

台灣高級茶區之手採改行機採

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摘 要

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採工不足與高茶葉採摘成本，為台灣茶園經營最困擾問題。如何將手採改行機採，為茶農最迫切需要者。由已往試驗結果，我們已可肯定，目前在各茶區最主要的青心烏龍種茶樹，若予適當的剪枝整型，也可適於機械採摘。

雖然手採茶菁製成之茶葉，其平均品質稍優於機採，但其差異並不顯著。

事實上，機採的成本還低於手採成本之十分之一，它是引發農民興趣的主因。截至目前為止，本省已有超過 80%以上茶園由手採改行機採。

CONVERSION OF HAND PLUCKING TO MECHANICAL PLUCKING IN HIGH GRADE TEA AREAS IN TAIWAN

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Abstract

Labor shortage and high cost of hand plucking are the most limiting problems for tea farmers in Taiwan. To solve these problems, conversion from hand plucking to mechanical plucking is urgently needed. This can be realized if proper pruning and plucking can be carried out for Ching-Hsin-Oolong cultivar which is the most important local cultivar in Taiwan.

On average, the quality of partially-fermented made tea from hand plucking was found to be slightly better than that of mechanical plucking, although, the difference was not highly significant.

The fact that the cost of mechanical plucking was found to be as low as one-tenth that of hand plucking has attracted the attention and interests of tea growers. Currently, more than 80% of the tea growers in Taiwan have converted from hand plucking to mechanical plucking.

Introduction

Ching-Hsin-Oolong is the most important cultivar in producing high grade partially fermented tea in Taiwan. In such tea areas, the plucking period is too short and concentrated for tea growers to pluck leaves with a shortage of labour. Owing to this, growers are forced to advance or defer their plucking time to lengthen the plucking period. Thus, parts of made tea quality cannot be controlled resulting in a reduction of tea quality. Although growers are able to hire labourers, it is difficult to persuade them to pluck only one bud plus two or three leaves by hand, because wages of the labourers are paid according to weight of the plucked leaves. Tea growers have to face the labour shortage plus problems of the increasing cost of plucking and the decrease in tea quality. In order to investigate and resolve these problems in tea leaf plucking, an experiment was conducted from the winter of 1982.

Power tea pluckers are used mostly in green tea or lower grade partially-fermented tea areas where Ching-Hsin-Dah-Pan cultivar is common. Mechanical plucking and proper pruning were found to cause a change in the characters of tea shoots and enlargement of the plucking surface resulting in a yield increase (Fong, 1982). High plucking efficiency and low plucking cost are special features of mechanical plucking (Chang, 1966). In converting from hand plucking to mechanical plucking in the high grade partially fermented tea areas, two-men power tea pluckers instead of one man power tea pluckers were introduced (Hsu and Lee, 1978) according to the growth of tea bushes and the situation of the experimental tea gardens. After two years experimental work and demonstrations and extension on mechanical plucking, over 3000 hectares of previously hand plucked high grade partially-fermented tea gardens have been converted to mechanical plucking.

Materials and Methods

Two tea areas were chosen, namely Ming-Chien located in central Taiwan, and Tung-Shan located in northeast Taiwan. Most tea gardens in these two areas are on level topography and are suitable for mechanical plucking by the two-man power tea plucker. The Japanese model Ochai V8-ZA 1000 plucker was used.

Two treatment plots (hand plucking and mechanical plucking) without replications were set up in each area. Statistical analysis was based on five seasonal crops in which experimental errors were calculated. The experimental plots of each treatment comprised 3 rows of 67 m length and 4 rows of 77 m length in Ming-Chien and Tung-Shan, respectively. For mechanical plucking, tea leaves were plucked to the level which maintained at least one or more flush leaves on the flush shoot. Analysis of the pluck showed that approximately two thirds of the plucked leaves were found to be one bud with two to three leaves. For hand plucking, one bud with two to three leaves were plucked.

Before converting hand plucking to mechanical plucking, it was necessary to prune tea bushes in the winter a year before (Fong, 1980) to establish a proper plucking surface for two-man power tea plucker. The differences in tea shoot characters, yield of tea leaves, quality of made tea, and the cost analysis between hand plucking and mechanical plucking were investigated. The experiment was conducted from winter 1982 to the end of 1984.

Results

After two years of machine plucking, the width of the tea bush was found to have increased by 38 % compared with hand plucking in Tung-Shan, and the increase was 15 % in Ming-Chien. However, only a small difference in height of tea bushes was found between hand and mechanical plucking treatments.

Twig density and tea shoot growth were found visually to have greatly changed after being converted to mechanical plucking. Table 1 shows the twig density and twig diameter on the pruned surface in winter. The results indicated that density increased while diameter decreased in the mechanical plucking treatment. Such growth characteristics are considered to be advantageous for uniformity of tea shoot growth.

Table 1. Density and diameter of twig (measured on a 30cm × 30cm sector) on the pruned surface in winter.

		1982		1983		1984	
Tea area	Plucking method	Density of Twig	Diameter of twig(mm)	Density of Twig	Diameter of Twig(mm)	Density of Twig	Diameter of Twig(mm)
Tung-Shan	Mechanical	67.4	2.6	78.0	1.6	82.1	1.5
	Hand	65.4	2.8	59.8	2.8	63.5	2.5
Ming-Chien	Mechanical	61.1	2.5	80.4	1.6	84.2	1.6
	Hand	58.6	2.3	56.6	2.3	58.5	2.2

Results in Table 2 show that the sprouting density in the mechanical plucking treatment

has been inceased dramatically and the increase was more obvious in the 2nd year. Though high sprouting density is advantageous for greater uniformity of tea shoot growth, the tea shoots grow thinner and smaller. All the data shown below were the yearly five seasonal crops. M. P. refers to mechanical plucking and H. P. refers to hand plucking. Using the paired t-test.

Table 2. Comparison of sprouting density (buds/900 cm²)

Year	Tea area	Plucking method	Crops					Ave.	t-value
			Spring	1st Summer	2nd Summer	Autumn	Winter		
1983	Tung-Shan	M.P.	31.0	70.4	84.4	80.1	85.9	70.4	4.156(*)
		H.P.	23.3	26.9	43.1	59.5	60.4	42.6	
1984	Tung-Shan	M.P.	124.6	133.5	151.0	147.0	155.0	142.2	9.345(**)
		H.P.	78.0	49.1	63.0	68.0	60.0	63.6	
1983	Ming-Chien	M.P.	36.2	69.3	110.3	95.2	112.3	84.6	2.511
		H.P.	48.6	45.5	56.9	61.6	63.1	55.1	
1984	Ming-Chien	M.P.	130.3	141.2	131.9	137.1	100.7	124.8	14.092(**)
		H.P.	54.8	79.7	66.7	57.9	47.7	61.4	

$t_{0.05}^4 = 2.776(*)$ $t_{0.01}^4 = 4.604(**)$

In the winter before the plucking experiment was carried out, the experimental tea bushes were pruned heavier than usual for the purpose of using the power tea plucker. For this reason, the twig density and sprouting density were reduced significantly in the first year. This explains why the yield of mechanical plucking was close to that of hand plucking in the first plucking year, 1983. In the second plucking year 1984, the width of the tea bushes and density of sprouting increased dramatically leading to a larger yield increase in mechanical plucking treatment (Table 3).

Table 3. Comparison on yield of fresh tea leaves (Kg/plot).

Year	Tea area	Plucking method	Crops					Ave.	t-value
			Spring	1st Summer	2nd Summer	Autumn	Winter		
1983	Tung-Shan	M.P.	49.0	98.4	61.2	88.8	71.1	81.2	0.661
		H.P.	76.1	71.0	49.7	65.7	73.2	67.1	
1984	Tung-Shan	M.P.	126.2	122.4	128.2	110.5	79.4	113.3	2.251
		H.P.	113.7	79.6	86.7	93.2	82.9	91.2	
1983	Ming-Chien	M.P.	54.0	78.0	109.0	93.0	72.0	81.2	0.351
		H.P.	78.0	73.2	89.0	89.0	80.9	82.0	
1984	Ming-Chien	M.P.	108.4	109.4	111.8	90.0	47.0	93.3	1.426
		H.P.	120.0	94.4	87.0	80.0	42.0	84.7	

$t_{0.05}^4 = 2.776(*)$ $t_{0.01}^4 = 4.604(**)$

A significant change in tea shoot characters can be found by comparing the weight of 100 tea shoots. Table 4 shows that there was little difference between hand plucking and mechanical plucking treatments in the first year. In the 2nd year, the weight of 100 tea shoots from mechanical plucking was significantly smaller.

Table 4. Comparison of the weight of 100 tea shoots(g).

Year	Tea area	Plucking method	Crops					Ave.	t-value
			Spring	1st Summer	2nd Summer	Autumn	Winter		
1983	Tung-Shan	M.P.	61.0	81.1	83.0	67.0	59.0	70.2	0.009
		H.P.	45.8	88.6	83.5	66.0	65.2	69.8	
1984	Tung-Shan	M.P.	85.0	65.0	71.0	68.0	40.0	65.8	-4.122(*)
		H.P.	90.0	68.0	80.0	70.2	45.0	70.6	
1983	Ming-Chien	M.P.	69.5	80.5	70.2	68.2	63.4	70.4	1.004
		H.P.	71.4	76.0	68.2	68.7	62.0	69.3	
1984	Ming-Chien	M.P.	76.5	73.0	68.0	63.0	58.0	67.7	-4.786(**)
		H.P.	80.0	76.5	75.1	67.0	60.0	71.7	

$t_{0.05} = 2.776(*)$ $t_{0.01} = 4.604(**)$

For tea quality, the plucked fresh tea leaves were sent to the grower's factory to process the partially fermented tea. The total scores (100%) of made tea quality comprised 20% appearance, 20% colour, 20% colour of liquor, 30% flavor and taste, and 10% of infused leaves. A comparison of tea quality is shown in Table 5. The made tea quality from mechanical plucking was found to be inferior to that of hand plucking, however the difference was not significant. The quality of the made tea from mechanical plucking in the second year was better than the first year. This was due to the improvement of sprouting density and the uniformity of tea shoots.

Table 5. Comparison of the quality of made tea. (sensory testing scores)

Year	Tea area	Plucking method	Crops					Ave.	t-value
			Spring	1st Summer	2nd Summer	Autumn	Winter		
1983	Tung-Shan	M.P.	75.3	71.6	72.5	67.5	73.5	72.1	-1.109
		H.P.	74.4	71.7	75.2	69.5	72.7	72.7	
1984	Tung-Shan	M.P.	72.5	73.1	73.8	76.2	77.1	74.5	-0.311
		H.P.	76.5	72.8	72.5	75.2	76.8	74.8	
1983	Ming-Chien	M.P.	72.3	71.5	72.0	66.0	75.0	71.4	-2.657
		H.P.	75.2	72.1	72.2	68.5	76.2	72.8	
1984	Ming-Chien	M.P.	74.6	72.7	73.2	77.3	78.2	75.2	-0.478
		H.P.	76.8	74.2	74.3	74.3	78.2	75.6	

$t_{0.05} = 2.776(*)$ $t_{0.01} = 4.604(**)$

The Ming-Chien tea area was chosen to conduct cost analysis for the two plucking methods for estimating cost-effectiveness of the 2 systems.

The cost of purchasing, maintenance, fuel, labor of operating machine and the incomes of selling made tea were cosidered in the analysis. As a result, the total annual profits for the growers who have converted hand plucking to mechanical plucking in Ming-Chien tea area might be over 200 thousand N.T.\$ per year.

Discussion

Converting from hand plucking to mechanical plucking was found to have both positive and negative influences on the growth and yield of tea plants and made tea quality. However, most tea growers have accepted that mechanical plucking can not only reduce the plucking costs, dramatically increase the profits, and obviate the labor hiring difficulty, but can also pluck and suitable quantity of fresh tea leaves to the factory within the best plucking interval. For the present, some high grade tea areas still pluck tea leaves by hand. Probably there is no serious problem for labor hiring in these areas. Moreover, in the areas, the negative effect of mechanical plucking on quality may not be compensated by the positive effect of yield increase and lowering costs from mechanical plucking. For these reasons, such areas are not our targets of converting the plucking method yet, but we strongly believe they will change to mechanical plucking one day.

It is important that before converting from hand plucking to mechanical plucking, tea bushes must be pruned properly. The skills of mechanical plucking must be studied. Also the phenomenon of increased sprouting density which may cause the tea shoots to become thinner, smaller and lighter must be attended to. It is very important for tea growers who convert from hand plucking to mechanical plucking to restore the vigour of the tea plants by pruning and thus improve the characteristics of the tea shoots.

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