

## INFLUENCE OF MOTHER LEAF OF CUTTING AND OF TIME AND FREQUENCY OF DISBUDDING AND DECAPITATION OF THE NEW SHOOT ON GROWTH OF YOUNG TEA, *CAMELLIA SINENSIS* (L.)\*

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The importance of the mother leaf in the early growth of the tea cutting was studied by removal as well as by clipping off the top half of the mother leaf periodically from planting of cuttings. The effect of the time of commencement and frequency of disbudding and of different degrees of decapitation were also studied in young tea plants. Removal of the mother leaf arrested new growth up to week 12, while clipping off the top half of the mother leaf arrested growth only for eight weeks. Disbudding plants at four months of age produced plants with a low spreading habit compared to disbudding of younger or older plants. Disbudding twice and "thumb-nailing" twice gave a better plant spread. Disbudding in addition, improved overall growth. Comparing the different degrees of decapitation, disbudding alone produced more side shoots. Decapitation removing six leaves produced longer and heavier side shoots compared to decapitation removing fewer leaves. All decapitation treatments except disbudding depressed the dry weight of roots but plant dry weight remained unaffected. Keywords: Tea; Disbudding; Decapitation; Mother leaf removal; Shoots.

Tea is now propagated almost exclusively by single-node cuttings consisting of a nodal mother leaf, internode and included axillary bud. The importance of the mother leaf for the growth of the new shoot cannot be overemphasized. The new growth depends on the mother leaf for several factors including photosynthates until such time as it unfolds new leaves and is able to synthesize its food. Experiments involving defoliation of the mother leaf and clipping off the top half of the mother leaf at periodic intervals from planting of cuttings were carried out to see at what stage the new shoot growth becomes independent of the mother leaf.

Tea cuttings are usually grown in nurseries for periods of 32-48 weeks before field planting. The duration of this period is dependent on several factors, such as climate, elevation, type of cutting, nursery management, etc. There are several methods of encouraging bush formation in young tea. These methods are applied to plants in the nursery or in the field or in both (Manipura, 1971). In the nursery any treatment designed to improve the growth of the plant will influence its development in the field. The primary object of some of the nursery operations carried out on young plants is to encourage rapid growth in height and branching suitable for field planting. If a tea plant is allowed to grow freely the main shoot shows extension growth and will later bear lateral shoots at various distances above the ground level and the plant soon assumes the form of a pyramid. This is due to the fact that the central leader is 'dominant' over lateral branches and it always

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surpasses them in height unless checked. In addition, the leader shoot also becomes much thicker than the laterals. Any operation which restricts the continued growth of the leader would result in the production of lateral branches of comparable thickness. Since yield is the main criterion, the aim is to develop a bush early with a large number of plucking points. This involves regulating the pattern of growth of the tea plant in such a manner as to encourage uninhibited growth of laterals. The various methods adopted to maintain the bush in a shape and of a size that may be harvested economically act by preventing the centre of the bush dominating the outer branches. In the nursery disbudding and thumbnailing are devices to ensure a more equal distribution of growth over the plant.

## MATERIALS AND METHODS

A series of studies was conducted on young tea plants at different stages of growth in the nursery during 1973/1974. These included mother leaf removal, clipping off the top half of the mother leaf, disbudding young plants at different ages, disbudding and decapitation of new shoots and disbudding and different degrees of decapitation of new shoots.

### *Experiment 1: Mother leaf removal*

In this experiment cuttings of clone TRI 2025 were chosen with each mother leaf having an area of approximately 65 cm<sup>2</sup> to ensure uniformity of leaf size.

After the cuttings were planted in soil in polyethylene bags the mother leaves were removed at intervals of 2 weeks from day 0 up to week 24. At each defoliation the mother leaf was severed at the base of the petiole. The design was a randomized block type with five replicates. Each plot measured 785 cm<sup>2</sup> and contained 10 plants. The mother leaf of the control plants was left intact. The plants were separated into leaves, stems and roots four weeks after the last defoliation and the dry weight of each component was determined.

### *Experiment 2: Clipping off the top half of the mother leaf*

This experiment was similar to the previous experiment in all details except that the treatments involved clipping off the top half of each nodal leaf. The nodal leaves of the control plants were left intact.

### *Experiment 3: Age of plant at disbudding*

Disbudding was done on plants of the slow growing clone DT 1 at 2, 4, 6 and 8 months of age. The treatments included a control. The design was a randomized block type with six replicates. At each disbudding the terminal buds were clipped off at their base. The number and length of primary and secondary shoots as well as the dry weight of primary and secondary shoots and of leaves were determined two months after the last disbudding. A count was made of the number of plants with side shoots according to node position, the nodes being counted from below upwards.

### *Experiment 4: Frequency of disbudding and decapitation ('thumbnailing')*

In this study, 16-week-old plants of clones TRI 2025 and DT 1 were used.

The treatments were:

1. Control
2. Disbudding once
3. Disbudding twice
4. Thumbnailing once
5. Thumbnailing twice

Disbudding was done as in the previous experiment. Decapitation or thumbnailing involved the removal of the terminal bud and the first two leaves with included stem. The plants had eight leaves when treatments commenced. The layout was a randomized block design with five replicates of 50 plants per treatment per clone. The first disbudding and thumbnailing was done on the main shoot of each plant. Half the number of plants of each treatment were removed 12 weeks after the treatments were given and the dry weight of the plant parts determined. Disbudding and thumbnailing were repeated immediately on all shoots of plants in treatments three and five respectively. The dry weights of the components of the remaining plants were determined 10 weeks after the first assessment.

#### Experiment 5: Effect of disbudding and different degrees of decapitation

Plants of clone TRI.2025 were given the following treatments when they were 20 weeks old:

1. Control
2. Disbudding
3. Decapitation by removing two leaves with included stem (thumbnailing)
4. Decapitation by removing four leaves with included stem
5. Decapitation by removing six leaves with included stem

When treatments commenced the plants had an average of 10 leaves. The design was a randomized block type with five replicates. Plant height was measured from top of the original cutting up to and including the first side shoot. The plants were removed 18 weeks after the treatments were given and the dry weight of the components of the plants was determined.

## RESULTS

### Experiment 1

Removing the mother leaf up to week 12 reduced plant height and the dry weight of leaves, of stems and of the plant and not thereafter, while the dry weight of roots and leaf production were reduced by removing the mother leaf up to week 14 (Table 1).

TABLE 1 — Effect of removing mother leaf at fortnightly intervals on growth and dry matter production at 28 weeks (means of 50 plants). (Back-transformed numbers are given in parentheses)

Time of defoliation, weeks	Final		Dry weight, g			
	Height, cm	Leaf number $\sqrt{n+1}$	Leaves	Stems	Roots	Plant
Control	26.00	3.82 (13.59)	1.46	1.20	0.95	3.61
0	0	1.00 (0.00)	0	0	0	0
2	0	1.00 (0.00)	0	0	0	0
4	4.60	1.41 (0.99)	0.36	0.31	0.28	0.95
6	8.80	2.85 (7.12)	0.58	0.45	0.36	1.39
8	12.90	3.00 (8.00)	0.81	0.64	0.44	1.89
10	16.40	3.40 (10.56)	1.13	0.92	0.51	2.56
12	22.80	3.66 (12.40)	1.26	1.04	0.63	2.93
14	23.70	3.68 (12.54)	1.35	1.13	0.79	3.27
16	24.40	3.72 (12.84)	1.38	1.16	0.87	3.41
18	26.40	3.85 (13.82)	1.43	1.19	0.91	3.53
20	28.90	3.95 (14.60)	1.47	1.25	0.97	3.69
22	29.20	4.05 (15.40)	1.51	1.33	1.04	3.88
24	29.50	4.12 (15.97)	1.54	1.36	1.07	3.97
LSD (P=0.05)	2.34	0.12	0.16	0.13	0.12	0.36

## Experiment 2

Clipping off the top half of the mother leaf up to week 12 reduced plant height (Table 2) while leaf production was decreased up to clipping at week 10. The treatments reduced the dry weight of leaves up to week 8, of stems and the plant up to week 10 and of roots up to week 14.

TABLE 2 — *Effect of clipping off the top half of mother leaf at fortnightly intervals on growth and dry matter production at 28 weeks (means of 50 plants). (Back-transformed numbers are given in parentheses)*

Time of clipping, weeks	Final		Dry weight, g			
	Height, cm	Leaf number $\sqrt{n}$	Leaves	Stems	Roots	Plant
Control	25.30	3.80 (14.44)	1.36	1.14	0.74	3.24
0	10.72	3.58 (12.82)	0.54	0.55	0.26	1.35
2	12.08	3.40 (11.56)	0.69	0.65	0.29	1.63
4	14.50	3.47 (12.04)	0.88	0.72	0.33	1.93
6	16.78	3.38 (11.42)	1.03	0.83	0.39	2.25
8	19.00	3.44 (11.83)	1.19	0.91	0.46	2.56
10	20.02	3.65 (13.32)	1.27	0.98	0.51	2.76
12	23.70	3.72 (13.84)	1.39	1.06	0.57	3.02
14	24.92	3.72 (13.84)	1.44	1.14	0.61	3.19
16	25.68	3.80 (14.44)	1.48	1.22	0.69	3.39
18	27.16	3.88 (15.05)	1.53	1.31	0.73	3.57
20	28.90	3.89 (15.13)	1.62	1.38	0.79	3.79
22	29.85	3.95 (15.60)	1.69	1.45	0.84	3.98
24	32.35	3.96 (15.68)	1.76	1.52	0.96	4.24
LSD (P=0.05)	1.45	0.14	0.14	0.11	0.08	0.25

## Experiment 3

A count of the number of plants with side shoots according to node position from below upwards showed that in the undisbudded control plants the greatest number of side shoots occurred at nodes 10 and 11 (Table 3). In plants disbudded at two months, four months, six months and eight months the greatest number of side shoots occurred at nodes 4 and below, between nodes 5 and 8, between nodes 9 and 11 and between nodes 9 and 12 respectively.

TABLE 3 — *Effect of age of plants at disbudding on the number of plants with side shoots. (Back-transformed numbers are given in parentheses,  $\sqrt{n+1}$ )*

Node position*	Age of plants at disbudding				
	Control	2 months	4 months	6 months	8 months
1	1.19 (0.42)	2.42 (4.86)	1.43 (1.04)	1.19 (0.42)	1.07 (0.14)
2	1.00 (0.00)	2.08 (3.33)	1.19 (0.42)	1.00 (0.00)	1.07 (0.14)
3	1.00 (0.00)	2.19 (3.80)	1.21 (0.46)	1.00 (0.00)	1.07 (0.14)
4	1.00 (0.00)	2.49 (5.20)	1.63 (1.66)	1.00 (0.00)	1.00 (0.00)
5	1.07 (0.14)	1.71 (1.92)	2.13 (3.54)	1.07 (0.14)	1.14 (0.30)
6	1.14 (0.30)	1.14 (0.30)	2.52 (5.35)	1.38 (0.90)	1.26 (0.59)
7	1.37 (0.88)	1.07 (0.14)	2.28 (4.20)	1.64 (1.69)	1.60 (1.56)
8	1.88 (2.53)	—	2.23 (3.97)	2.41 (4.81)	2.40 (4.76)
9	2.28 (4.20)	—	2.01 (3.04)	2.79 (6.78)	2.61 (5.81)
10	2.77 (6.67)	—	1.48 (1.19)	2.87 (7.24)	2.90 (7.41)
11	2.64 (5.97)	—	1.07 (0.14)	2.94 (7.64)	2.89 (7.35)
12	2.37 (4.62)	—	—	2.54 (5.45)	2.64 (5.97)
13	2.08 (3.33)	—	—	2.18 (3.75)	2.37 (4.62)
LSD (P=0.05)	0.38	0.58	0.42	0.32	0.35

\*Node position counting from below upwards.

The number of plants with side shoots from node 14 to 21 are not presented here for reasons of space.

Plants disbudded at eight months produced more primary shoots while those disbudded at four months had longer primary shoots with greater dry weight (Table 4).

Plants disbudded at two and four months produced more and longer secondary shoots, those disbudded at two months showing greater dry weight. Plants disbudded at four and six months produced more leaves on the primary and secondary shoots compared with plants disbudded at eight months and the control.

The effect of age of plant at disbudding on growth and branching is shown in Fig. 1.

#### Experiment 4

At the first assessment, disbudding and thumbnailing produced more and longer side shoots and more leaves (Table 5). Disbudding reduced the dry weight of stems and the plant while thumbnailing reduced that of stems, leaves, roots and of the plant, the dry weight of the plant being even less than that of the disbudded plant.

TABLE 4 — *Effect of age of plants at disbudding on the number and length of side shoots and dry matter production. (Back-transformed numbers are given in parentheses)*

Age of plants at disbudding	Number $\sqrt{n}$	Primary shoots		Number $\sqrt{n+1}$	Secondary shoots		Leaves of primary and secondary shoots Dry wt. g
		Length cm	Dry wt. g		Length, Dry wt. cm g		
Control	1.76 (3.10)	26.65	0.20	1.01 (0.02)	0.03	0.01	1.18
2 months	1.55 (2.40)	47.61	0.68	2.08 (3.33)	15.02	0.40	2.67
4 months	1.63 (2.66)	59.28	1.01	1.88 (2.53)	13.11	0.24	2.73
6 months	2.07 (4.28)	51.58	0.56	1.19 (0.42)	1.57	0.08	2.73
8 months	2.38 (5.66)	34.64	0.42	1.02 (0.04)	0.05	0.01	2.30
LSD (P=0.05)	0.15	6.54	0.15	0.23	4.53	0.06	0.42

At the final assessment, disbudding and thumbnailing twice produced more and longer side shoots compared with all other treatments. Disbudding once and disbudding and thumbnailing twice increased leaf production. In general, disbudding twice increased the dry weight of the components of the plant compared with all other treatments.

#### Experiment 5

Decapitation with removal of four leaves and six leaves reduced plant height compared with disbudding and the control (Table 6).

Disbudding produced more side shoots compared with decapitation with removal of four leaves and of six leaves and the control. Decapitation with removal of six leaves with included stem produced longer side shoots of greater dry weight (Table 7). Decapitation with removal of two, four and six leaves reduced the dry weight of roots.



Fig. 1. — Effect of age of plant at disbudding. L to R. Undisbudded control, plants disbudded at 2, 4, 6 and 8 months of age respectively. Photograph taken two months after the last disbudding was done at eight months.

**TABLE 5** — *Effect of frequency of disbudding and thumbnailing on growth and dry matter production averaged over two clones (means of 100 plants) at 1st and 2nd assessment. (Back-transformed numbers are given in parentheses)*

Treatments	Side shoots		No. of leaves on main + side shoots, $\sqrt{n}$	Dry weight, g			
	Number $\sqrt{n}$	Length, cm		Leaves	Stems	Roots	Plant
<b>1st assessment</b>							
Control	0.97 (0.94)	5.13	3.25 (10.56)	2.14	1.47	1.21	4.82
Disbudding	1.32 (1.74)	11.10	3.58 (12.82)	1.79	1.24	1.09	4.12
Thumbnailing	1.35 (1.82)	11.32	3.69 (13.62)	1.55	1.08	0.95	3.58
LSD (P=0.05)	0.17	0.53	0.32	0.42	0.23	0.18	0.25
<b>2nd assessment</b>							
Control	1.85 (3.42)	29.81	8.49 (72.08)	5.05	4.58	3.68	13.31
Disbudding (1)	2.28 (5.20)	52.33	9.54 (91.01)	6.07	5.42	4.32	15.81
Disbudding (2)	2.76 (7.62)	75.24	10.17 (103.43)	7.27	6.73	5.42	19.42
Thumbnailing (1)	2.45 (6.00)	41.71	9.35 (87.42)	5.93	5.03	3.67	14.63
Thumbnailing (2)	2.76 (7.62)	66.89	9.84 (96.83)	5.93	5.27	4.12	15.32
LSD (P=0.05)	0.26	10.91	0.89	1.26	1.15	0.72	2.18

**TABLE 6** — *Effect of disbudding and different degrees of decapitation on growth and branching (means of 50 plants). (Back-transformed numbers are given in parentheses)*

Degree of decapitation	Final height, cm	Side shoots		No. of leaves on main + side shoots, $\sqrt{n}$
		Number $\sqrt{n}$	Length, cm	
Control	50.00	2.24 (5.02)	23.59	8.15 (66.42)
Disbudding	47.16	2.89 (8.35)	29.34	8.34 (69.56)
Decapitation with removal of 2 leaves	40.94	2.49 (6.20)	32.60	7.88 (62.09)
Decapitation with removal of 4 leaves	32.44	2.01 (4.04)	37.80	7.50 (56.25)
Decapitation with removal of 6 leaves	35.08	2.00 (4.00)	46.12	7.49 (56.10)
LSD (P=0.05)	9.54	0.61	14.48	NS

**TABLE 7** — *Effect of disbudding and different degrees of decapitation on dry matter production (means of 50 plants)*

Degree of decapitation	Dry weights, g							Roots	Plant
	Leaves		Leaves on main stem + side shoots	Stems		Main stem + side shoots			
	on side shoots	on main stem		side shoots	main stems				
Control	2.06	3.48	5.54	0.62	4.90	5.52	3.62	14.68	
Disbudding	2.49	3.38	5.87	0.96	4.40	5.36	3.26	14.49	
Decapitation with removal of 2 leaves	2.03	2.76	4.79	0.98	3.49	4.47	2.31	11.57	
Decapitation with removal of 4 leaves	2.18	2.30	4.48	1.28	2.79	4.07	2.18	10.73	
Decapitation with removal of 6 leaves	2.27	2.12	4.39	1.69	2.71	4.40	2.19	10.98	
LSD (P=0.05)	NS	0.79	NS	0.28	1.21	NS	1.03	NS	

## DISCUSSION

Removal of the mother leaf arrested new growth up to week 12 (Table 1). This shows that new growth depends at first for its assimilates on the activity of the nodal (mother) leaf. However, by about week 12, it becomes independent of the mother leaf as it is able to synthesize its own requirements by this time as it is at this stage that roots are put out.

A similar conclusion was drawn from the leaf clipping work (Experiment 2) but growth was arrested for a shorter period of only 8 weeks (Table 2). This is understandable as the remaining half of the mother leaf would have been functional and continued to supply a share of the requirements of the new growth. Pethiyagoda (1967), who made preliminary observations on the role of the mother leaf, found it to be important in the early survival of cuttings. The deleterious effects of its removal decreased with age from planting. Kathiravetpillai and Kulasegaram (1981), found a large increase in dry matter in the mother leaves of clones TRI 2025 and DT 1 during 0-10 weeks from planting of tea cuttings, indicating that the mother leaf continued to produce photosynthates. During the next 10-14 weeks they observed increases in dry matter in the new shoot growth of the vigorous clone TRI 2025 that corresponded to the period of largest increment of new leaf area and to a peak in E, the net assimilation rate, suggesting that the new leaves had taken over the function of the mother leaf during this period. In the slow growing clone DT 1 these periods occurred later and it may be that in such clones the new shoot takes a longer time to become independent of the mother leaf. The results of their study lends further support to the present work.

The count of the number of plants with side shoots according to node position indicated that disbudding the plants at four months of age resulted in the production of plants with a low spreading habit (Table 3, Fig. 1). These plants had longer primary shoots than those disbudded at a younger or older age (Table 4). For field planting it is desirable to have a plant with a low spreading habit. When plants are disbudded earlier than at four months it might affect their survival as they do not produce much growth during this period. Plants disbudded later than at four months produce side shoots higher on the stem. Since it is desirable to have more secondary and higher order shoots on the original stem during its period in the field a bush with a better and even frame would be advantageous.

At the first assessment, disbudding and thumbnailing once increased side shoot growth by reducing the dry weight of the plant (Table 5). Repeating the operations, when more leaves were produced, resulted in more and longer side shoots with the disbudding treatments causing a greater accumulation of dry matter in the plant which resulted in better overall growth. It is to be noted that disbudding is a less severe operation than thumbnailing and does not result in removal of valuable growth; from this point of view disbudding would be preferable in young tea. Kathiravetpillai *et al.* (1977) have shown that for a slow growing clone it would be desirable to disbud the plants as thumbnailing at an early stage arrests the growth of the plants.

Decapitation with removal of four leaves and six leaves with the included stem reduced plant height (Table 6). Disbudding alone produced more side shoots as more nodes remained on the stem. Though decapitation with removal of six leaves produced fewer side shoots, as the number of nodes available for side shoot production was less in them, the side shoots were longer. The removal of a greater amount of top growth would have altered the ratio of shoots to roots and the root system has to support only fewer shoots which could consequently grow longer.

It was seen that decapitation with removal of two, four and six leaves depressed the dry weight of roots (Table 7). The removal of leaves would be expected to curtail photosynthetic activity forcing the new growth to depend on root reserves (Tubbs, 1937). It is to be noted that the treatments involving different degrees of decapitation did not alter the dry weight of the plant as more dry weight was diverted into the side shoots.

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