FIELD RESEARCH REPORT

REJUVENATION PRUNING - A PATH-BREAKING TECHNOLOGY FOR CONSOLIDATION OF DEBILE TEA IN SOUTH INDIA

*** V.S. SHARMA** AND ****B.CHANDRA MOULI**.

ABSTRACT

The technology of "Rejuvenation pruning"of unthrifty Tea was conceptualized and developed in south India during the late 1960s and early 1970s. Rejuvenation pruning stimulates the development and growth of a new, strong and healthy primary frame, supporting good secondary branch systems and higher productivity for a prolonged period. Wide acceptability and success of this concept obviated the need for uprooting and replanting of old tea in south India , to a great extent.

Rejuvenation pruning facilitates infilling the vacant patches that arose due to the death of old bushes owing to various causes over the decades; it also makes possible putting out a new plant between the old bushes existing at the original wide spacing, leading to a doubling of the population.

The benefit by way of increased yield due to rejuvenation ensues from the third year from pruning and that due to infilling and interplanting from the fourth year from planting. The break-even of the expenses and crop loss could be achieved by about six years.

Keywords: Rejuvenation pruning, infilling, inter-planting, consolidation.

1. INTRODUCTION

Most of the 'Tea' in south India, having been planted in the early 1900s,is 100 years or so. The original populations ranged from 5000 bushes per hectare upwards. But, over the decades the plant populations dwindled due to pests, diseases and periodic severe droughts; the average vacancy in tea fields across south India could be placed approximately at 20 per cent. However, tea fields with the surviving populations do continue to respond to increased inputs and improved field technologies despite the age and declined numbers of the bushes.

**** V.S.SHARMA***

*The B.B.T.C.Ltd. Mudis P.O. 642 117, Coimbatore District, India (Formerly Director, UPASI TRI, Valparai 642 127, Coimbatore District, India.)
E-mail: jyosharv@yahoo.com

*****B.CHANDRA MOULI.***

**Advisor & Consultant-Tea, "Pragathi", 35(456), Varma Layout, 8th Cross, Bhuvaneswari Nagar, Hebbal, H.A.Farm PO.Bangalore 560 024,India (Formerly Head, Plant Pathology Division,UPASI Tea Research Institute, Valparai 642127, Coimbatore District, India)

In certain cases, however, the bush frames particularly the primary branches have become knotted and channelled with canker and wood-rot caused by *Hypoxylon serpens* (Pers.)Kickx and *H.nummularium* Bull. invading the bark that was scorched because of the earlier pruning into dry weather; in extreme cases the damage has extended to the bole. Fields with such cankered bush frames respond to neither enhanced inputs nor improved cultural practices; yields of such fields not only stagnate but start dropping in due course (Ranganathan and Chandra Mouli, 1984; Chandra Mouli and Sharma, 1993).

Uprooting and replanting of tea fields in south India is beset with problems of serious concern: tea is planted in south India on hill-slopes with gradients ranging between 16 and 35 per cent; as such, the fields on uprooting, are highly vulnerable to enormous soil erosion leading to

further decline of its organic matter status and Cation Exchange Capacity (CEC). The prolonged droughts extending from 90 to 120 days (up to 150 days in Karnataka) jointly, with poor soils make the task of establishment of replanted tea fields doubly difficult, if not impossible. Additionally, the profit margins on tea being very narrow, the break-even for replanting may extend up to 16 years or more. As a whole, uprooting and replanting in south India, particularly in the present scenario is not an attractive proposition, despite the subsidy from the Tea Board of India.

REJUVENATION PRUNING

'Rejuvenation pruning', a technology to repair the damage that occurred to the bushes over the years was developed in south India to consolidate poor fields (Venkataramani and Venkata Ram 1968;Venkata Ram, 1974; 1976). It involves the removal of all the dead and dying tissue by severe surgery into healthy wood of the primary frame, as hard and as low as is necessary; in certain cases it could go even to the collar of the bush (Fig.1). Tea bushes in south India withstand such severe and hard prune because of their strong and thick root system growing often, six meters or deeper into the soil. Such an operation stimulates regeneration and development of a new, strong and healthy primary bush frame that supports further branch system, which in turn, sustains higher productivity for a prolonged period.

Fig.1a : Rejuvenation pruning ;

Fig.1b : Infilling

A survey of tea fields in south India revealed that about 31,250 hectares, with debilitated bush frames need and will be benefited by rejuvenation pruning (UPASI, 2007: personal communication)

ASSESSMENT OF CANKER

Two to three blocks of hundred bushes (ten rows/ ten bushes) each per hectare may be marked at different gradients and aspects of a field and mapped: mark 'v' (vacancy) at the places where bushes are missing and 'b' to ear-mark a bush with bole canker; the number of primary branches on a bush and number of those cankered may be expressed as number of cankered branches /number of primary branches (=n/d) occurring in a bush (Fig.2). The data thus collected may be used to arrive at the per cent canker in the field. Rejuvenation pruning of a field with 50 per cent or more cankered branches proves economically viable (Chandra Mouli and Sharma, 1993).

Tea Board of India stipulates that rejuvenation pruning should be carried out at a height of 30 cm in the case of "Assam" and "Assam" hybrid jats and 20 cm in "China" hybrid for which subsidy is given; it may be stated here that "Assam" jat responds to rejuvenation better than " China".

Ten Rows	2/6	b	3/4	0/5	0/5	V	4/4	b	3/7	2/5	14/36 b2 v1
	4/6	2/5	2/6	4/6	4/7	3/7	2/5	1/7	3/6	3/7	28/62 b0 v0
	2/5	1/6	2/5	1/6	b	1/5	2/5	V	b	1/7	10/39 b2 v1
	2/4	V	2/5	1/4	1/5	3/7	3/4	V	3/5	2/5	17/39 b0 v2
	2/5	3/6	1/5	3/4	V	¼	1/5	5/6	b	2/4	18/39 b1 v1
	2/5	2/4	3/6	1/4	V	2/3	2/4	3/5	5/6	2/4	22/41 b0 v1
	1/4	1/6	3/6	2/5	2/6	¾	V	3/5	4/6	2/5	21/47 b0 v1
	2/5	3/4	1/4	b	1/5	2/5	3/5	3/7	2/5	3/5	20/45 b1 v0
	1/4	2/4	3/4	2/5	V	2/4	V	1/4	V	1/5	12/30 b0 v3
	2/6	2/5	V	4/7	4/5	V	3/6	b	2/6	1/6	18/41 b1 v2
	Ten Bushes										

Fig. 2. Assessment of canker on primary frames: b = bole canker; v = vacancy; numerator = number of cankered branches; denominator = number of branches in a bush; % cankered branches = 42.75; % vacancy = 12; % bole canker = 7

After Chandra Mouli and Sharma, 1993

INFILLING AND INTERPLANTING

Low prune facilitates infilling the vacancies that arose over decades. Infilling is carried out by putting out the new plants 90 cm away from the existing old bushes on either side of the vacancy (vacancies) in a tea row, with a spacing of 60 cm between them; it leads to plural supply of new plants at the rate of '2N', where N is the number of vacancies (Fig. 3). Rejuvenation pruning also facilitates introducing a new plant in between the old bushes existing at the original spacing leading to doubling of the bush population (Fig 3) 50 per cent or more of which comprises improved plant material such as clones, nursery grafts and/or biclonal seed-stock. Infilling the vacancies and / or doubling the population by interplanting are the sure means of enhancing the productivity. Infilling vacancies ranging between ten and 25 percent was reported to increase the yield up to 15 per cent (Sharma, 1975). The entire operation of consolidation by rejuvenation pruning, infilling and interplanting is subsidized by the Tea Board of India.

Centering of the "infills" and "inter-plants" may be carried out during late-Oct /early- November or the following April/May depending upon the merits of the plants. The single "infills" and" "inter-plants" may be centered at 25 cm from ground ensuring that a minimum of ten healthy leaves are left behind on the plant; lateral branches growing beyond may be tipped at 30 to 35 cm. Plucking table may be established at 50 to 55 cm or at the same height as that of the neighboring rejuvenated bushes. Young plants in block–infilling may be given two-stage (two–tier) tipping (Satyanarayana and Sharma 1991; Sharma et al., 1990).

CARBOHYDRATE STATUS AND RECOVERY FROM REJUVENATION

Recovery from such a severe operation as rejuvenation pruning depends largely on the carbohydrate reserves in roots and stem-bark; the reserves fluctuate with the seasons and growth phase of the bushes. Critical investigation (Sharma et al., 1990) indicated that total carbohydrate reserves in roots should be around 18.5 per cent for an early and satisfactory recovery from rejuvenation. The results of the above studies further indicated the months of August and May, in that order, as being ideal to carry out rejuvenation pruning in south India; at mid-elevations receiving heavy south-west monsoon, August should be the preferred month (Ranganathan and Chandra Mouli, 1984).

Carbohydrate reserves in the roots reach the desired levels by resting the bushes from four to six weeks prior to rejuvenation (Sharma et al., 1990).

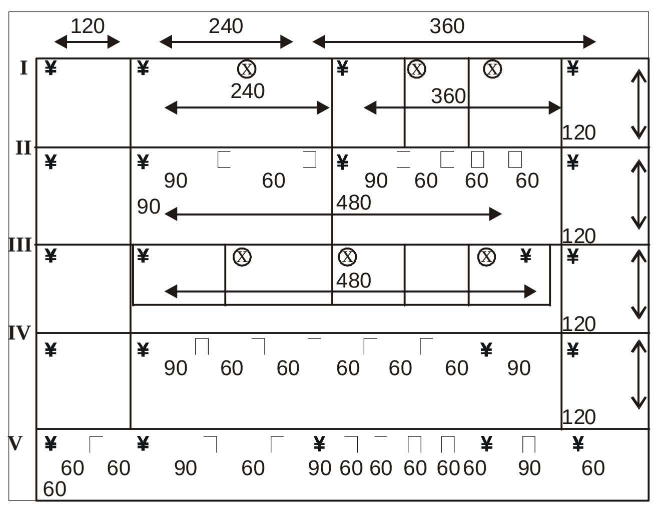

Fig. 3. A field showing vacancies, their plural supply and inter-planting; original plant

spacing: 120 X 120 cm square; ¥ : existing bush; ⊗ : vacancy; □ : infill; □: new inter- plant (all figures in centimeters)

I. Single and double vacancies in a tea row
II. Infilling single and double vacancies
III. Three vacancies in a tea row
IV. Infilling of three vacancies
V. A tea row following infilling and inter-planting

BUSH SANITATION AND POST-PRUNE CARE

1. Large pruning cuts should be covered by wound dressing compound prepared by mixing one part each of copper oxychloride-50% and linseed oil by weight; similar preparation with wettable Sulphur -80% in linseed oil was also found to be effective and economic (Ranganathan and Chandra Mouli, 1984).

2. Channels and hollows formed on frames by *Hypoxylon serpens* should be cleaned thoroughly and filled with a mixture of molten tar and fine sand at one part to nine parts,respectively.

3. Bush frames should be given a lime wash to remove moss: a thick suspension of one kilogram of micronised shell-lime in ten litres of water may be prepared for the purpose and applied either with a hand-brush or diluted and sprayed through a sprayer; 1100 litres of the suspension will be required to cover one hectare through a motorized mist blower (Venkata Ram, 1974).

4. Effective control of blister blight (*Exobasidium vexans* Massee*)* leaf disease is of paramount importance because of the occurrence of an abundance of vulnerable tender shoots on the bushes recovering from rejuvenation. Currently, the fungicidal combination ,hexaconazole at 200 ml and copper oxychloride-50% at 210g per hectare is claimed to give effective, economic control of the disease; propiconazole at 125ml may be used in the place of hexaconazole, but it is more expensive. The spraying rounds should be spaced at three to five days in the initial months. Motorized mist-blowers fitted with number II nozzle covering two rows on either side or knapsack sprayers fitted with NMD nozzle covering one row on either side could be used for spraying ; spray fluid of 90 to 120 litres per hectare with the former and 175 to 250 litres per hectare in the case of the latter will be required for effective coverage (Victor Illango, 2007).

5. Secondary pests such as thrips, aphids, leaf-roller, flush-worm and other cater-pillar pests that attack tender shoots should be controlled effectively with appropriate pesticides. Mid-cycle application of an effective approved pesticide such as lambda cyhalothrin against shot-hole borer is imperative, around 18 months following rejuvenation pruning, in the fields with a history of shot-hole borer.

MANURING

Large quantity of wood that develops during the formation of the new primary frame and secondary branch system throwing up a profusion of foliage need large quantities of nutrients, particularly N and K_2O; in view of higher demand on K_2O, the ratio of N:K_2O should be maintained at 1:2 in the 12 months from pruning, with a minimum of 160 kg N per hectare, irrespective of the anticipated yield; N:K_2O ratio may be altered to 2:3 in the second and third year and to 1:1, thereafter. P_2O_5 may be applied at 80 kg per hectare in the year of rejuvenation and during the third year of the cycle. Manuring should be completed seven to ten days before the northeast monsoon is expected to tail off to avoid salt concentration in the soil and damage thereof to the infills during the ensuing drought.

TIPPING

Field investigations established (Satyanarayana *et.al*. 1995) that two-tier (two-stage) tipping of the rejuvenated bushes, first at 50 cm from ground followed by the second at 65 cm, facilitates the formation of a compact bush with well filled-in branch systems; such bushes lend themselves satisfactorily to a cut-across at 70 cm or higher at the end of the rejuvenation cycle of five years at mid-elevations and six years at high altitudes.

POSSIBLE YIELD TRENDS AND ECONOMICS

Crop loss is inevitable in the year of rejuvenation pruning because of the delayed recovery from the hard prune and the consequent delay in tipping; the losses may continue even into the second year if the plant protection measures are indifferent. However, the total crop harvested for the entire rejuvenation cycle, as also the mean per each corresponding year will be higher when compared to those that were obtained during the previous cycles (Table 1) (Ranganathan and Chandra Mouli, 1984).

Table 1. Yield trend in rejuvenated field (with infilling only) in comparison to that without rejuvenation pruning

Year	Yield in kg per ha	
	Not rejuvenated	Rejuvenated
1990	1900 (pruned)	1063 (Rejuvenated)
1991	2650	2574
1992	3000	4069
1993	3300	4300
1994	1800 (pruned)	5200
1995	2500	2900 (pruned)
1996	2900	4600
1997	3200	5500
Mean	2656	3775

(Source: Tyagi, 1993)

Note: Mean of eight years is projected in the table because the rejuvenation cycle is extended by a year over the normal cycle of four years. The benefit due to rejuvenation pruning by way of enhanced yield is experienced from the third year following the prune and that due to infilling and interplanting from the fourth year from planting (Tyagi, 1993). The break-even period for the expenses on various operations and the financial loss caused by the crop loss in the initial years of the cycle is reported to extend up to six years, depending upon the severity of rejuvenation, crop loss, the magnitude of infilling, interplanting and the tea prices. The subsidy from the Tea Board of India eases the burden on the grower to some extent by condensing the period of break-even(Ranganathan and Chandra Mouli, 1984).

CONCLUSION

Salient points emerging from the overview of the entire gamut of operations leading to rejuvenation pruning are summarized here:

1. Fields yielding less than the estate average should be chosen for rejuvenation pruning
2. It is advantageous to rejuvenate fields wherein the canker on the primary frame exceeds 50 per cent.
3. “Assam” jat responds better than “China” jat
4. It is desirable to rest the bushes for four to six weeks prior to rejuvenation.
5. The ideal periods for rejuvenation pruning are August and May
6. Fill the channels and hollows formed by *Hypoxylon* sp. on the primary frame with a mixture of tar and fine sand at the ratio of 1:9
7. Higher levels of K_2O in relation to N should be applied all through the rejuvenation cycle
8. Bushes recovering from rejuvenation may be given two-tier (two-stage) tipping
9. The infills and inter-plants may be protected from radiation damage through drought by topical application of kaolin; they may be given sub-soil irrigation at the desired level and intervals to tide over long droughts of south India
10. The first prune following rejuvenation cycle should be at 70 cm from ground.

ACKNOWLEDGEMENTS

The authors wish to record their appreciation and admiration of the pioneering efforts of Dr. K.S.Venkataramani and late C.S.Venkata Ram in innovating and developing the concept of rejuvenation pruning of Tea and making it popular in south India ; they wish to dedicate this paper to them for their untiring pusuit of 'Tea Science' and establishing tea cultivation in south India on a firm, unassailable scientific basis. They thank Mr. Ebenezer Raj for developing the computer graphics.

REFERENCES

Chandra Mouli, B. and Sharma, V.S. (1993) Rejuvenation pruning - recent developments. UPASI Tea Sci.Dep. Bull 46 : 22-25

Ranganathan, V. and Chandra Mouli, B. (1984). Principles of rejuvenation pruning. UPASI Tea Sci.Dep. Bull. 39 : 41-43

Satyanarayana, N. and Sharma, V.S. (1991) Training of young tea by two-stage tipping. UPASI Tea.Sci. Dep. Bull. 44 : 59-60

Satyanarayana, N., Spurgeon Cox and Sharma, S. (1995) Two-stage tipping of rejuvenated tea. UPASI Newsletter -4 (2) : 3-4.

Sharma, P.C. (1975) Two and A Bud. 22 : 89

Sharma, V.S., Murthy, R.S.R. and Joseph, C.P.D. (1990) Period of rest prior to rejuvenation pruning. UPASI Handbook of Tea Culture, Section 8, pp 4.

Sharma, V.S., Satyanarayana, N. and Spurgeon Cox (1990) Training of young tea by two-stage tipping. J. Plant. Crops 20:45-49.

Venkata Ram, C.S. (1974) Pruning for rejuvenation. Planters' Chron. 69 : 279-282.

Venkata Ram, C.S. (1976) Rejuvenation of unthrifty tea. Warta BPTK 2 : 133-140.

Venkataramani, K.S. and Venkata Ram, C.S.(1968) Rejuvenation Pruning. Planters'. Chron. 63:156-157

Victor, J. Ilango (2007) Rejuvenation pruning and replanting of tea in south India. Planters' Chron. 103 (4&5): 6-12.