

SUCCESS STORIES

Polytray tobacco seedlings : Boon to tobacco farming

Tray Seedlings are cost effective, free from soil borne diseases, uniform in growth, cent per cent establishment, improves the resource use efficiency, increases the yield by 10-25% adopted by 90% tobacco farmers.

PREAMBLE

Tobacco, one of the important high value low volume commercial crops in India, is valued for its potential to generate farm income and employment to farmers and farm labours, and revenue to the government. It is grown in area of 0.433 M ha in the country. With a production of 721 M kg India ranks third in the world tobacco production, after China with 2997 M kg and Brazil with 862 M kg (2014). Tobacco production is an important source of livelihood and provides direct and/or indirect employment to about 41.6 million people. During 2015-16, tobacco made a significant contribution of Rs. 29,376 crore to Indian economy in terms of excise revenue (Rs. 23,318 crore) and export earnings (Rs. 6,058 crore). Among the different tobacco types grown in India, FCV tobacco is cultivated in Andhra Pradesh and Karnataka to an extent of 1.46 lakh ha producing 190 M kg.

Tobacco seeds very small (0.75x 0.53 mm) with thick seed-coat (approximately 11,000 – 12,000 seeds/ gram of tobacco seed), nursery raising and transplanting is inevitable in tobacco production. Tobacco seed requires optimum temperature (18-25°C) and moisture for germination. Tobacco nurseries raised during summer months when the prevailing temperatures are above 30°C results in very poor germination in the nursery beds.



Conventional Seedling Production

Ideal soils (Well drained light textured soils, with low soil chlorides (< 100ppm)) is a prerequisite for successful nursery raising. Pre-sowing operations viz., deep ploughing, bed cutting and post sowing operations viz., mulching, regular watering (4 times a day) and weeding, pest and disease control measures are essential in conventional nursery which is costly and requires the good amount of natural resources. Application of water and weeding are labour intensive and there will be Shortage of labour due to its seasonality. Seedlings are ready for transplantation in 70-75 days.



Disadvantages associated with conventional nursery raising was (i) Seedlings will experience transplantation shock and hence more gap fillings as a result the crop growth will not be uniform (ii) Water and fertilizer use efficiency will be less (iii) Weeds are major problem (iv) Incidence of pests and diseases more (v) Total mandays for seedling production is high (vi) cost of production of seedlings is high.



Poly Tray Seedling Production:

A tray nursery technique has been developed and standardized to produce healthy tobacco seedlings to overcome disease problems and to preclude transplantation shock. The technique is simple and entails sowing tiny tobacco seeds on coconut 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.

Mother trays : In tray seedling production unlike in conventional method, seedlings are raised on composted coir pith medium (coir pith alone or coir pith + FYM (3:1)) in mother trays (cement bins/trays/brick beds) for about 25-30 days under protected condition. Coir pith medium is to be fortified with single super phosphate @ 300 g of single superphosphate, 250 g ammonium sulphate, 150g potassium sulphate/100kg. Spraying of blitox @ 2g/l on the medium is to be done as a precautionary measure to avoid soil born diseases. In these Mother trays sand is added at the bottom and only top 4" is to be filled with the coir pith medium. Before sowing lines are to be made with broomstick on the media and the seed is sown @ 0.4 -0.6 g/sq mt. Water application is to be done in the initial stage with sprayer two times a day. Excess watering is to be avoided. Seeds start germinating from 5th day onwards and the germination will be completed by 7-8 days. Fertiliser spray with 10g each of Ammonium sulphate/CAN and potassium sulphate/10 litre is to be given two times @ 10 days interval after sowing. Seedlings will be ready for transplanting the trays by 20-25 days.



Resetting in trays: Fortified coir pith is to be filled tightly in the cells by periodical pressing in trays of 70/98 cells. Before filling coirpith is to be moistened by applying required quantity of water so that filling is easy. After filling, the trays seedlings of 20-25 days are planted in the trays by making a suitable hole using a nail or small stick. After planting the media around the seedling is to be pressed. After resetting, the trays are to be



kept in shade for 3-4 days. After that the trays are shifted to the raised beds in shade net (50%). Fertilisers are to be given three times at 5,20 and 25-30 days @ 100 ml,200ml and 300 ml of N and K (50g of CAN + 50 g of Sulphate of potash in one litre) in 10 litres rosecan/ 40 trays. Washing of the seedlings is to be done after fertilizer application. Three days after third dose of fertilizer application seedlings are to be kept outside shade for about 7 days for hardening. Thus healthy seedlings will be ready after 60-65 days. At this stage when it is pulled seedlings will come easily from the tray because the coir pith is covered by the root mass. Clipping can be done if the field conditions are not ready for planting. Three to four days before transplanting ridomil @ 2.5 ml/10 litre and Flue bendamide @ 20g/10 litre is to be sprayed to avoid subsequent mortality in the main field due to the incidence of leaf blight and stem borer.

Advantages of tray nursery

- 100% establishment, improves the yield by 10-25%
- Uniform crop growth due to less gap fillings (<1%), no transplantation shock, Uniform field operations viz., topping and harvesting.
- No Weed problem in tray nursery
- Water and fertilizer use efficiency will be more. Hence, seedlings can be raised even under water scarcity.
- Pests and diseases Incidence very less.
- Farmer friendly technology: Can be performed in back yards unlike conventional nursery
- Tray seedlings improves moisture and nutrient holding capacity and the soil health
- Higher net returns and cost benefit ratio.
- Total man days for seedling production less
- Crop duration will be reduced by 10 days
- Reduces the pest and disease incidence in main field
- Total cost of cultivation reduced



Extent of Adoption: Front line demonstrations and training programmes were conducted to farmers and stake holders at different locations. In collaboration with tobacco board, sensitization programmes were conducted through Field Friends programme. More than 80% farmers in Northern Light soils of Andhra Pradesh and 90% farmers in Karnataka light soils adopted the technology.

Yield : Tray seedlings enhances the FCV tobacco yield by 10-25% depending on the growing conditions.

Economics : The cost of production for 1 lakh seedlings in conventional nursery is Rs. 55,000/- whereas in tray seedling production it is Rs. 33,000/-. The net profit in raising the tray seedlings is Rs. 22,000/- per 1 lakh seedlings apart from considerable saving in irrigation water.

Drip Fertigation: A Tool for higher Yield, Water and Nutrient Use Efficiency

Drip fertigation, ensures the efficient use of nutrients, fertilizers, environmental protection and better economics of tobacco production. Fertigation with tray seedlings will further enhance the yield and quality of FCV tobacco.

Tobacco as a commercial crop has unique place in India, as it generates substantial amount of about Rs 23,318 crores to the national exchequer in terms of excise revenue and foreign exchange of Rs 6058 crores. Tobacco is grown under different agro-climatic conditions viz., monsoon and also in post rainy season under conserved soil moisture. It is grown under irrigated (furrow irrigation) conditions in West Godavari and East Godavari districts of Andhra Pradesh and Khammam district of Telangana to an extent of 28,000 ha. As the soils are light textured (sands and sandy loams) in this zone, water and nutrient use efficiency are low with furrow irrigation.



DRIP IRRIGATION

New irrigation technologies, such as drip irrigation to grow tobacco, not only enables the efficient use of every drop of applied water but also leads to enhanced crop growth and yield. This is due to maintenance of uniform soil moisture regime in the crop root zone by way of frequent irrigations at shorter intervals. Besides irrigation, a major component of profitable tobacco production is sound and balanced fertilization. Fertigation i.e., application of fertilizers via irrigation system i.e. Drip fertigation, ensures the efficient use of nutrients, fertilizer conservation, environmental protection and economics of tobacco production. In addition, fertigation with tray seedlings for healthy and uniform seedlings will enhance the yield and quality of FCV tobacco apart from higher water and nutrient efficiency.



Drip irrigation with Recommended Doses of Fertilizers (RDF) in FCV tobacco proved its superiority over furrow irrigation with RDF. Drip irrigation with RDF recorded increased green leaf yield by 16%, cured leaf yield by 18% and grade index by 15% per hectare when compared to furrow irrigation with RDF.

DRIP FERTIGATION

Drip fertigation with 100% RDF proved its superiority over Drip irrigation with RDF and furrow irrigation with RDF. Drip fertigation with RDF recorded increased green leaf yield by 27%, cured leaf yield by 12% and grade index yield 11% when compared to drip irrigation with RDF. When compared to furrow irrigation with RDF, the green leaf yield increased by 47%, cured leaf yield by 32 % and grade index by 28% per hectare. Drip fertigation with 80% RDF recorded yields comparable to Drip fertigation with 100% RDF and significantly higher than drip irrigation with RDF and furrow irrigation with RDF there by saves fertilizers to an extent of 20%.



TRAY SEEDLINGS WITH DRIP FERTIGATION

Planting of tray seedlings proved advantageous compared to conventional seedlings in terms of early establishment, uniformity of growth, duration and productivity. The tray seedlings with drip fertigation plot recorded increased green leaf yield by 18%, cured leaf yield by 16% and grade index yield by 24% per hectare when compared with conventional seedlings and furrow irrigation. The additional profit accrued due to tray seedlings and drip fertigation was Rs 25,285/- per ha with a B: C ratio of 1.823. In addition to the monetary benefits, total irrigation water requirement is only 57.2% of total furrow irrigation water requirement, thus showing 42.8% saving in irrigation requirement. The water use efficiency values for tray seedlings with drip fertigation and conventional seedlings with furrow irrigation are 11.74 and 5.77 kg CL/ha-mm of water which resulted in 103.5% increase in WUE by using tray seedlings with drip fertigation.

The technology was popularized through front line demonstrations and trainings. Apart from this, the technology was popularized through Tobacco Board and Trade partners (ITC, GPI etc). A total of 15 per cent of farmers adopted this technology in an area of 4000ha. The area under drip irrigation-fertigation is steadily increasing. Within a next couple of years, drip irrigation and fertigation system will be the prevailing irrigation system in the region.

FCV Tobacco Varietal Development

Tobacco is a low volume high value commercial crop grown in India. Among the different styles of tobacco cultivated in the country Flue Cured Virginia tobacco belongs to exportable type and has lion share in total tobacco exports. Indian FCV tobacco has unique demand in the international market as price competitive natural neutral filler to semi flavorful tobacco. Cost escalation in FCV tobacco production over the years has resulted in gradual reduction of farmers' net income. Hence, in order to sustain the competitive edge in the international market and to enhance the monetary benefits accrued to the farmers, there is a need to enhance the productivity of FCV tobacco.

During the last five years, with the objective of increasing and stabilizing the yield levels and enhancing leaf quality with reduced harmful substances two FCV hybrids and 3 FCV varieties were released for commercial cultivation. Further one FCV cultivar and two Chewing cultivars were identified for release. The salient features of these cultivars are furnished below.

S.No	Variety	Year of release	Recommended areas	Productivity (kg/ha)	Salient traits
Flue-cured tobacco					
1.	FCH 222	2012	<i>Fusarium</i> wilt endemic Light Soils of Karnataka (KLS)	3,000	Suitable to. Has high degree of tolerance to <i>Fusarium</i> wilt disease
2.	CH-1	2015	Northern Light Soils (NLS) areas of Andhra Pradesh	2,900	Flavourful hybrid
3.	N-98	2015	Andhra Pradesh	2,200	Rainfed conditions of Southern Light Soils
4.	LT Kanchan	2015	NLS areas of Andhra Pradesh	2500	Low tar yielding
5.	CH-3	2016	KLS of Karnataka	2,700	Flavourful hybrid
6.	TBST-2*	2014	Black Soils and Southern Light Soil areas of Andhra Pradesh	3300	Aphid tolerant and TMV resistant

* Identified for release

- **FCH 222:** It is a *Fusarium* wilt tolerant variety having an yield potential of 3000 kg/ha released for cultivation in light soil region of Karnataka. Since its inception, the variety has been cultivated and witnessed a steady progress covering majority of wilt endemic area, at present it is being cultivated in around 6000 ha in KLS.



- **LT Kanchan :** A low tar (less by 10%) flue-cured Virginia tobacco variety with high yield potential of 2,500 kg/ha is suitable for commercial cultivation in the Northern light soil region covering West Godavari district of Andhra Pradesh. Low tar content (harmful smoke constituent) in cured leaf biomass is the special trait associated with this variety.



- **CH-1:** A CMS based flue-cured Virginia tobacco hybrid is released for commercial cultivation in the Northern light soil region of AP. This hybrid is known for its high yield potential (2900 kg/ha) as well as its superior leaf quality in terms of smoke flavor resulting from relatively higher concentration of neutral volatile compounds.



- **N-98:** A high yielding (2,200 kg/ha) FCV tobacco variety is suitable for commercial cultivation in Southern Light Soils region of Andhra Pradesh. It is the most preferred tobacco variety in the recommended area and currently being cultivated in about 3000 ha in SLS/ SBS areas of Andhra Pradesh.



- **CH-3:** A high yielding (2500 to 2700 kg/ha) FCV tobacco hybrid suitable to Karnataka light soil FCV tobacco growing areas. CH-3 recorded significantly higher values of flavour causing neutral volatile compounds than the check variety, Kanchan. It is steadily replacing the varieties grown in light soils of Karanataka and Andhra Pradesh (NLS). At present it is cultivated in 17000 ha (including 22% of KLS and 80% of NLS).



- **TBST-2** : High yielding FCV tobacco variety TBST-2 is identified for its resistance / tolerance to TMV and aphid infestation. It is suitable for cultivation in Southern Light Soils and Black Soils regions of Andhra Pradesh. In view of its higher yield and pest tolerance, its gaining popularity among the farmers.



Impact of the released varieties/hybrids:

- The released varieties/hybrids during the period have occupied around 20% of the FCV tobacco growing areas replacing the existing cultivars.
- The average FCV tobacco productivity was increased from 1205 kg/ha (2010-13) to 1394 kg/ha (2013-16), witnessing an increase of 189 kg/ha depicting the inevitable contribution of released varieties/hybrids during the period.

INSECT BAIT: AN ECO FRIENDLY PESTICIDE APPLICATION FOR MANAGEMENT OF TOBACCO CATERPILLAR

Baiting technology will avert or abviate blanket application of insecticides and contribute in reduction in pesticide pollution due to drift and water pollution. As the insecticides used are low a.i. and relatively safe to the non target organisms and beneficial are not affected. The baiting technology helps in minimising the pesticide residues in the end product which is a cause of concern for commodities like tobacco, chillies and other agricultural products meant for export purpose.

Preamble

Spodoptera litura is a serious polyphagous pest in India and attacks various crops viz., tobacco, groundnut, chilli, pulses, cotton, sunflower, soybean and several vegetable crops. Farmers heavily depend upon chemical control to protect the crop from the pests resulting in negative economic as well as ecological consequences. Indiscriminate use of synthetic insecticides has led to development of resistance in the pests, destruction of beneficial organisms, resurgence of insect pests and pesticide residues in agricultural produce leading to health hazards. Due to a combination of factors the frequency of pest control failures has increased and high pesticide input based agricultural technology has led to poor economic returns. Insecticide baits are popular among farmers and are used under out break situations and cyclonic weather conditions that prevail during November to January with cloudy weather and continuous rains. Under such situations foliar sprays are ineffective and insecticide baits have been recommended for management of the pest. However, the baits with chemical insecticides viz., chlorpyriphos, monocrotophos and carbaryl are not eco-friendly and pose a hazard when used indiscriminately. Under such situation the baits with new low a.i and relatively safe insecticides go a long way in protecting these crops from the ravage of the polyphagous pest *Spodoptera litura* and help in realising the potential yields and contribute to the national economy.



Technology

Insecticides (Emamectin benzoate 5 SG, lufenuron 5 EC, novaluron 10 EC,) baits were prepared with rice bran + jaggery + water, against *S.litura* on FCV tobacco. Emamectin benzoate bait treated plots recorded least infestation both at 4 (4.60 %) and 10 (4.80 %)



Insecticide bait with rice bran + Jaggery + water

days after treatment (DAT). Novaluron baited plots recorded 5.40 & 6.00 % infestation

whereas, lufenuron bait treated plots recorded 6.60 & 6.80 per cent infestation at 4 & 10 DAT, respectively, compared to the untreated plots (16.20 and 20.80 per cent infestation). Emamectin benzoate provided maximum protection to tobacco leaves as shown by less number of leaves damaged (1.26 & 1.40), similarly, by



novaluron (1.86 & 2.20) and lufenuron (2.10 & 2.50) baits as compared to control (5.26 & 6.40) both at 4 and 8 DAT respectively. Based on the results, baits prepared with Emamectin benzoate bait and IGRs, novaluron and lufenuron can be used instead of chlorpyrifos bait in tobacco field crop.

As regards leaf area damaged at 4 DAT, emamectin benzoate recorded least leaf area damaged (2.19 %) followed by novaluron (3.16 %) and lufenuron (3.40 %) and all these were significantly less to untreated control (10.2).

Economics






Emamectin benzoate bait treatment recorded highest cured leaf yield (1982 kg/ha) and net returns (Rs 1,39,966/ha) with an ICBR of 1:16.28 where as novaluron and lufenuron bait treated plots recorded 1931 & 1812 kg cured leaf yields per hectare with net returns of Rs 1,34,203 & 1,20,756 and ICBR of 1:14.83 and 1:11.48 respectively.

Advantages

- The baiting technology will avoid blanket application of insecticides and contribute in reduction in pesticide pollution due to drift and water pollution.
- As the insecticides used are low a.i. and relatively safe to the non-target beneficial organisms.
- Baiting technology helps in minimising the pesticide residues in the end product which is a cause of concern for commodities like tobacco, chillies and other agricultural products meant for export purpose.

HIGH YIELDING ROOT-KNOT RESISTANT BIDI TOBACCO VARIETY - ANAND BIDI TOBACCO 10 (ABT 10)

A high yielding root-knot resistant *bidi* tobacco variety - Anand *bidi* tobacco 10 (ABT10) was released for irrigated conditions under middle Gujarat. The variety registered 31 and 6% increase in yield in farmers' field over A 119 (root-knot susceptible variety) and GT 5 with similar quality parameters and exhibited resistance to root-knot disease in controlled, sick plot and field conditions at BTRS farm and also on farmers' fields at different villages of Gujarat.

	
	
Root-knot resistant ABT 10	Root-knot susceptible A 119
	
ABT 10 & A 119 varieties in root-knot sick field at Vanoda Village	

Varietal characters : The variety has shy suckering habit, thick bodied and better smoke taste than GT 5, with low incidence of other diseases and tolerant to wet-footing under nursery. Without any additional cost, ABT 10 variety reduced root-knot disease by 100% in first year. Planting of ABT 10 (RKI, 0.00) consecutively for six years in severely root-knot infested field (RKI, 2.99) found to reduce the disease by 77% in seventh year. This resulted in 526% increase in yield over the susceptible variety A 119 in sick field under farmers condition, fetching an additional income of Rs. 1.50 lakhs /ha.

The technology is recommended in the endemic areas of the root-knot disease.

HIGH Yielding BIDI TOBACCO VARIETY: GUJARAT ANAND BIDI TOBACCO 11

In Gujarat *bidi* tobacco is cultivated in an area of 1,50,000 ha. Maximum area (90%) is concentrated in middle Gujarat under irrigated conditions. At present GT-7 (45% area), A 119 (40% area) and MRGTH 1 (15%) are the important varieties occupied maximum area in the middle Gujarat.

Varietal characters: A high yielding (4175 kg/ha), thick bodied, shy suckering variety with better smoke taste. On an average GABT 11 has given 86.6 and 10.5 *per cent* higher yield than existing varieties A 119 and MRGTH 1, respectively under irrigated conditions at BTRS, Anand. It is comparable to MRGTH 1 in chemical constituents.



Economics

- ✓ Increase in yield by about 86% (4175 kg/ha) over A 119 (2275 kg/ha) variety on research farm
- ✓ Increase in monetary return by more than Rs. 95,000/ ha.
- ✓ GABT 11 showed 33% higher cured yield (4480 kg/ha) over ABT 10 (3360 kg/ha) which ultimately fetched monetary return about Rs. 56,000 to the farmer
- ✓ Land can be spared for other food crops
- ✓ No additional input cost.
- ✓ Reduction in labour cost due to shy suckers

MODIFIED FLUE PIPE SYSTEM: FOR ENHANCED FUEL USE EFFICIENCY IN FLUE-CURING

Traditional Barn: In traditional barns (13'X13'X13'), the flue distribution is restricted to pipe systems which cover a small portion of area. This system of conveyance resulted in uneven distribution of temperature inside the barn at any given point of time causing lot of wastage of energy. There is frequent blockage of pipes due to ash deposition resulting major heat losses in the form of exhaust gas and overheating of pipes. The present study is an effort to overcome these disadvantages.

Modified flue pipe system: The new system of heat conveyance inside the curing chamber was found very efficient for curing tobacco leaves. The surface area is increased by 92% in the modified system with increase in volume available for the flue gas flow inside the floor. The quantity of wood used was 602 kg with 88 hrs of curing as against 1081 kg in traditional barn thereby saved wood to the extent of 45 per cent. The results on quality parameters are awaited.



MODIFIED FLUE PIPE SYSTEM WITH VENTURY FURNACE

Comparison of traditional barn With Modified system

Parameters	Traditional barn	Modified system
Surface area for heat transfer	14.13 m ²	27.33 m ²
Gas holding capacity	1.166 kg	6 kg
Heat flow rate	3384 watts	8187 watts
Heat transfer rate	7758 watts	12623 watts

Alternative Uses of Tobacco:

Conventionally tobacco is used in the manufacture of cigarettes, bidis, chewing mixtures, cigars, cheroots, hookah tobacco paste, snuff, gutka, zarda and quiwam. However, tobacco is an excellent source of photochemical having pharmaceutical, agricultural and industrial importance. Thus, alternatively, tobacco can be the source for extraction of nicotine, an alkaloid, solanesol, a trisesquiterpene alcohol and organic acids (malic and citric). Apart from these chemicals, there are other possibilities such as protein recovery from green leaf, oil from seed, rutin (Vitamin P) from cured leaf and furfural (industrial solvent) from stalk.

Nicotine: A bench-scale technology, employing ion-exchange resins, was developed for recovery of 40% Nicotine sulphate. The product was tested and found to be effective in controlling different pests attacking various crops, particularly its action on Brown plant hopper (BPH) and Green leaf hopper (GLH) damaging paddy is note worthy. As nicotine sulphate is banned in the country for internal consumption as pesticide, commercialization of the technology has not taken-off. Recent scientific evidence suggests that nicotine and nicotine like compounds may slow or ameliorate the symptoms of certain diseases like Tourette's syndrome, Alzheimer's, Parkinson's disease, Ulcerative Colitis and Attention Deficit Disorder (ADD).

Solanesol: A bench-scale technology was developed for recovery of solanesol 95+%. The collaborative programme with Central Drug Research Institute, Lucknow has established the possibility of synthesizing new bioactive compounds, starting from solanesol, which could lead to new drug development. There is considerable interest among the entrepreneurs in the technology and after obtaining the patent, the technology will be transferred as per ICAR guidelines. Patent application is being filed for "Process for purification of solanesol (95+%) from crude/enriched extracts of tobacco green leaf/cured leaf/tobacco waste".

Solanesol has been a starting material for synthesis of Vitamin K2 (anthemorrhagic vitamin), Vitamin E (anti-sterility vitamin) and Coenzyme Q10 (physiologically active substance with high pharmaceutical activity against cardiac insufficiency, muscular dystrophy, anemia etc.). As per the latest findings in the literature, Japanese scientists have used the solanesol derivative, Nsolanesyl-N, N1-bis (3,4-dimethoxy benzyl) ethylenediamine for potentiation of anti-tumor drugs. CTRI will be conducting research in collaboration with Central Drug Research Institute, Lucknow under the project “Synthesis and biological evaluation of solanesol derivatives as novel bioactive substances” The project sanctioned by the Indian Council of Agricultural Research (ICAR), New Delhi, with an outlay of Rs.27.08 lakhs will undertake testing of solanesol derivatives for hypolipidaemic, anti-tubercular, wound healing and anti-oxidant activities.

Organic acids: Crude organic acid fraction containing malic acid and citric acid obtained as an effluent in the nicotine recovery process was found to be effective in solubilising Rock phosphate. Apart from utilization of tobacco waste, the possibility of growing tobacco for recovery of phytochemicals is also being explored at CTRI. It is estimated from this study that 380 kg of crude protein, 97 kg of 40% nicotine sulphate, 18 kg of 95+% solanesol and 56 kg of seed oil could be recovered from the crop grown in area of one hectare. If tobacco is to be exclusively grown for alternative uses (extraction of chemicals) farming practices are to be modified to optimize the levels of the chemicals and CTRI has already initiated work in this direction. Generally, flue-cured Virginia (FCV) tobacco is a better source for extraction of solanesol and air-cured tobaccos like bidi, natu & chewing are ideal for recovery of nicotine and organic acids. It has been identified that chewing tobacco variety ‘Abhirami’ and HDBRG tobacco are good sources for both nicotine and solanesol. Nicotine sulphate (40%) and solanesol (95+%) have good export potential. Hence, to exploit the immense economic potential, evolving proper marketing systems for the chemicals and their value added products is essential to sustain tobacco production. The seed oil content in tobacco seed estimated to vary from 35-39%. Nutritional quality of tobacco seed oil, free from nicotine, is found to be better than groundnut, mustard and cotton seed oils, on par with sunflower seed oil which is being considered as best for heart patients. The potential of tobacco as an oil seed crop is firmly established with the possibility of production of 1171 kg/ha seed

with a recovery potential of 433 kg/ha oil from a chewing tobacco crop (Var. A-145) with modified agro techniques.

Integrated Barn

In case of FCV tobacco, 30% of cost of cultivation goes for curing of tobacco. To minimize curing costs several efforts were made for energy conservation. To evaluate the combined efficacy of different energy saving techniques, an “Integrated barn” was designed with low profile barn + ventury furnace + ceiling insulation with paddy straw + modified flue system and tested at CTRI Research Station, Hunsur during 2001 season. The mean fuel use from seven curing tests was 2.43 kg wood per kg cured leaf, giving a fuel saving of about 51% over the absolute control barn of 16’ x 16’ x 16’ size (without any energy saving modifications). The significant decrease in wood fuel use in this model integrated barn is due to the combined effects of efficient burning of wood fuel, minimization of heat loss, retention of heat generated for longer time and better heat transfer inside the barn. The integrated barn, with its high energy saving potential, can drastically minimize the fuel requirement for flue curing of tobacco in the states of Karnataka and A.P., the major FCV tobacco producers of the country. Without altering the size of their barns, the small and marginal farmers can easily adopt ventury furnace, modified flue system and ceiling insulation at a combined investment of Rs.9,500 to Rs.11,000/- per barn depending on size, and can recover this cost in 10 to 12 curings, spread over two seasons. In addition to the monetary benefits, integration of energy saving modifications will also reduce the total fuel requirement for flue curing. Popularization of the energy efficient barn coupled with the alternative fuels like coffee husk, briquettes, coconut halves and other agricultural waste will significantly reduce the consumption of wood for curing of FCV tobacco.

Banana Fibre Extractor:

The Krishi Vigyan Kendra of Central Tobacco Research Institute has designed and developed a machine called “Banana Fibre Extractor” for extraction of fibre from pseudo stems, leaf stalks and peduncle of banana. The machine is first of its own kind in this field, developed for the commercial exploitation of unutilized banana waste. The

machine consists of a rigid frame on which the roller rotates. The roller consists of horizontal bars with blunt edges. The roller is connected to one HP motor by belt pulley mechanism. The machine is driven by one HP single phase electric motor (220 v). Adjustable guiding rollers are fitted for feeding purpose. Safety precautions like pulley guards are incorporated in the machine. The machine reduces drudgery and increases the fibre production fifty times compared to manual process. It is user friendly and economical with less maintenance cost and safe to operate. Superior quality fibre in terms of length, softness, strength and colour, can be obtained with this machine. The machine helps banana cultivators to get additional income through economic utilization of the hitherto unutilized portions such as pseudo stems, peduncle and leaf stalk. An additional income of Rs 2500/ acre is assured to the banana cultivators. There is heavy demand for this machine from different parts of the Country. The manufacturing rights were given to AP Agro Industries Corporation, Hyderabad. In the current World Scenario, the banana fibre is being extensively used as a blending material in textile industry in countries like Philippines, Malaysia, Manila, Japan and Korea. Being a natural fibre it easily blends with other fibres such as Jute and Mestha. Therefore industrial products like gunny bags, door mats, carpets, yarn, rope, geo textiles, travelites, luggage carriers and interior decorative items can be made out of this fibre. The USA being the main importer of banana fibre, the export of fibre will earn considerable foreign exchange to our country.

Palmyrah Fibre Separator:

The extraction of fibre from the fronds is one of the important rural and tribal cottage industries in the coastal districts of Andhra Pradesh, Tamilnadu and parts of Kerala. Palmyrah fibre is the product obtained from the fronds (leaf bases) of Palmyrah trees. More than 30,000 families belonging to scheduled castes and tribes community are depending on this fibre industry for their livelihood. Our country is earning more than 100 crores of foreign exchange every year through this rural cottage industry. Traditionally fibre separation is a very tedious and cumbersome process, which includes heavy drudgery. A family comprising of 4 to 5 members can hardly produce 5 to 6kg of fibre per day earning about Rs.50/- to 60/- only. The rural and tribal poor who are the main pillars of this industry are hardly earning for their livelihood. The heavy drudgery

causes ill effects to the rural and tribal poor. The bodies of the children get deformed at chest and shoulders level. The middleaged men get chest pains, arthritis, respiratory disorders etc. An in depth survey in this particular industry was conducted by this Kendra and found that introduction of suitable technology and mechanization is a must to reduce the drudgery and to make the profession much more attractive by improving per day income and healthy aspects.

Mechanization was introduced for the first time in the History of Palmyrah Fibre Industry by this Kendra, a machine PALMYRAH FIBRE SEPARATOR and a combing device was designed and developed in the year 1997 and 1998 respectively. The enthusiasm of the rural and tribal people especially from tribal women towards mechanization of this trade is very much encouraging. Taking the advantages of both the machines made earlier finally a machine called New Palmyrah Fibre Separator was designed and developed by this Kendra as per the desire of the Tribal and rural women. The women groups in the rural and tribal areas received these latest machines under IFAD project with 75% subsidy through ITDA. Presently these women groups are producing 50 to 60 kg fibre per day and earning Rs.500 to Rs.900 of net income per day. Further they are also processing the fronds of others those who have not received the facility by charging @ Rs.3/- per kg fibre.

The Government and Non-Government organizations like DRDA, ITDA, Forest departments and Voluntary organizations involved in rural and tribal development activities supplied these machines to the needy people with 50 to 75% subsidy. Presently more than 250 machines were in operation in East and West Godavari districts of A.P. This machine brought a revolutionary change in the lives of rural and tribal poor who are depending in this field of palmyrah fibre for their livelihood. On its initial success in the Andhra Pradesh, the machine is now becoming popular in the coastal belt of Tamil Nadu and Kerala.

Revolving Fund Scheme on Tobacco Seed and Seedling

Introduction

Tobacco is an important commercial crop cultivated in 0.4 million ha producing 700 million kilos of leaf annually. As in other crops, raising uniform crop is essential to obtain higher yields and superior quality tobacco. Use of pure seed of recommended varieties can easily ensure high yields and quality. Keeping this in view, Central Tobacco Research Institute (CTRI), Rajahmundry has started producing and distributing the pure seed of approved tobacco varieties to the farmers since 1952. In view of the purity and quality of the seed produced by CTRI, the demand for tobacco seed supplied by CTRI has



steadily increased over the years. Mean while, in 1956, a scheme was sanctioned to CTRI during the 2nd five-year plan for the production and distribution of pure seed and healthy seedlings of tobacco to farmers. The scheme was continued in 3rd five-year plan also as a committed expenditure scheme under developmental activity and later it was merged with the Institute's main programme from April, 1978 on wards.

Origin of Revolving Fund Scheme

In view of popularity and efficiency of the seed production programme of CTRI, the Indian Council of Agricultural Research, in 1990, has sanctioned a “Revolving Fund Scheme” (RF Scheme) to CTRI with the objective of supplying pure seed and healthy

seedlings of approved tobacco varieties to growers to improve the yield and quality of flue-cured tobacco.

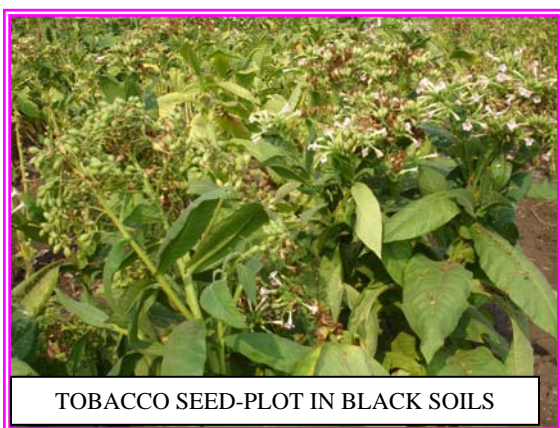
CTRI has created the Seed Production Section for efficient running of the RF scheme. Under regular supervision of the Director, CTRI and Seed Production Officer of the Section, a dedicated team of scientific / technical staff are working for the production and supply of pure seed to the farmers.

RF Scheme: A Model for Emulation

Usually, nearly 18,000 to 20,000 kg of FCV tobacco seed and 400-600 kg of Lanka tobacco seed (Non-FCV) are produced and distributed to the tobacco growers in Andhra Pradesh. CTRI adopts a novel methodology for the production of this huge quantity of pure seed. Every year, Seed Production Section raises tobacco nursery in an area of 2.25 ha and supply the healthy seedlings @ 30,000/ha to 130-150 seed plot growers of East Godavari and West Godavari district of A.P. Further, seedlings are also supplied to gap fillings, if necessary, in order to optimize the plant stand for achieving higher seed yields. Progressive farmers are chosen to raise the seed plots to maintain seed purity. In general seed plots are selected on the basis of their nearness to the Institute, willingness of the farmers and suitability of the variety to the region. The seed plot farmers are given a subsidy of Rs. 500/ha besides free supply of seedlings for planting and gap filling.

Seed-Plot Maintenance and Seed Collection

The seed-plots are planted directly under the supervision of the Seed Production Section staff. Adequate isolation distance (3.0 m) is maintained while planting seed plots. In general, 200-225 ha of seed plots are raised in East Godavari and West



Godavari districts. The plots are regularly monitored by the plant breeders and necessary instructions are given to the farmers for raising the healthy crop. The plots are regularly rogued to remove the off-types once at the grand growth

stage and the second at the flowering stage to avoid varietal contamination. As the leaf is the commercial product, the farmers harvest and market the leaf and get the price for their leaf



produce. At the end of the season, CTIRI staff collects the seed capsules and bring them to the main Institute. These capsules are dried, in the hot summer sun. Threshed and winnowed to remove debris. The seed are later thoroughly dried to maintain seed moisture level below 4.0%, treated with insecticide and packed into half kg polythene sachets. Germination tests are conducted at regular intervals and only the tobacco seeds having more than 90% germination are sold to the farmers.

Scope of RF Scheme



Under the 'Revolving Fund Scheme', the institute produces seeds of recommended FCV and Lanka tobaccos varieties. The quantity of seed production depends on the demand of the individual variety. During the 2007-08, FCV varieties, 'Siri, Hema and VT 1158' are having very good demand. Non-FCV variety 'Lanka Special' seed production and distribution is more or less stable as the lanka tobacco is cultivated in a limited area. Though the 'RF Scheme' was initially started with Rs 3,00,000/- in 1990, receipts of the RF scheme are Rs. 75,00,000/- during 2007. This phenomenal achievement is the testimony for the dedicated and relent less efforts of CTRI in the seed production arena.



Advantages of RF Scheme

As the seed plot farmers are not losing the economic product, farmers coming forward to take up seed plots. In view of this, our cost of seed production is very low as compared to other FCV tobacco producing countries in the world. At this juncture it is worthwhile to mention that the cost of one kilogram of FCV tobacco seed in Brazil is \$3,000/- while we sell at \$10 per kilogram of seed to our farmers. Further, tobacco

seed is not covered in the Seed Act. Hence, CTRI produces foundation seed and distributes the same to the growers. As private companies are not involved in the seed market, CTRI takes up the responsibility of supplying the pure seed to the farmers. In any given season, more than 90% of the tobacco crop area is planted with the tobacco seed supplied by CTRI particularly in Andhra Pradesh.

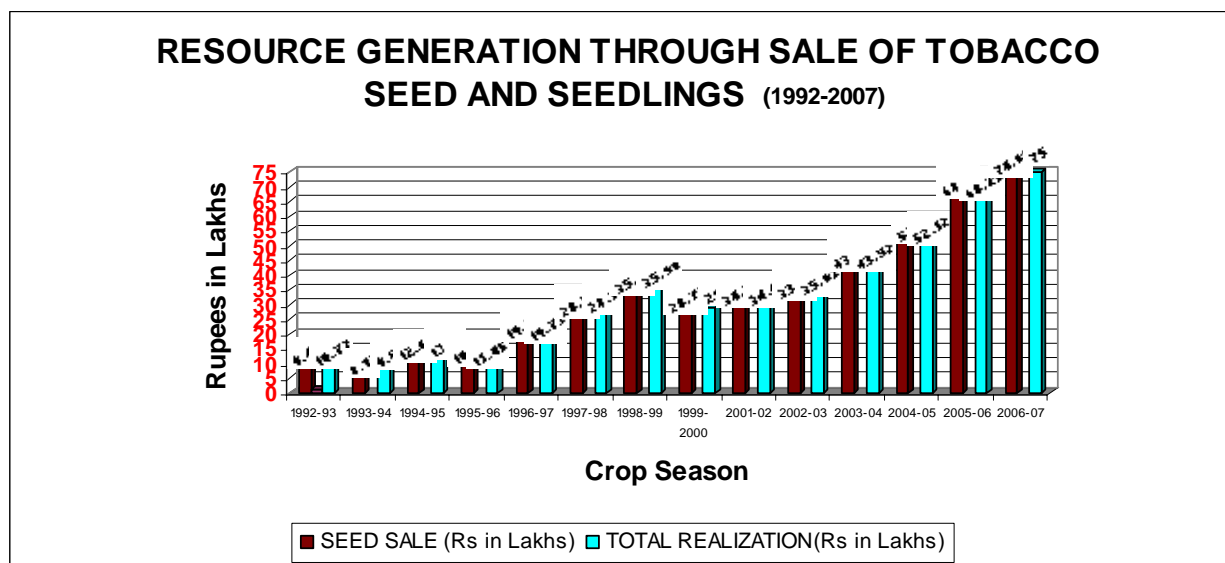
The service rendered by the Institute, to the farming community in seed production aspects is paying richer dividends in terms of uniform crop growth and higher leaf yields. The tobacco farmers are also appreciative of the contribution of CTRI in the production of quality tobacco seed and seedlings.

Trends in seed production since 1990:

Year	Seed plot area (ha)	Seed production in Kg	Nursery area in ha	Seedlings production	Seed sales Rs.	Seedlings sales Rs.	Total Rs.
1990-91	182.16	19,850	-	-	-	-	1028037
1991-92	-	11,322	-	1,18,84,000	-	-	-
1992-93	217.98	17,562	2.29	1,45,39,500	9,44,565	1,33,155	10,77,720
1993-94	147.95	27,201	2.00	99,36,700	8,13,070	1,54,765	9,67,835
1994-95	127.92	19825	2.00	68,65,000	12,63,539	37,870	13,01,409
1995-96	219.78	5445	2.20	96,56,000	10,78,555	66,480	11,45,035
1996-97	226.7	16689	2.2	96,84,000	19,38,642	34,750	19,73,390
1997-98	218.60	19,781	2.20	97,68,000	28,53,500	17,610	28,71,111
1998-99	232.40	38,261	2.20	92,29,000	35,62,933	37,060	35,99,993
1999-00	226.60	15,981	2.42	82,23,000	28,77,514	23,050	29,00,564
2000-01	Crop Holiday in Andhra Pradesh and hence, no seed production						
2001-02	239.4	30,250	2.35	87,99,000	34,33,000	28,039	34,61,039
2002-03	180.0	15,507	2.00	70,69,000	33,94,540	1,09,000	35,03,540
2003-04	185.0	16,000	2.00	50,00,000	43,19,847	32,780	43,52,627

2004-05	191.0	18,507	2.00	60,27,000	52,00,000	12,500	52,12,500
2005-06	149.0	18,800	2.00	67,10,000	68,17,274	8,000	68,25,724
2006-07	195.0	20,000	3.0	78,76,500	74,85,500*	14,200	75,00,000*

*: Estimated, seed sale is in progress



SIRI

Siri", a high yielding and superior quality Flue-Cured Virginia (FCV) tobacco variety was released by the Central Tobacco Research Institute (CTRI), Rajahmundry for cultivation in the rainfed Vertisols of Andhra Pradesh during 2006-07 crop season, which performed very well under farmers field conditions in Black soils of Andhra Pradesh with an average yield of 3000 kg/ha-an yield of 1000 kg higher than the existing cultivars in Black soils. It is estimated that an additional production of 10 million kilos was obtained during 2006-07 season due to the cultivation of this variety. Trade, farmers and Tobacco Board have impressed with the performance of Siri cultivar under field conditions. During 2007-08 season, the demand for Siri seed was unusually high. During 2007-08 season, this variety is expected to occupy 30,000 ha out of 40,000 ha of Black soil in Andhra Pradesh.

MEENAKSHI (CR)

A caterpillar resistant chewing tobacco variety Meenakshi (CR) was released during 2007-08 for cultivation in the Inland chewing tobacco tract, i.e. Southern, Central & Western chewing tobacco zones of Tamil Nadu under irrigated conditions. It has an yield potential of around 3500 kg/ha with added resistance to *Spodoptera litura*.

ALTERNATIVE CROPS TO TOBACCO

Intensive research work has been carried out to identify the remunerative alternative crops to tobacco. None of the alternative crops tested under mono cropping system are as remunerative as tobacco in almost all tobacco growing areas. Some of the alternative crops identified are maize and sugar cane in Northern light and Black soils of Andhra Pradesh; red gram and maize in Central Black soils; Black/green gram and sunflower in Southern Black and light soils; cotton and maize and ragi in Karnataka light soils; turmeric and sugarcane and sunflower in chewing tobacco areas of Tamil Nadu; potato, garlic mustard in Bihar; Aman rice, aus rice and mustard in West Bengal; mustard, ground nut and chilies in Gujarat; potato, wheat and bhendi in Uttar Pradesh and Chickpea, sunflower and jowar in Natu and Bidi tobacco areas of Andhra Pradesh.

CROPPING SYSTEMS ALTERNATIVE TO TOBACCO

Inter cropping trials and cropping sequence studies have clearly indicated that net returns accrued by growing two or more crops are higher than the returns obtained from sole crop of tobacco. Remunerative cropping systems to tobacco are given below.

Type of tobacco and zone	Remunerative cropping systems
FCV tobacco – Northern Light Soils (NLS)	Redgram+groundnutgreengram/ summer vegetables or Groundnut + Maize –Greengram
FCV tobacco – Northern Black Soils (NBS)	Rainfed agro-eco system: Maize- Bengalgram Irrigated agro-eco system: Sugarcane (Mono crop)
FCV tobacco – Central Black Soils (CBS)	Soybean + Redgram or Maize -

	Redgram
FCV tobacco – Southern Black Soils (SBS)	Fallow-Bengalgram or Jowar-Mustard
FCV tobacco – Southern Light Soils (SLS)	Groundnut - Redgram
FCV tobacco – Karnataka Light Soils (KLS)	Cotton – Ragi or Cotton + Soybean or Chillies
Chewing tobacco – Tamil Nadu	Onion – Annual Moringa or Chillies – Annual Moringa
Chewing tobacco – Bihar	Maize - Potato or Potato + Garlic
Chewing tobacco – West Bengal	Jute - Aman paddy – Potato or Jute - Aman paddy – Mustard
Bidi tobacco – Gujarat	Cotton–Groundnut or Castor- roundnut (Summer)
Chewing and Hookah tobacco – Uttar Pradesh	Maize - Potato