

Pruning: An Indispensable Operation in Tea Culture (*Camellia L. Spp.*)

V. Ranganathan

Author's Affiliation: IMT Technologies Ltd., Pune-4, Maharashtra.

Abstract

The general understanding of pruning in the various branches of Agriculture and its role in Tea growing for commercial purposes are reviewed. The objectives of pruning vary from crop to crop. Tea is basically a tree growing to a height of 20 to 30 feet and the periodical correction of its height by cutting branches to a specified intensity is indispensable to maintain the height of plucking table for efficient crop removal for economically viable and sustainable productivity.

Keywords

Pruning, Objectives and Practices.

Introduction

The traditional meaning and objectives of pruning and its varied applications in different crops are synopsized (Table 1).

Table 1: Traditional usage of the term Pruning

Synonyms	Shorten, reduce, cut down, Clip, Pollard, Lop, Hack, epitomize, abbreviate, curtail, abridge, concise, Elise, contract, retrench
Objectives	It is defined as the removal of vegetative parts with a definite objectives: a) Correct-Height; b) Restore- Juvenility; c) Repair- unwanted and moribund branches; d) Renew, Refresh-Foliage; e) Revise-vegetative cycle; f) Refit, Mend-direct the growth pattern; g) Recuperate, Rejuvenate, Revitalize - restoring juvenility and health. For other parts
Pruning Terms	The traditional usages of Pruning terms in different crops are listed below. a) Coffee- Cleaning; Desuckering b) Tea- i) centering, ii) skiffing, iii) breaking back, iv) lane cutting, v) cut-across, vi) pollarding and lopping shade trees; vii) Shearing- Plucking with hand or mechanical shears c) Cardamom- i) Dressing, ii) Thrashing; d) Forestry- i) coppicing, ii) lopping, iii) fire line cutting; e) Fences-Shearing; f) Sugarcane- Thrashing; g) Rose-pruning to activate flower bud initiation;

Pruning in Tea- Objective

Pruning in tea is done mainly to keep the height of plucking table at a manageable level for hand plucking, hand shears or mechanical shears. Every year the height of plucking table increases naturally and also by allowing a raise in crop advertingly by adding new foliage to sustain the photosynthetic yield for supporting new growth. Therefore it requires

periodic pruning to maintain the height between reasonable limits for efficient harvesting. Pruning is also utilized to remove moribund and cankered wood and also to replenish juvenility in tea shoots for

Corresponding Author: V. Ranganathan, Retired Scientist, Block-12, Flat H-1, Jain's green acres 91 Darga Road, Z.Pallavaram, Chennai-600043, Tamil Nadu.
E-mail: vedantarangan@yahoo.com

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sustaining productivity and the quality of end product.

The average height of pluckers necessitates it to be maintained at around 100 cm for efficient harvesting. Pruning is done at different heights for different situations and objectives. The height (or the creep as normally addressed) increase every year and the time it takes to reach around 100 cm from the time of prune is the length of pruning cycle. The post - pruning operations for shoot generations to achieve the yield expectations in the years following pruning for sustaining high estate averages are well documented and needs no repetition (Ranganathan 2014, 2015, 2016). Various types of pruning appropriate to the objectives and immediate needs fronting the management are hashed out to mold appropriate pruning blueprints for sustainable productivity on the long run.

Standards of pruning; 1) Pruning in TEA is defined as removing the wood below the tipping level (first plucking of all primary shoots emerging after the prune). 2) Skiffing is the removal of wood above the tipping level. 3) Cut-across was used to refer cutting at the level where the circumference is largest. The above definition is now obsolete. Now it is restricted to refer the pruning done without any cleaning.

Types of Prune

1. *Clean prune:* It refers to a) pruning at or around 45 cm with removal of below- pencil thick branches and shoots to generate shoots of uniform size b) removal of unwanted and moribund wood and c) thinning and cleaning the center to force the centrifugal spread and d) removal of knots and snags. In earlier days all prunes were clean ones.
2. *Cut across:* in recent times after a clean prune, there are two systems of handling further pruning. a) In "STEP UP" the pruning height is increased by 2.5 to 5 cm above the previous cut on the new wood for 3 to 4 cycles up to around 60 cm and then brought down to 45 cm by a clean prune and the cycle repeated. In between, all prunes are cut-across implying they are done without cleaning. b) In the other "STEP Down" system, after the clean prune at 45cm, the following pruning is a cut- across one done at 60 cm followed by cut across each time at 2.5 to 5cm below the previous cut at each pruning till it reaches around 45 cm. At 45 cm it is a clean prune again and the cycles are repeated. The advantage of 3 to 4 cut across cycles in between

two clean prunes is the quicker bud break and recovery as the cut is above or below new wood.

3. *Skiffing:* It is the lighter form of pruning done above the tipping level and plucking surface. It is done without cleaning. It is classified according to the depth of foliage removed between the tipping height and plucking surface
 1. Light skiffing- removing top 1/3rd of the depth of foliage between tipping height and plucking surface (2.5 to 5.0 cm from the top)
 2. Medium Skiffing - removing top 2/3rd of the depth of foliage between tipping height and plucking surface (5.0 to 7.5 cm from the top)
 3. Deep Skiffing- removing foliage above the tipping level (7.5 to 10 cm from the top or 2.5 to 5.0 cm above the tipping level)

Skiffing is generally done to extend the pruning cycle by one or two years. It is also done prior to onset of drought to reduce leaf area index to alleviate drought effect. It is practiced for the same reasons in the new clearings from third year onwards up to the first prune. But the above practice has not given consistent results and hence not recommended as a general practice.

4. *Rejuvenation Prune:* It is a clean prune removing all cankered and moribund wood, branches going in odd direction (Inwards, out ward, crossed, lanky ones, water suckers, diseased wood, tetchy branches, knots). Uprooting of death bushes and in filling vacancies is undertaken. Pruning sometimes goes down to ground level. The maximum height of prune is 20 cm and 30 cm respectively for China and Assam type bushes. There is no minimum height stipulated and depends solely on the merits of individual bushes. The main objective of rejuvenation prune is to develop healthy primary branches. After 4 to 5 years of rejuvenation prune, a clean prune is done at 30 to 40 cm height to develop secondary and tertiary branches. Infilling also increases the population density to the latest norms to achieve sustainable yield averages for the estate.

Rejuvenation pruning is done below 20 to 30 cm. The normal pruning with or without cleaning is done above 45 cm (Low/hard prune-45 cm; Medium prune-45-60 cm, and Light prune -60 cm). Pruning and cut across differ only in cleaning component and hence it is desirable to express pruning by height followed by a suffix to specify the type of prune e.g. 45 cm clean prune, 45 cm cut -across, 70 cm Skiff and so on.

5. Lung pruning; this refers to leaving branches containing about 300 leaves at the rim or periphery of the bushes at the time of pruning. These lungs are removed at the time of tipping at tipping height. This is resorted to i) When harder types of prune are done out of season ii) while handling weaker bushes iii) after a heavy crop iv) at low elevations and v) in situations where low carbohydrates reserves are likely to be encountered during post prune bud-break recovery period.

Concepts of Clean Prune

In earlier days, every prune is a low clean prune. It was done to remove knots, mass callusing and girdling due to repeated cuts at the same level (Baggan effect). In the present pruning systems with "Step up or step down" cut-across prune done above or below 2.5 to 5.0 cm on new wood in between clean prunes, the Baggan effect is largely eliminated. In absence of regular nutritional practices, thinning of branch density was also in vogue to sustain the size of tea shoots against the feared competition when too many of them were allowed to grow. With the planned nutritional inputs in relation to productivity, this practice is now obsolete. Apart from removing unruly and naughty branches as described earlier, the other post-prune operations carried out were a) demossing the frames and cleaning cankered bowl at the base and filling it with a mixture of sand and tar or with any other inert binding material, b) painting the cut surfaces with fungicide paste, c) removal of pruning or burning them in situ, d) Clean weeding with kokra and e) forking the soil. Except phytosanitary measures most of them are not necessary and have done more harm than good, particularly clean weeding and forking the soil. South Indian Tea soils are kaolinite and do not compact and hence loosening of the soil does not do any good; on the hand they result in soil loss with runoff water during monsoon creating micro watersheds in the sloping tea fields. All these soil disturbing operations and clean weeding in the pruned year were responsible for stagnation in productivity during nineteen forties and fifties. Now cleaning is restricted only at the time of rejuvenation and clean prune which are done once in 4 to 6 pruning cycles and that too restricted to the removal of redundant branches and wound dressing. Prunings are used to cover the pruned bushes till bud break and, then thick stems are allowed to be taken away after chopping and spreading the foliage around the bushes as organic

manure. Soil disturbance in any form is prohibited and tea culture is trending towards "Zero or minimum tillage"

Length of Pruning Cycle

It is mainly decided by the rate of growth of shoots as influenced by the mean annual temperature. The other criteria which have bearing in deciding the length of pruning cycle are

1. Flowering at the plucking table and the yield trend: The productivity decline is faster in China Jats and also flowers profusely. Hence the length of cycle is shorter for China jats compared to Assam ones,
2. Banjhiness, flush size, and plucking average: bhanji formation increases, flush size and plucking average decreases as the pruning cycle advances. The overall economics of harvesting in relation to crop and productivity decides the length of cycle to be adopted in an agro climatic zone.
3. Creep: The height and type of prune and its impact on creep in a given system of plucking determine the length of the cycle to maintain plucking surface at manageable height (<100cm) for efficient harvesting. The sensitivity analysis of data over several years hands out the following guidelines for fixing the length of the cycle.

Thumb Rule for Pruning cycle in years (N):

$N = (\text{Altitude in m} / 300) \pm 1$ with riders as given below:

- A. Jat: China+1; Hybrids ± 0 ; Assam +1
- B. Yield decline in the cycle -1; No yield decline +1.
- C. Continuous drought period; up to 60 days ± 0 ; 60 to 120 days -1; 120 to 150 days -2.
- D. Prune types; Rejuvenation prune +1. Clean prune and cut across prune ± 0 ; Skiffing -1.
- E. Pruned year yield as % of mean yield of the cycle: above 67% -1; 40 to 67 % ± 0 ; less than 40% +1.
- F. Steep fall in plucking average after 30 to 36 months: -1.

Recovery after Prune

It implies how soon the bushes are brought to regular plucking after the prune and expressed in days. It is said to be even if more than 90% of bushes reach the plucking stage at the same time; otherwise it is called uneven or staggered recovery. Mortality of bushes is less than 0.1% per annum under good crop husbandry practices; various odd practices increase

it to above 1.0% per annum. The requirements for blameless recovery are;

A good carbohydrate reserves during post-prune recovery period help in even and quicker recovery. As such, pruning should not be done after a heavy crop. It is best carried out before the rush crop and into the growing season. Dry weather pruning to avail the adverse growing conditions and the lowcrop during that period was practiced in earlier days and this led to invasion by wood rot fungus and gradual decline in health of frames. Mortality of bushes increased to more than one percent over the years which necessitated large scale rejuvenation pruning with infilling in fifties and sixties of the last century. Lot of care is now given to protect the branches by covering them with the pruning till first tipping. Clean weeding and forking the soil are given up and the prunings are chopped and spread around the bushes to tame the runoff water. These practices reduce soil erosion to sustain its organic matter equilibrium and thereby its' fertility on the long run.

Table 2: Recovery time

Recovery time	(720/12) ± 20 days
Correction factor is for factors influencing recovery as detailed earlier	

It requires 720 day degrees for the bushes to attain the plucking stage. The mean ambient temperature during post prune recovery stage is $23.5 \pm 2^\circ\text{C}$ and the critical temperature for growth for tea crop is 12.5°C . Hence the day degree during the recovery period is around 12°C .

It is, also, approximately equal to 3600 divided by the height of prune in cm with 10 to 20 % added for cleaning done and anticipated deficit in carbohydrate reserves.

Time of Pruning

To sum up, for quicker and even recovery and to reduce mortality of bushes over the years, the pruning should be done a) into the humid growing season with minimal occurrence of days with maximum ambient temperature above 28°C to avoid high temperature damages to the exposed frames and b) also when adequate carbohydrate reserves is

assured to prevail in the bushes in the post prune period for early bud break and to support their growth in initial stages until they become photosynthetically self-supportive. Pruning into dry months should be avoided to evade bark damage and wood rot infection which jack up mortality of bushes over the years warranting replanting or rejuvenation pruning with or without infilling at least once in 40 to 50 years. Pruning is to be clocked just before entering into a rush crop to conserve carbohydrate reserves for the recovery period.

Yield Pattern in the Pruned Year

There is no regular plucking of tea leaves to manufacture for two to three months following the prune until the plucking table is established by carrying out the tipping of all the primary shoots at postulated tipping height. Tipping height is set at 15 to 20cm above the pruning cut. That means it is done when the primary shoots grow and put out 7 to 8 leaves above the pruning cut. At tipping the standard of plucking are 3 to 4 leaves and a bud leaving minimum 3 leaves above the tipping height. This, also, allows availing the quicker bursting and growth of buds in the axils of 4 to 6th leaves below the growing point which have just matured and have not entered into dormancy (Afshan Akbar et al 2014; Hand book Of Tea culture, UPASI TRF Valparai); Sivapalan et al 2009). Tipping and subsequent plucking systems to maximize harvest index and to maximize pruned year yield were scripted earlier (Sharma et al 1981; Ranganathan 2014, 2015 and 2016)

Pruned year yield depends on the depth of pruning, tipping and plucking practices and also on the degree of breaking back practiced to have aesthetic look of plucking surface. Minimum yield in the pruned and other year to be targeted are given in Table 3.

Trend in Yield Patterns

In the past, the estate and regional averages of productivity were pulled down by the pruned year yields for various reasons discussed earlier. The distribution of yield achieved in various years of pruning cycle is shown in Table 4.

Table 3: Minimum expected yields in the pruning cycle

Pruned year	40 times the pruning height in cm (with 20% more for cut across ones)
2 nd year	3500kg/ha ¹ or 1.5 times the pruned year yield whichever is higher
3 rd year	3500kg/ha ¹ or 1.1 times the second year yield whichever is higher
4 th year	3500kg/ha ¹ or 1.05 times the third year yield whichever is higher

Table 4: Year wise Distribution of yield in the pruning cycle – realized in the past

Pruning type	Average Yield achieved over the years (kg ha ⁻¹)					Projected mean yield for (kg ha ⁻¹)			Pruned year yield as % of cycle mean		
	Pruned yr	2 nd yr	3 rd yr	4 th yr	5 th yr	3yr cycle	4yr cycle	5yr cycle	3yr cycle	4yr cycle	5yr cycle
1	300	500	700	1000	1200	500	625	740	60	48	41
2	400	790	1200	1300	1300	797	923	998	50	43	40
3	1149	1540	2298	2398	1915	1662	1821	1840	69	63	62
4	1600	2500	2800	2700	2600	2330	2400	2440	70	67	66
5	2069	2845	3233	3427	3427	2716	2893	3000	76	72	69
6	1700	1800	1750	---	---	1750	---	---	97	----	----
7	2000	2700	3500	3500	3400	2733	2925	3020	73	68	66

Pruning type -explanation

1	Rejuvenation prune (no infilling)	4	Clean Prune and light cut-across without breaking back
2	Clean Prune (With breaking back)	5	Medium and high cut across prune without breaking back
3	Cut-across prune (With breaking back)	6	Skiffing (no cleaning and no breaking back)
7	Shearing/machine harvesting -- muttom (level) shearing without putting hands below the muttom ; shearing from second year onwards, no intermittent hand plucking		

It will show the importance of pruned year yield in augmenting the average yield of an estate or a region. Against this how yield pattern is changed following the new norms on pruning system is shown in Table 5.

Table 5: Yield achieved In the pruning Cycle kg ha⁻¹

Type of prune	Pruned year	2 nd Year	3 rd year	4 th year	MEAN cycle
A	1800	3500	3850	4245	3346
B	2600	3900	4290	4719	3877

A-45 cm clean prune; B-60 cm cut across

Systems of Pruning

Since the type of prune and degree of cleaning up and wound dressings are field specific they are corrected over the years and a pruning system is evolved with a combination of different types of prune incorporating the past experiences with long term interests for the future.

TRADITIONAL SYSTEM; in the traditional systems continuous low/medium clean prune is done every cycle with emphasis on cleaning bowl or center of the bush with religious adherence to bush sanitation measures. The productivity in the pruned year is less than 40% of other years' yield and takes 3 years to reach respectable yield levels.

NEW SYSTEMS; as bud breaks are quicker in new wood, cut across prune ensures a higher number of growing points to start with and thereby increasing the productivity in the pruned year to 67% or more of other years' yield. Other advantages are 1) flexibility in timing of pruning and 2) assured carbohydrate supply from foliage left on the bushes. Combination of low prunes with 3 to 4 cut across ones in between

two low prunes is advantageous for the overall profitability and sustaining the rate of increase in productivity.

The present system envisages the schedule of different types of prune in a sequence as follows (Table 6).

Table 6: Pruning System

Low prune (45 to 55cm) 4to 5 years	2to 4 cut across (60 to 70 cm) 4:3:3 cycle (10 years)	Low prune (45 to 55 cm) Cycle repeats
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Low prune to low prune 12 to 15 years

Rejuvenation pruning after 3 prune cycles i.e once in 45 years
Skiffing need based for crisis management; mostly skipped.

Depending on the mean length of pruning cycle of all the fields, about 20 to 30% acreage will face knifing; Out of these the pruning types will be distributed as follows (Table 7).

Table 7: Distribution of pruning types

6 to 9 %	Low Prune ; (of which 50% rejuvenation)
6 to 9 %	60cm cut across,
6 to 9 %	65 cm cut across
6 to 9 %	70 cm cut across

To recap a pruning system is a necessity for managing long term interests on bush health and sustainability of productivity trends. Pruning traditionally is done manually and mechanization of the operation is picking up. Be it manual or mechanized operation the objectives are the same and all precautions on systems of pruning, timing, and types of prune, post prune operations and recovery after prune applies equally to both of them. A three year cycle in drought prone areas and low elevation tea gardens is made viable by increasing the pruned year yield to more than 70% or more of the cycle mean

by combination of different types of prune followed with good post prune crop husbandry practices.

Young Tea

Decentering the leader growth is done as early as possible below 20 cm with a cut across prune to the branches at 35 cm. Tipping is done at 55 cm. Decentering wherever necessary is done in the second year. In the fourth year, 45 cm cut across is done and tipped at 65 cm. Thereafter the normal pruning system is followed.

Northeast India

In Assam valley where tea is grown in plains at around sea level under humid hot climate, annual pruning to bring down the height is an ecological compulsion. Pruning system runs like this; once in 15 to 20 years the bushes are cut low, over the original frame forming prune followed by a light prune 4 to 5cm over the previous cut after a year or two. Thereafter bushes are pruned every year at 1.5 cm above the previous cut for another 15 to 20 years before going again for a low prune. In neoteric systems, starting with a medium prune, various combinations of deep, medium and light or level off skiffing for 2 to 3 years are carried out before getting back to medium prune. Depth of skiffing refers to the severity of removal of wood between pruning and tipping heights. The term "Skiffing" in NE India is analogous to that of "cut across" in South India (Barua 1989; www.tocklai.net/activities/tea-cultivation TRA Kolkata)

Summary

Tea, a tree is trained as a bush for exploiting the growing points for commercial tea manufacture. Starting from the centering the young tea to put forth branches from as low as possible, subsequent pruning techniques are planned for centrifugal spread of branches and creation of optimum leaf area index, maintaining manageable plucking height and repeated operations to ensure juvenility of growing points for continual supply of quality tea leaves to the factory. Understanding the implications of different types of prune and putting them in a system for sustaining the overall profitability and productivity trends to make the industry viable one poses challenge to the Industry for sustaining overall profitability and its 'economic survival

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