

EFFECT OF SEVERITY OF PLUCKING ON THE GROWTH AND YIELD OF LOW GROWN TEA

(PENGARUH BERAT-RINGANNYA PETIKAN PADA PERTUMBUHAN DAN HASIL TEH DATARAN RENDAH)

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RINGKASAN

Pada waktu yang silam di Sri Lanka pada umumnya dilakukan pemetikan dengan meninggalkan satu daun di atas kepel-kepel. Tetapi sekarang kebanyakan kebun melakukan pemetikan dengan menggabungkan petikan di atas satu daun dan petikan di atas kepel licin (kepel besar, "fish leaf"). Dalam karangan ini cara tersebut terakhir disebut "cara kebun" ("estate practice").

Di kebun Percobaan Ratnapura, yang terletak di dataran rendah di Sri Lanka, dilakukan percobaan untuk membandingkan "cara kebun" dengan petikan di atas kepel licin dan petikan di atas kepel ceuli (kepel kecil, "janam"). Percobaan dilakukan pada tanaman klon TRI 2025 yang berumur empat tahun.

Sampai setahun sesudah dipangkas, semua petak dipetik dengan "cara kebun". Sesudah itu selama dua tahun tanaman dipetik dengan: (1) "Cara kebun" sebagai kontrol, (2) Petikan diatas kepel licin, dan (3) Petikan di atas kepel ceuli.

Perdu-perdu yang dipetik di atas kepel ceuli tampak kurus, kecoklat-coklatan karena daunnya kurang. Perdu-perdu yang dipetik di atas kepel licin maupun kepel ceuli memberikan hasil, yang lebih tinggi daripada yang dipetik dengan "cara kebun", yaitu berturut-turut 503 dan 557 kg per ha. Perbedaan hasil ini hampir seluruhnya terjadi pada tahun pertama. Antara yang dipetik di atas kepel licin dan di atas kepel ceuli tidak terdapat perbedaan hasil yang dapat dipercaya.

Makin berat cara pemetikannya, makin banyak jumlah pucuk pada perdu, tetapi, pucuk-pucuk ini makin ringan. Demikian pula makin berat cara pemetikannya makin sedikit berat pangkasan pada pemangkasan berikutnya.

Yang di luar dugaan adalah tidak terdapatnya perbedaan yang nyata dalam cadangan makanan (polysaccharida) dalam akar pada ketiga perlakuan tersebut. Demikian pula pada ketiga perlakuan itu tidak terjadi perbedaan yang nyata dalam kecepatan pertumbuhan tunas-tunas sehabis dipangkas.

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The effects of janam plucking (a very severe system of plucking practised in North-East India), fish-leaf plucking, and a combination of fish-leaf plucking and single-leaf plucking which is the current estate practice (control) on the growth, yield and on recovery from pruning of clonal tea are described. Fish-leaf and janam plucking gave significantly higher yields in the first year, but not in the second; in the first six months there were large increases of 35% and 42%, respectively. Fish-leaf and janam plucking increased the crop shoots per bush but decreased shoot size. Janam plucking significantly increased the proportion of shoots with active terminal buds. Fish-leaf and janam plucking decreased the production of non-harvestable growth. Increasing the severity of plucking increased the "harvest index", and it is suggested that very hard plucking over short periods, to exploit seasonal price increases, may be feasible. Reasons for the yield increases with harder plucking are discussed. It is suggested that the diminishing yield returns from hard plucking may be due to the aging of maintenance foliage.

Plucking tables formed by fish-leaf and janam plucking were uneven and ragged. The latter was twiggly in appearance. Continuous single-leaf plucking was impracticable as the plucking rapidly increased in height.

With fish-leaf and janam plucking the root reserves status at the time of pruning and, the growth and development of shoots after pruning was similar to the control, indicating that two years of janam plucking had not caused a permanent set-back.

INTRODUCTION

The commercial yield of tea is the product made from the ten derapical portions of secondary and higher order shoots (Portsmouth, 1957). These shoots which appear above the plucking table are normally harvested or plucked at intervals of 4 to 10 days depending on climatic conditions, jat of tea and the rate of growth.

The crop shoot or the unit harvested comprises the terminal bud and the internodes and partially expanded leaves or appendages immediately below it. Crop shoots are divisible into two categories according to the state of the terminal bud. Crop shoots with actively growing buds are termed flush shoots or active shoots and those where growth has temporarily ceased are termed banji shoots or dormant shoots. When the harvest unit is made up of the bud plus one or two leaves the plucking is described as fine plucking, while in coarse plucking larger units with more than two leaves are taken. Banji shoots are plucked as soon as the terminal bud becomes dormant.

The plucking of crop shoots acts as a stimulus for further shoot production by temporarily destroying apical dominance (Tubbs, 1937; Portsmouth and Rajiah, 1957). The axillary bud immediately below the point of plucking is activated and develops into a new shoot. At times more than one bud is activated.

The unfolding of an axillary bud generally, produces sequentially two scale leaves, two appendages showing foliar characters which are commonly designated as the small fish-leaf and the big fish-leaf, and a series of true foliage leaves (Bond, 1942; Portsmouth and Rajiah, 1957) after which there is a temporary cessation of growth and the terminal bud becomes dormant. The point at which the crop shoot is plucked determines the severity of the operation in terms of the quantum of maintenance foliage added onto the bush. Generally, the crop shoot is harvested immediately above either the first foliage leaf or the big fish-leaf. The former termed single-leaf plucking is referred to as light plucking and, the latter termed fish-leaf plucking is referred to as hard plucking, as less maintenance foliage is added onto the bush with fish-leaf plucking. Single-leaf plucking was the standard estate practice in Sri Lanka (Portsmouth, 1957; Eden, 1958), but now a combination of single-leaf plucking and fish-leaf plucking is popular especially in low-grown tea. North-East India the crop shoot is plucked immediately above the small-fish leaf. This system, called janam plucking, is the most severe of the

systems of hard plucking in practice in that no leaf is added to the maintenance foliage and the table does not rise more than 5 cm per year.

Visser (1960) compared single-leaf plucking throughout the pruning cycle with single leaf plucking in the first nine months followed by fish-leaf plucking for the rest of the cycle (limited fish-leaf plucking) on seedling tea in the low-country. He showed that the latter system increased the yield by 15% over 3 years. The aim of the present study was to ascertain the effects of three severities of plucking on the yield and other growth parameters of mature clonal tea under low-country conditions. This paper describes the results over the first pruning cycle and the period of post-pruning recovery.

MATERIALS AND METHODS

The experiments was carried out on four-year old tea of clone TRI 2025 at the Tea Research Institute, Low Country Station, Ratnapura. The treatments were as follows:

1. Estate practice (control) — A combination of fish-leaf plucking and single-leaf plucking. About 60 - 75% of tea crop shoots were plucked to the fish-leaf and the balance to the first foliage leaf. The single-leaf plucking is done chiefly to maintain a level plucking table.
2. Fish-leaf plucking.
3. Janam plucking.

In the first two treatments the harvest unit was the bud and two leaves. In janam plucking the harvest unit was the bud and two leaves and the big fish-leaf. When banji shoots occurred the harvest unit was smaller.

In a preliminary trial continuous single-leaf plucking was tested but found to be impracticable on account of the rapid increase in the level of the plucking table.

The experimental plots were pruned in June 1972 and plucked uniformly (estate practice) until the treatments were imposed in June 1973. The plucking was done at approximately weekly intervals and the fresh weight of crop shoots harvested was measured on each occasion. The number and dry weight of the active and dormant crop shoots at each pluck was determined for a period of six months commencing from September 1974. The tea was pruned at a height of 45 cm in June 1975, two years after the treatments were imposed. The fresh weight of prunings, separated into leaves and stems, was measured.

Root samples, 1.0 to 1.5 cm in diameter and 5.0 to 6.0 cm in length taken before pruning were analysed for reserves in the root wood by the method described by Kandiah (1971). The sample size was 5 bushes per plot (Pethiyagoda, 1964a).

The numbers of new shoots and leaves developing on each bush after pruning and, the leaf area per bush 4 months after pruning was also determined. The leaf area was determined on six bushes per treatment using the leaf area grid described by Pethiyagoda and Rajendram (1965).

RESULTS

1. Appearance of the plucking table

Even after a few plucking rounds differences in the appearance of the plucking table in the three treatments become discernible and were clearly noticeable a few

months after the treatments were imposed. The plucking table in the control plots was level while in both fish-leaf and janam plucking the table was uneven and ragged. The plucking table in janam plots was twiggy and devoid of foliage and had a brownish-green appearance while the other treatments looked green and leafy. The janam plots appeared to have more plucking points but the crop shoots were clearly smaller in size. Towards the end of the cycle the plucking table of the janam plots appeared to have a smaller surface area.

2. Commercial yield

The yield of made tea obtained over the two-year period of treatment is given in Table 1.

TABLE 1 — *Effect of severity of plucking on yield of made tea (kg/ha)*

Treatment	Period of treatment				
	1st six months	2nd six months	3rd six months	4th six months	Total over two years
Control	1075	991	1016	964	4046 (100)
Fsh-leaf plucking	1455	1108	1044	942	4549 (112)
Janam plucking	1529	1072	1028	974	4603 (114)
LSD (P=0.05)	93	101	86 NS	70 NS	224 (5.5)

Notes: Yields expressed as a per cent of the control is given in parenthesis.

Over two years, fish-leaf and janam plucking gave a significant increase in yield of 503 and 557 kg per hectare over the control. It is interesting to note, however, that over 75% of the increase was obtained during the first six months and over 95% during the first year. During the third and fourth six month periods the yields were not significantly different between any of the treatments. There was no difference in yield between fish-leaf and janam plucking at any stage over two-year period.

3. Characteristics of yield components

The average number of crop shoots harvested over 23 consecutive plucking rounds and their characteristics are presented in Table 2.

TABLE 2 — *Effect of severity of plucking on the characteristics of yield components*

	Treatments			
	Control	Fish-leaf plucking	Janam plucking	LSD (P=0.05)
Mean number of crop shoots per bush per pluck(a)	4.71	5.07	5.39	0.23
Back transformed number	22.2 (100)	25.8 (116)	29.1 (131)	—
Mean dry weight per crop shoot (g)	0.128 (100)	0.116 (91)	0.095 (74)	0.005 (4)
Per cent crop shoots with active buds (b)	23.63	23.91	29.30	2.27
Back transformed per cent	16.2	16.6	24.0	—

Notes: (a) Analysis done on arcsin transformed data.

(b) Analysis done on arcsin percentage transformed data.

Data expressed as a per cent of the control is given in parenthesis.

The mean number of crop shoots per bush increased significantly while the mean dry weight of a crop shoot decreased significantly with increasing severities of plucking. Fish-leaf plucking, and janam plucking resulted in an increase in the number of crop shoots of 16% and 31%, respectively, over the control, and a corresponding decrease of 9% and 26% in the weight of a crop shoot. The proportion of active shoots is generally low as the assessment was made towards the end of the third year of the pruning cycle and partly during the dry season. With janam plucking the number of active shoots was significantly greater than with the other two treatments. There was no difference in the proportion of active shoots between the fish-leaf plucking and the control.

4. Weight of prunings

The fresh weight of prunings, separated into foliage and stems is given in Table 3.

TABLE 3 — *Effect of severity of plucking on foliage and stem production*

Treatment	Fresh weight of pruning in kg/ha		
	Foliage	Stem	Total
Control	5,760 (100)	10,890 (100)	16,650 (100)
Fish-leaf plucking	4,710 (82)	10,300 (95)	15,010 (90)
Janam plucking	3,150 (55)	8,700 (80)	11,850 (71)
LSD (P=0.05)	767 (13)	1316 (12)	1608 (10)

Notes: Data expressed as a per cent of the control is given in parenthesis.

The weight of pruning was significantly decreased with increasing severities of plucking. The prunings from the fish-leaf and janam plucking treatments were 10% and 29% respectively, less than that of the control. Fish-leaf and janam plucking markedly affected the foliage component of the prunings and was 18% and 45%, respectively, less than the control. The weight of stems in the fish-leaf plucking treatment was not significantly different from the control but the janam plucking decreased the stem weight significantly by 20%.

5. Root reserves

The amount of polysaccharide reserves in the root wood at the time of pruning is given in Table 4.

TABLE 4 — *Effect of severity of plucking on root reserve (polysaccharide) status prior to pruning*

Treatment	Reserve in root wood (g/100 g residue)
Control	17.9
Fish-leaf plucking	20.5
Janam plucking	19.6
LSD (P=0.05)	2.9

There was no significant difference between treatments in the level of reserve in the root wood two years after the imposition of the plucking treatments.

6. Recovery from pruning

The number of new shoots, number of leaves, mean leaf size and leaf area per bush 4 months after pruning are presented in Table 5.

TABLE 5—*Effect of severity of plucking on the development and growth of new shoots after pruning*

<i>Treatment</i>	<i>New shoots per bush a)</i>	<i>Fully Expanded leaves per bush a)</i>	<i>Leaf area per leaf (sq. cm)</i>	<i>Leaf area per bush (sp. cm)</i>
Control	3.70 (13.8)	9.32 (88)	30	2661
Fish-leaf plucking	3.69 (13.7)	9.35 (90)	33	2990
Janam plucking	3.65 (13.6)	9.92 (102)	30	3208
LSD P=0.05)	0.34	2.36	4.7	1711

Notes : a) Analysis done in arcs in back-transformed data within parenthesis.

These growth parameters were not significantly different between treatments.

DISCUSSION

The results presented in Table 1 clearly indicated that the more severe methods of plucking gave higher yields. Over a period of two years the yield from fish-leaf plucking and janam plucking was 12% and 14% more than that from the estate practice, which was, the least severe method of plucking tested. During the first six months the increase was spectacular with fish-leaf plucking and janam plucking yielding 35% and 42% more than the estate practice. A smaller increase of approximately 10% was obtained during the next six months, and over the second year there was no significant difference in yield between the three severities of plucking.

Visser (1960) compared continuous single-leaf plucking with "limited fish-leaf plucking" in low-grown seedling tea. The latter gave a yield increase of 15% over a period of three years. He postulated that the increase in yield by harder plucking was due to (a) quicker production of crop shoots of harvestable size, (b) production of larger numbers of crop shoots per bush, (c) enhanced photosynthetic efficiency as a result of better light penetration into the lower layers of the crop canopy, and (d) stimulation of leaf growth at the expense of wood growth. Our results indicate that these factors contribute in some measure towards the increase in yield with harder plucking.

In other studies on shoot growth, we have noted, in high yielding clonal tea in the low country, an axillary bud develops into a shoot with three foliage leaves in 47 days. The average time taken for the addition of a foliage leaf is five days (unpublished). Therefore, in fish-leaf plucked tea a crop shoot would remain on the bush for 5 days less than in single-leaf plucked tea. This means, the turnover of crop shoot is about 10% greater with fish-leaf plucking and, a corresponding increase in yield could be expected.

Fish-leaf plucking and janam plucking increased the number of pluckable shoots by 16% and 31%, respectively, over the estate practice (Table 2). This is attributed to multiple shoot growth with harder plucking (Visser, 1960). Our observations confirm this finding. However, the increase in the number of crop shoots is accompanied by a corresponding decrease in the weight per shoot which nullifies any advantage that might accrue from the proliferation of plucking points. This, however, needs further investigation, as it must be noted that the assessments of the size and number of crop shoots in the present study was carried out during the course of the second year, when, in fact, the difference in yield between treatments was not significant.

The severity of plucking also influenced the proportion of crop shoots with active buds. Janam plucking gave the largest number of crop shoots with active buds. While this could be attributed to the earlier harvesting of shoots it may also be a reflection of the general state of "activity" of the entire bush. The excessively shaded, old maintenance leaves in lower layers of the canopy have been suspect as sources of growth inhibitors (Pethiyagoda, 1964b). Janam plucking drastically reduced the number of maintenance leaves, and this allows better light penetration and illumination of the foliage at lower levels. If the hypothesis advanced by Pethiyagoda is valid, janam plucking would reduce the production of inhibitors which in turn would reduce the formation of dormant buds and shorten the duration of the dormant phase. The production of a large number of crop shoots per bush, as well as the increase in the proportion of crop shoots with active buds brought about by janam plucking lend support to this hypothesis.

The production of wood, foliage and crop shoots, which comprises the major portion of the vegetative growth over the three-year cycle, is summarised in Table 6.

TABLE 6 — *Effect of severity of plucking on crop, foliage and stem production over the three-year cycle (kg/ha fresh weight)*

	Crop		Prunings		Total Growth	Harvest Index
	1st year (No treatments)	2nd & 3rd years	Foliage	Stem		
Control	4210	20,230	5760	10,890	41,090 (100)	59.5%
Fish-leaf plucking	4225	22,745	4710	10,300	42,010 (102)	64.3%
Janam plucking	4305	23,015	3150	8,700	39,170 (95)	69.7%
LSD (P=0.05)	NS	1120	767	1316	2013 (5)	

Notes: Data expressed as a per cent of control is given in parenthesis.

It is evident that vegetative growth as a whole has not been substantially altered by the various methods of plucking. The increase in yield with harder plucking is associated with a decrease in the production of non-harvestable vegetative tissues *viz.* stems and maintenance leaves. The "harvest index" has been raised progressively by increasingly harder plucking. Increasing the severity of plucking, therefore, offers a mechanism for channelling a greater proportion of photo-synthates into harvestable crop. In the case of janam plucking the decrease in non-harvestable growth is large, and greater than that expected on account of increased crop. It may therefore be argued that the continuous debilitation of the stems forming the frames is not advisable in a perennial crop such as tea.

However, the feasibility of employing very hard systems of plucking over relatively short periods (not exceeding 3 months each year) should be examined. If this was practicable it would afford a means of boosting yields during the seasons when teas fetch premium prices.

In this study the yield response to fish-leaf and janam plucking gradually diminished with time and, there was no difference in yield after one year. These two systems of plucking are such that very little foliage is added onto the bush and the replenishment of the maintenance foliage is minimal. The diminishing yield response may therefore be due to the aging of the maintenance leaves which could be expected to lower their photo-synthetic efficiency. This constraint may be overcome by limiting hard plucking to short periods as suggested.

It is interesting to note that even though the maintenance foliage and wood growth was considerably reduced by the harder systems of plucking particularly janam plucking, neither the root reserves nor the recovery from pruning was affected. It would seem, therefore, that even two years of continuous janam plucking has not caused a permanent setback. This investigation is being continued to study long-term effects.

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