI sheet from inside the roof. This technology is cost effective with a fuel saving of around 30%.

Use of Alternative fuels: As the wood is becoming costly and scarce, alternative fuels like coffee husk, briquettes from coffee and agri wastes, coconut fronds, coconut halves, arecanut shells, maize rinds etc., can be used as an alternative to wood or in combination with the wood fuel to reduce the dependence on wood and to save the environment.

Energy plantation: Farmers are advised to grow their own fuel wood by planting fast, straight growing and drought tolerant tree species like *Casuarina equisetifolia*, *Eucalyptus* sp., *Acacia nilotica*, *Acacia auriculiformis* etc. to meet fuel requirement for curing their tobacco.



CURING PROCESS OF FCV TOBACCO

Stage of Curing	Barn Temp.		Relative Humidity		Leaf Moisture		Biochemical changes
	Initial	Final	Initial	Final	Initial	Final	
Yellowing 30-45 h	85°F	105°F	90%	55%	80%	60%	<ul style="list-style-type: none"> Hydrolysis of starch, proteins & fats to sugar, amino acids & peptides Conversion of above to CO₂, H₂O & Ammonia Ammonia reacts with acidic sap to form salts / amides Chlorophyll breaks down Yellow / Orange - Xanthophyll, Carotene are exposed Oxidation of polyphenols
Colour Fixing 5-11 h	105°F	125°F	55%	28%	60%	45%	Arresting biochemical changes by desiccation
Leaf Drying 35-45 h	125°F	140°F	28%	25%	45%	15%	Physical dehydration of leaf body
Midrib Drying 25-40 h	140°F	160°F	25%	15-17%	15%	8%	Dehydration of stems & veins



POST HARVEST PRODUCT MANAGEMENT (PHPM)

The major issues involved in the PHPM are scientific curing, conditioning, bulking, storage, Plant position grading, baling, Non tobacco related matter, and product integrity

- After completing the curing, allow cured leaf sticks either in the barn or arrange them on conditioning racks to get optimum condition.
- Stick bulk for 3 – 4 days followed by unstringing and bulking.
- Destruction of previous year's crop residue and cleaning the room and white washing the walls with lime.
- Keeping the room exclusively for tobacco storage as far as possible.
- Avoid storing pesticides, fertilizers and other crop produce and unwanted materials in the tobacco storage / bulking room.
- Spread paddy straw on the floor and prepare a thick bed and cover the bed with clean tarpaulin.
- Pick wise bulking is advised to facilitate plant position grading.
- Bulking 2 feet away from wall and restrict the bulk height to 5 - 6 feet.
- Cover the bulk with clean tarpaulins to maintain optimum moisture.
- Examine the bulk for moisture level at regular intervals and rebulk at regular interval.
- Bale the tobacco immediately after grading to avoid possible drayage and colour losses..
- A model storage facility is advised to facilitate avoiding mould development, beetle attack and improvement in colour intensity/quality, to maintain optimum moisture, to avoid heat development and to reduce scrap generation as well as to eliminate NTRM



CURED LEAF GRADING :

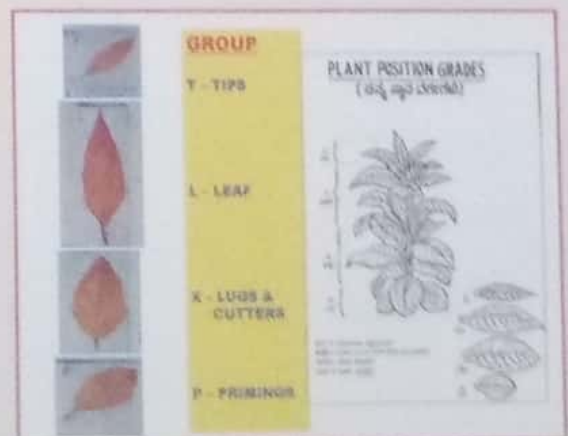
The cured leaf should be graded based on the position of the leaves on the tobacco plant (Plant position grading) and further classification based on the quality and colour. The plant position grading system has three main components viz., Group, Quality and Color.

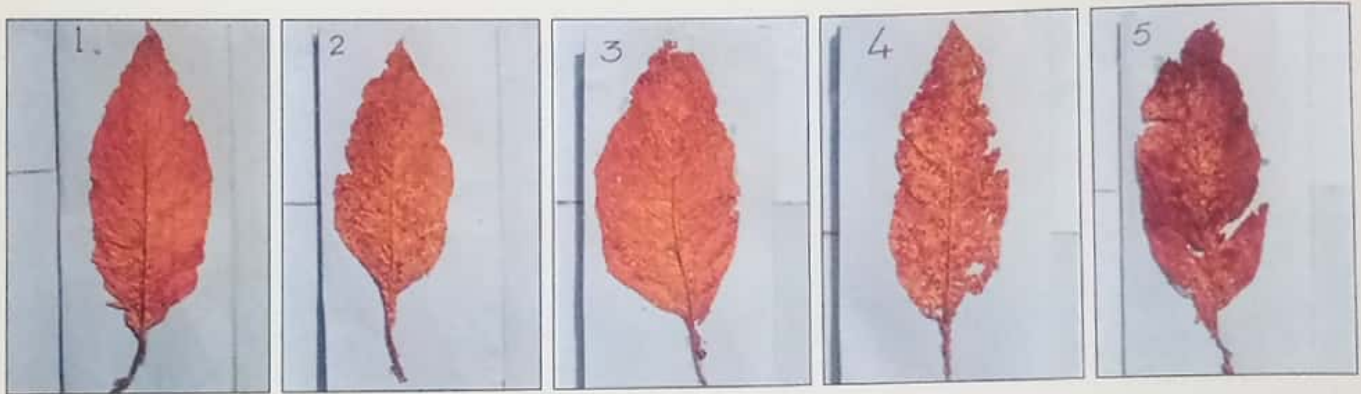


QUALITY :

Group	Quality	Damage due to spots / blemish / injury / wastage	Colour
P-Priming	1	Up to 20%	L-Lemon
X-Lugs & Cutters	2	20-30%	O-Orange
L-Leaf	3	30-55%	G-Green
T-Tips	4	55-80%	J-'J' Style
	5	80% & above	

Quality is normally denoted by the digits 1-5, based on extent of spots, blemish, and wastage in the leaf in each group





AVOIDING 'J' STYLE LEAF PRODUCTION:

Thin bodied, slick spotless tobacco due to harvest of immature leaves, nitrogen deficiency, excessive rains, dry and coarse tobacco are considered as J style. Curing defects like sponging, runback and caramalized leaves are also classified under J style. Proper scientific curing, proper fertilization and harvesting matured and ripe leaves helps in reducing the J style production.

NON-TOBACCO RELATED MATTER:

Recently the NTRM is a serious issue affecting the sustainable export demand of KLS. The commonly encountered materials in tobacco are Plastic pieces, Plastic sachets, Grass, Paper pieces, Jute twine, Gunny pikes, Small stones, Feather of birds, Beedi bits, etc. Care should be taken to avoid the entry of these material right from harvesting, conditioning, stick bulking, storage, grading and baling as well as during transportation and handling.



MINIMIZING THE LOW GRADE PRODUCTION:

1. Proper nutrient management especially recommended K application (in 2 splits).
2. Timely and correct application of the fertilizers (to avoid late application of N.)
3. Harvest properly matured and ripe leaves and follow green leaf grading before loading.
4. Avoid overloading of barns and follow recommended curing practices.
5. Maintain proper bottom and top ventilators to provide sufficient aeration in the barn.
6. Use curometers for regulating the temperatures in the barn while curing.
7. Maintain optimum moisture conditions during bulking/storing.

MITIGATION PRACTICES FOR ABERRANT WEATHER CONDITIONS/SITUATIONS:

Drought conditions during the crop growth:

1. Timely application of fertilizers and avoid late application.
2. Go for shallow intercultural operations only to conserve moisture and to control weeds. The soils around the plant should be loosened for better aeration to the growing plant.
3. Provide 1-2 protective life saving irrigation with good quality water (50 ppm chlorides)
4. Foliar application of nutrients through Potassium nitrate @ 1% (100 g/10 lit water) for sustaining the crop growth and increase drought tolerance.
5. Follow scrupulous topping and desuckering to avoid false maturity and encourage leaf development.
6. Timely harvesting of leaves as and when they are matured.

**Excess moisture or wet weather situations:**

1. Avoid water stagnation in the field and provide proper drainage.
2. Interculture operations to be done at optimum moisture condition as early as possible.
3. Supplement the crop with 10 Kg N/ha to compensate for the leaching losses (within 45 days).
4. Foliar nutrition of N and K through Potassium nitrate at 1% at later stages for compensating leaching losses.
5. Avoid fast maturity through timely topping and desuckering.
6. Avoid over maturing of leaves and take up timely harvesting.
7. Remove excess water from the harvested leaves and delay loading to the barn.
8. Provide sufficient aeration during yellowing and colour fixation to avoid barn rot.

SUSTAINABLE FARMING PRACTICES:

- Conservation of soil and water through contour bunds/graded bunds.
- Deep Ploughing during summer to conserve moisture and avoid crust formation.
- Forming the ridges across the slope to avoid water and soil run off from the fields.
- Enrichment of soil with enough organic matter (FYM, Press mud, Vermicompost etc).
- Growing and incorporation of green manure crops like Sun hemp after the harvest of tobacco.
- Follow ideal crop rotations practices to avoid pests and diseases incidence like root knot and wilt
- Following Integrated nutrient management and pest management practices.
- Early planting with tray nursery seedlings.
- Follow Integrated Pest management practices like crop rotations, growing barrier crop, trap crops, yellow sticks and pheromone tarps.
- Need based application of pesticides at recommended dose only and at the right time to avoid residue problems.
- Conserve energy through fuel conservation technologies and using alternative fuels.

Effective Lab to land Extension Activities

- To organise awareness training programmes to growers involving Scientists & Trade representatives and Board Officials to update the farmers.
- To organise On Farm Trials & Model Project Area schemes to demonstrate the results of research to the farmers.
- To motivate the growers to adhere to GAP as recommended by CORESTA at all crop stages.







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