*THE MECHANICAL PLUCKING OF TEA

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Introduction.

The experiments on the mechanical plucking of tea as carried out by me here on Dickwella Estate, Hali-Ela, with the Tarpen Cropper with advice and assistance from the Tea Research Institute of Ceylon have, I think, created some controversy and enough interest to justify a review of my work to-date.

Dickwella, near Badulla in the Uva Province of Ceylon, lies in hilly country between 2,000, to 4,000 feet, where rainfall is low and annual droughts coupled with high wind in the S.W. monsoon are a normal occurrence.

Before proceeding, I have to record the Tarpen Engineering Company's and my grateful thanks to the Directors of the Dickwella Tea Company, Ltd., and Messrs. Whittall & Company, Colombo, for kindly permitting us to carry out the experiments, and also to the numerous officers of the Tea Research Institute for their readily offered and gratefully accepted guidance, assistance and encouragement in the work involved. I have also to thank the Assistants and the members of the estate staff here who readily co-operated in the work, at the expense of their leisure.

Machines.

The Tarpen Cropper is too well known to call for repetition of its description here, except to report that a new system of power transmission has been evolved by which the cropper is driven by a flexible drive powered by a fractional H.P. motor. This motor is carried on the operator's back. The original electric model is supplied with power from a portable generator through long flexes or cables These cables are hauled through the tea by the operator as he works up a row, and drawn back to the road by another labourer as required. Although this system appears cumbersome it is not so in actual use.

Mr. H. M. O'Connor of the New Dooras Tea Estates, Dooras District, S. India, has ably demonstrated that the Jeep will afford further mobility to the electric model. However, the new flexible drive or knapsack model should give complete freedom of operation and prove particularly useful in contour planted areas.

A possible refinement in the use of the electric model has been suggested by Mr. C. J. Harrison of the Indian Tea Association Experimental Station at Tocklai, Assam. It is however restricted to flat land which, unfortunately, is not available in Ceylon tea districts. The method requires a light frame mounted on wheels and high enough to straddle one row of bushes. This frame would carry the generator and also a light cross arm. The cross arm would bear six or eight equally spread power plugs. The croppers could then be plugged into the points on the cross arm and the whole unit pushed along the row at the rate required by those operating the croppers. The wheels could be mounted on the same way as castors for.

* The Institute does not necessarily endorse the views expressed in papers contributed by persons other than members of the staff.

Fig. 1. Mechanical Plucker in action.

Figs. 2. General view of mechanical plucking showing battery of pluckers and generator.

Experiments.

Dr. T. Eden, late of the Tea Research Institute, organised the field experiments on Dickwella. The main aims of the experiments are —

1. To compare the cropping capacity of the bushes plucked by hand and by mechanical means both with regard to total crop, and to the distribution of crop within the season and the pruning cycle.

2. To compare the quality of tea made from each source.

Two units were laid down, with adequate randomized replication and they are known as Units 1 and 2, each of 6,000 and 8,000 productive bushes respectively, half of which are hand and half machine plucked.

I myself put a third Unit or block of tea of some 9 to 10 acres under mechanical plucking with a view to using this Unit as a school for labour, a demonstration plot, and also to yield data on break-downs, fuel consumption, the reactions of the equipment to weather, costs, etc.

It is relevant to point out here that the 3 units are widely dispersed over the estate, they were all three, pruned, tipped and brought into hand or mechanical plucking at approximately the same time (about two years ago) and in the case of Units Nos. 1 and 2, the machines are pitted against the best hand pluckers. Further, no special pruning or manurial preparation of the Units has been done before or since the start of the experiments. The system of pruning and manuring most suitable to mechanical plucking has yet to be investigated.

Unit No. 1.—This unit is divided into 30 blocks, half of which are hand and half machine plucked. Harvesting by both methods is done on the same day at set 10 day or average 10 day intervals, irrespective of growth or any other factor, and all yields carefully recorded.

The first cropping or harvesting took place on the 9th of August, 1948, four months after pruning and two months after tipping, since when 63 pluckings have been done up to the 22nd April 1950 — a period of 621 days. The aggregate yield in the mechanically plucked blocks is 6,397 lbs. of green leaf against 6,227 lbs. from the hand plucked blocks in the same Unit. This Unit, as well as the other two, has another year to run before the end of the experiment at the completion of a 3 year pruning cycle. Table I, reproduced below, shows the result of each individual pluck and the yields obtained are in direct contradiction to those found by Mr. N. Kanagaratnam in Malaya (1).

TABLE I.

Unit No. 1. (Average 10 Day Rounds).

Yield of Green Leaf in pounds.

Date of Pluck.	Yield per pluck		Cumulative Total	
	Machine.	Hand.	Machine.	Hand.
9. 8.48	116.4	179.5	116.4	179.5
19. 8.48	93.6	115.0	210.0	294.5
30. 8.48	84.7	120.4	294.7	414.9
9. 9.48	68.2	78.3	362.9	493.2
18. 9.48	69.7	76.8	432.6	570.0
29. 9.48	55.9	65.1	488.5	635.1
9.10.48	51.3	42.1	539.8	677.2
20.10.48	52.2	50.5	592.0	727.7
29.10.48	65.7	63.3	657.7	791.0
8.11.48	168.7	135.1	826.4	926.1
18.11.48	104.7	128.1	931.1	1,054.2
27.11.48	118.6	107.0	1,049.7	1,161.2

TABLE I.—(Continued).

Unit No. 1. (Average 10 Day Rounds).

Yield of Green Leaf in pounds.

Date of Pluck.	Yield per pluck		Cumulative Total	
	Machine.	Hand.	Machine	Hand.
8.12.48	77.1	96.7	1,126.8	1,257.9
18.12.48	88.5	75.4	1,215.3	1,333.3
28.12.48	103.6	107.3	1.318.9	1,440.6
7. 1.49	103.3	110.3	1,422.2	1,550.9
17. 1.49	54.9	63.4	1,477.1	1,614.3
27. 1.49	52.6	48.7	1,529.7	1,663.0
5. 2.49	40 5	45.8	1,570.2	1,708.8
17. 2.49	49.5	54.3	1,619.7	1,763.1
26. 2.49	89.3	83.2	1,709.0	1,846.3
8. 3.49	127.4	127.4	1,836.4	1,973.7
18. 3.49	99.1	92.1	1,935.5	2,065.8
28. 3.49	95.2	81.2	2,030.7	2,147.0
6. 4.49	87.7	65.7	2,118.4	2,212.7
16. 4.49	110.2	84.4	2,228.6	2,297.1
26. 4.49	180.0	144.4	2,408.6	2,441.5
6. 5.49	165.5	151.9	2,574.1	2.593.4
16. 5.49	133.6	127.4	2,707.7	2,720.8
26. 5.49	88.3	79.9	2.796.0	2,800.7
6. 6.49	103.1	94.7	2,899.1	2,895.4
16. 6.49	80.9	87.2	2,980.0	2,982.6
25. 6.49	72.9	88.1	3,052.9	3,070.7
5. 7.49	56.7	57.0	3,109.6	3,127.7
15. 7.49	43.0	44.7	3,152.6	3,172.4
25. 7.49	42.6	38.4	3,195.2	3,210.8
4. 8.49	60.0	65.9	3,255.2	3,276.7
15. 8.49	93.7	109.3	3,348.9	3,386.0
25. 8.49	116.2	117.6	3,465.1	3,503.6
5. 9.49	123.4	132.9	3.588.5	3,636.5
15. 9.49	115.3	114.2	3,703.8	3,750.7
24. 9.49	115.1	121.7	3,818.9	3,872.4
4.10.49	134.5	137.8	3,953.4	4,010.2
14.10.49	114.7	116.8	4,068.1	4,127.0
24.10.49	124.0	128.6	4,192.1	4,255.6
4.11.49	180.0	171.9	4,372.1	4,427.5
14.11.49	152.3	138.5	4,524.4	4,566.0
23.11.49	131.9	107.7	4.656.3	4,673.7
3.12.49	141.4	126.9	4,797.7	4,800.6
13.12.49	120.5	108.8	4,918.2	4,909.4
23.12.49	174.0	132.9	5,092.2	5042.3
2. 1.50	82.2	61.8	5,174.4	5,104.1
12. 1.50	37.8	42.6	5,212.2	5,146.7
23. 1.50	59.7	44.8	5,271.9	5,191.5
1. 2.50	63.4	48.7	5,335.3	5,240.2
11. 2.50	94.5	81.6	5,429.8	5,321.8
23. 2.50	171.0	159.7	5,600.8	5,481.5
3. 3.50	167.6	156.9	5,768.4	5,638.4
13. 3.50	107.5	107.7	5,875.9	5,746.1
23. 3.50	120.5	110.5	5,996.4	5,856.6
1. 4.50	117.7	103.3	6.114.1	5,959.9
10. 4.50	124.8	117.5	6.238.9	6,077.4
22. 4.50	158.3	149.7	6,397.2	6,227.1

Unit No. 2.—The layout and treatment of this Unit is identical to Unit No. 1 except that it contains more tea bushes (8,000) and hence more blocks (40 in all) and a slight variation in the randomized replication has been applied. The aim in this Unit is to record the yield when crop is taken by hand or machine as and when either is judged ready.

It was easy to assess the readiness of the hand plucked blocks but my judgment as to when the machine plucked blocks were ready for harvesting was evidently seriously at fault and remained so until Mr. G. B. Portsmouth of the Tea Research Institute kindly made an appreciation of the situation and advised a drastic elongation of the rounds over the mechanical plucked blocks in this Unit. This gave immediate and phenomenal results in increased crops but again the human factor came into fault through too close cropping and yields started to fall off once more. Since then an improvement to the cropper, suggested by Mr. F. C. Daniel of St. Coombs (the Tea Research Institute Station) has been used automatically to control cropping levels.

The table of yields from this Unit appears below (Table II), and while it reflects the errors that occurred it also stresses the ignorance with regard to a *modus operandi* for mechanical plucking. This table together with that for Unit No. 1 also emphasises the fallacy of drawing dogmatic conclusions after a few weeks or even months experimentation.

TABLE II.

Unit No. 2. (Plucked when ready).

Yield of Green Leaf in ounces.

Date of Pluck.	Yield per pluck		Cumulative Total	
	Machine.	Hand.	Machine.	Hand.
10. 8.48	123.8	172.9	123.8	172.9
20. 8.48	110.6	172.4	234.4	345.3
27. 8.48	84.1	106.7	318.5	452.0
6. 9.48	91.8	119.0	410.3	571.0
15. 9.48	94.8	111.2	505.1	682.2
23. 9.48	90.5	135.2	595.6	817.4
2.10.48	81.6	121.6	677.2	939.0
11.10.48	131.7	150.0	808.9	1,089.0
19.10.48	117.6	118.5	926.5	1,207.5
28.10.48	116.5	112.6	1,043.0	1,320.1
5.11.48	150.8	147.0	1,193.8	1,467.1
12.11.48	122.9	149.8	1,316.7	1,616.9
22.11.48	148.3	153.5	1,465.0	1,770.4
30.11.48	145.0	147.6	1,610.0	1,918.0
9.12.48	130.7	178.2	1,740.7	2,096.2
20.12.48	124.3	112.9	1,865.0	2,209.1
30.12.48	98.4	122.3	1,963.4	2,331.4
11. 1.49	75.0	71.9	2,038.4	2,403.3
21. 1.49	8.6	11.4	2,047.0	2,414.7
31. 1.49	28.0	35.7	2,075.0	2,450.4
9. 2.49	69.3	87.5	2,144.3	2,537.9
19. 2.49	217.5	235.1	2,361.8	2,773.0
28.2.49	161.5	170.6	2,523.3	2,943.6
7. 3.49	220.9	216.3	2,744.2	3,159.9
15. 3.49	178.8	179.2	2,923.0	3,339.1
25. 3.49	124.4	127.6	3,047.4	3,466.7
2. 4.49	102.6	105.2	3,150.0	3,571.9
11. 4.49	150.4	166.1	3,300.4	3,738.0
20. 4.49	205.6	169.8	3,506.0	3,907.8
28. 4.49	273.5	288.1	3,779.5	4,195.9

TABLE II.—(Continued).

Unit No. 2. (Plucked when ready).

Yield of Green Leaf in ounces.

Date of Pluck.	Yield per pluck		Cumulative Total	
	Machine.	Hand.	Machine	Hand.
7. 5.49	239.5	208.1	4,019.0	4,404.0
17. 5.49	222.7	190.0	4,241.7	4,594.0
25. 5.49	152.7	229.6	4,394.4	4,823.6
3. 6.49	136.8	198.6	4,531.2	5,022.2
11. 6.49	202.0	264.4	4,733.2	5,286.6
21. 6.49	197.0	223.7	4,930.2	5,510.3
1. 7.49	92.6	128.2	5,022.8	5,638.5
11. 7.49	87.8	135.6	5,110.6	5,774.1
22. 7.49	168.2	150.5	5,278.8	5,924.6
1. 8.49	140.9	146.8	5,419.7	6,071.4
11. 8.49	138.5	163.9	5,558.2	6,235.3
20. 8.49	152.2	181.1	5,710.4	6,416.4
30. 8.49	285.6	296.8	5,996.0	6,713.2
9. 9.49	169.6	175.6	6,165.6	6,888.8
19. 9.49	202.0	189.7	6,367.6	7,078.5
30. 9.49	137.7	159.8	6,505.3	7,238.3
10.10.49	160.5	157.3	6,665.8	7,395.6
20.10.49	—	229.6	—	7,625.2
31.10.49	770.0	225.0	7,435.8	7,850.2
11.11.49	—	153.5	—	8,003.7
24.11.49	240.3	158.8	7,676.1	8,162.5
6.12.49	—	98.4	—	8,260.9
16.12.49	—	181.4	—	8,442.3
17.12.49	273.7	—	7,949.8	—
29.12.49	—	116.6	—	8,558.9
9. 1.50	177.4	—	8,127.2	—
13. 1.50	—	58.1	—	8,617.0
26. 1.50	—	52.1	—	8,669.1
30. 1.50	53.7	—	8,180.9	—
2. 2.50	—	54.8		8,723.9
14. 2.50	228.4	210.1	8,409.3	8,934.0
24. 2.50	—	356.9	—	9,290.9
1. 3.50	615.3	—	9,024.6	—
10. 3.50	—	594.0	—	9,884.9
18. 3.50	244.6	168.0	9,269.2	10,052.9
28. 3.50	—	328.8	—	10,381.7
5. 4.50	262.0	—	9,531.2	—
7. 4.50	—	232.0	—	10,613.7
18. 4.50	299.6	356.4	9,830.8	10,970.1

Unit No. 3.—This is a 9 to 10 acre block of tea, chosen by me for its variable terrain, on which to essay answers to the questions posed above. No scientific control appeared possible nor was any attempted, though the figures quoted are actual ones taken from the records.

It was evident very early on that it would be advisable to have as many labourers as possible familiar with Mechanical Plucking to dispel any illusions about the skill required in operation. The ease with which any ordinary male Tamil labourer adapted himself to the job soon overcame this possible defect.

As a demonstration plot, the area fully justified itself. The extraordinary improvement in the spread of the bushes and the high multiplication of the plucking points per bush are immediately obvious to anyone familiar with tea.

The plot also proved that the machines are mechanically sound. They have worked at 3,500 feet elevation in a battery of six, with no major breakdowns, except some teething troubles with the armatures in the cropping motors, in all kinds of weather from drought to torrential rain.

Before going into detail of costs it is necessary to stress the following —
1. Mechanical plucking enables harvesting to be done very much less frequently than hand plucking. At the present time the optimal frequency would appear to be about half that of hand plucking. The whole question, however, still requires much further investigation.

2. One cropper or two labourers can harvest between 3/4 to 1¼ acres of tea per 8 hour day.

Costs are so intimately related to the preparation of the bush from and including pruning, and the amount of crop on offer, that it is impossible to dogmatize at this stage. However, the following comparative figures of cost per acre and per pound of made tea together with actual harvesting figures are of interest and do, I think, establish the possibility of very substantial savings being inherent in mechanical plucking. It must be remembered that the mechanical plucking costs include work done by untrained labour, over unprepared bushes, as well as numerous adaptions in method as and when thought advisable.

Comparative Costs inclusive of Dearness Allowance but excluding depreciation.

	Per Acre.		Per Pound.	
	Machine.	Hand.	Machine.	Hand.
January 1950 (Low Crop)	Rs. 3/50	Rs. 2/78	Cts. 78.03	50.42
March 1950 (High Crop)	Rs. 5/68	Rs. 8/94	Cts. 14.57	21.77

Actual harvesting figures (green leaf) from the last three mechanical plucks of — Unit 3.

Date.	No. of Coolies.	Hours worked.	Green Leaf lbs.	Average per hour per cooly.
24/3 — 25/3/50	* 12½	250	2,300	9.2
11/4 — 12/4/50	* 13	266½	2,570	9.7
28/4 — 3/5/50	* 13	351½	3,560	10.0
Total	38½	868	8,430	9.7

* Including sack cooly.

	No.	MACHINES.		Avg. p. hour p. machine.
24/3 — 25/3/50	6	120	2,300	19.1
11/4 — 12/4/50	6	123	2,570	20.9
28/4 — 3/5/50	6	105	3,560	34.0
Total	18	348	8,430	24.2

The maximum crew required to operate electrically powered croppers is 2 labourers each, whereas a maximum of only 1.5 labourers per machine will be necessary to operate the "knapsack," self powered model with the added advantage of complete freedom of operation in the latter.

Manufacture.

In the early stages of my work (18 months ago) rigorously controlled experiments, on the manufacture of machine and hand plucked leaf gave a broad answer to the question of quality, at any rate sufficiently good to allay any fears of a marked deterioration in quality. Although standards of appearance declined, the results justified the continuation of the experiments.

Since then no further manufacturing experiments have been carried out until very recently when one was carried out to investigate the effect of an abnormally lengthy round on mechanically harvested leaf.

Unit No. 2 was plucked on the same day by hand and machine with the difference that the hand leaf was only 8 days old whereas the machine leaf was 17 days old. The samples drew a mixed reception, some tasters giving considerable preference to the hand plucked teas, others finding no difference whatever, except with regard to appearance which was rated inferior to the standard of hand plucking.

Social Repercussions.

It has been suggested that mechanical plucking of tea, when proved and generally adopted, will give rise to undue or mass unemployment. Such an outlook is reactionary to say the least, and similar to that of the opponents of the mechanization of the cotton trade in the last century. Such an attitude is incompatible with progress and the provision of better living conditions for tea estate labour.

Summary and Conclusions.

Machines.—It is obvious that such an adaption as mounting the generator on a Jeep or mobile frame, as envisaged above, will give full mobility to the electric models, though the aim is already accomplished by manhandling the generators, cables and machines as required.

Powering of the cropper by a light engine carried by the operator will give complete freedom of movement but has yet to be tested under field conditions.

Field Trials.—Data from Units 1, 2 and 3 prove that so far there is no danger of loss of crop and indicate a possible increase in yield. Over and above this, the market improvement in spread of the bushes gives the added benefits of increased plucking points and complete soil cover, thus reducing erosion and weed growth to a minimum.

Manufacture.—Here too there appear to be no ground to fear deterioration of the finished product except perhaps in appearance. Further knowledge of cropping procedure and improved coarse leaf extractors should overcome any defect in appearance. Also the fact that leaf is untouched by hand from bush to lofts is a great advantage.

Cost.—This will be the deciding factor where ample skilled labour is available but strong indications of substantial savings are apparent even where the machines are pitted against very efficient pluckers, as in Ceylon. In countries short of labour their advantage needs no emphasis.

Labour.—The mechanization of tea plucking is such a revolutionary process that it cannot help but effect labour conditions though obviously for the better in the long run.

Acknowledgment.

I have to reiterate my grateful thanks to those already mentioned and in particular to Mr. J. Lamb, the Director of the Tea Research Institute, for his unfailing help and encouragement.

Reference.

(1) Malayan Agricultural Journal, Vol. 32, No. 3 of July 1949.