

## **Yield performance and selection of potential Liberica coffee clones** (Prestasi hasil dan pemilihan klon kopi Liberica berpotensi)

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Key words: coffee, *Coffea liberica*, yield performance, selection, clones

### **Abstract**

An evaluation of 12 Liberica coffee clones including current recommended clone, as a check, showed significant differences in yield and other parameters evaluated. Three clones namely MCL 093, MCL 118 and MCL 169, which were superior in yield, berry and bean sizes, were identified and selected for recommendation. Their respective potential mean fresh berry yields of 24.27, 25.07 and 26.23 t/ha were equivalent to green bean yields of 2.45, 2.62 and 2.29 t/ha. Their average fresh berry and green bean yields of 25.19 t/ha and 2.45 t/ha were respectively 16% and 17% higher as compared to the check. The increment in the mean yields, berry and bean sizes of these three selected clones as compared to the mean of the current recommended clones was also discussed.

### **Introduction**

Liberica type coffee (*Coffea liberica* Bull ex Heirn) and Robusta type coffee (*Coffea canephora* Pierre ex Froehner) both indigenous to the African Continent, were introduced to Peninsular Malaysia in the 19th century (Bunting and Milsum 1930). Both species are suitable to be cultivated in the lowland areas of the warm tropical climate of this country. However, due to the high labour requirement especially during harvesting of ripe berries, the coffee species are planted by smallholders either as monocrop or intercropped with coconut and fruit trees. Liberica coffee is preferred by local growers as compared to Robusta coffee due to higher yield, ease of maintenance, lower pest infestation and fetches a better price.

The genetic base of Liberica coffee in this country could be considered narrow. However, due to its self-sterile nature

(Carvalho et al. 1969), variations in yield, berry and bean sizes and other related characters among both single plants (Muhamad Ghawas and Miswan 1985) and progenies (Muhamad Ghawas and Wan Rubiah 1988, 1991) were found to be significant. The breeding strategies and selection programme (short, medium and long term) for the development of better planting materials of coffee have been highlighted (Muhamad Ghawas 1986).

The request for better planting materials by the Ministry of Agriculture (Anon. 1985) has been partially fulfilled by MARDI through the release of polyhybrid planting materials (MKL 001) in 1992 (Razak Rashid 1992; Zulkifli 1992) and three clones (MKL 002, MKL 003 and MKL 004) in 1995 (Anon. 1995a, b). The acceptance of these recommended planting materials is encouraging. Until 2004, about 1.7 tonnes of seeds and 75,000 seedlings of

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polyhybrids (MKL 1) and 36,000 clonal seedlings and 19,000 scions of clonal materials have been sold by MARDI.

In a working paper on action plans for food production in the 8th and 9th Malaysian National Plans (Anon. 2000), it was stated that the government should still continue to give support to ensure that the local coffee industry in the country is sustainable. In view of this situation, an evaluation of new potential clones was conducted. The main objectives of the study were to identify and select clones with higher yield and better quality as compared to the current recommended clones (CRC). This article reports on the performance and selection of these clones for recommendation.

### Materials and methods

A total of 12 clones inclusive of a check, grafted on a randomly selected seedling, were evaluated. The check clone (MKL 003) designated as MCL 026 during its field evaluation (Muhamad Ghawas 1994) was one of the three clones recommended and released by MARDI in 1995 (Anon. 1995a, b; Muhamad Ghawas 1995; Muhamad Ghawas and Mohamed 1995). The other two CRC were MKL 002 and MKL 004 designated as MCL 021 and MCL 045 during their field evaluations. The 11 potential clones were obtained from screening of 44 clones in a preliminary yield trial for three years at MARDI Kluang, Johor.

A positive correlation coefficient of 0.63 for Liberica coffee clones was determined earlier between yields from three-year-old plants after field planting and cumulative yield over 8 years (Muhamad Ghawas 1994). Eight-month-old clonal materials of the 12 clones were field planted in mid 1996 on Rengam Series soil at MARDI Station in Kluang, Johor. The experiment site was about 100 m above sea level and has a mean annual rainfall of 2,300 mm with no regular dry seasons

(Nieuwolt 1982). The area was previously with coffee stand of about 8 years old.

The experimental design was a randomized complete block with three replications. Each treatment plot consisted of 18 plants, surrounded by a row of randomly selected guard plants. The planting distance was 3.0 m between plants arranged in triangular pattern, giving a density of about 1,280 plants/ha. Plants were grown in the open under rainfed conditions. They were maintained as single stems and topped at 1.7 m above the ground.

Basal fertilizers consisting of 150 g hydrated lime powder and 120 g CIRP were used in each planting hole. During the first and second years of growth, 46 kg N, 28 kg P<sub>2</sub>O<sub>5</sub>, 12 kg K<sub>2</sub>O, 6 kg MgO, 128 kg hydrated lime powder and 62 kg N, 62 kg P<sub>2</sub>O<sub>5</sub>, 87 kg K<sub>2</sub>O, 10 kg MgO, 256 kg hydrated lime powder per hectare were applied respectively. The rate was increased by 50% in the third year and by 100% in the subsequent years. Four applications with equal amounts were made each year. Application of Coprantol at 0.1% a.i. for protection against leaf rust disease and endosulfan at 0.1% against berry borers were given every six months.

The yield of individual plants was recorded from the first to the seventh year of plant growth. Samples of ripe berries from each treatment were collected for four seasons to determine berry and green bean sizes. The conversion percentages were obtained through processing fresh berries to green beans (12.5 ± 0.5% moisture). The green bean yield was obtained through calculation. Analyses of variance and Duncan Multiple Range Test (DMRT) on plot mean yield data and the other parameters were carried out. Significant differences among the potential clones as compared to the check were used as the basis to select a new set of clones for recommendation.

## Results and discussion

In general, each clone showed an increasing yield trend from the first to the fourth year, and stabilizing from the fifth year onwards (Figure 1). Significant differences among the treatments were observed beginning from the second year of production (Table 1). The yields of the 11 clones ranged from 2.6–3.8 t/ha, 4.2–13.8 t/ha and 13.0–21.0 t/ha respectively for the second, third and fourth year. None of the evaluated clones gave significantly higher yield as compared to the check (MKL 003) during these periods. The check clone yielded 4.5, 10.3 and 17.5 t/h respectively for the second, third and fourth year.

However, a few clones produced significantly higher yields as compared to the check at the beginning of the fifth year of production. For the fifth year, three clones (MCL 093, MCL 118 and MCL 169) which yielded 22.9, 22.9 and 23.9 t/ha respectively gave significantly higher yields than the check (20.2 t/ha). In the sixth year,

four clones (MCL 108, MCL 118, MCL 150 and MCL 169) yielded 24.3, 28.9, 26.2, and 29.7 t/ha respectively while in the seventh year also four clones (MCL 093, MCL 118, MCL 150 and MCL 169) with respective yields of 25.9, 23.5, 21.5 and 29.7 t/ha gave significantly higher yields than the check.

Analyses of fresh berries and green beans from the fifth to the seventh year of production showed that there were significant differences in fresh berry and green bean yields, conversion percentages, 100-fresh berry and 100-green bean weights monitored among the clones evaluated (Table 2).

The mean fresh berry and green bean yields of the potential clones were 17.28–26.23 t/ha and 1.69–2.62 t/ha respectively. The check clone (MKL 003) showed a mean fresh berry yield of 21.14 t/ha or an equivalent green bean yield of 2.03 t/ha. The four clones with the highest fresh berry production and significantly higher than the check were MCL 169 (26.23 t/ha), MCL 118

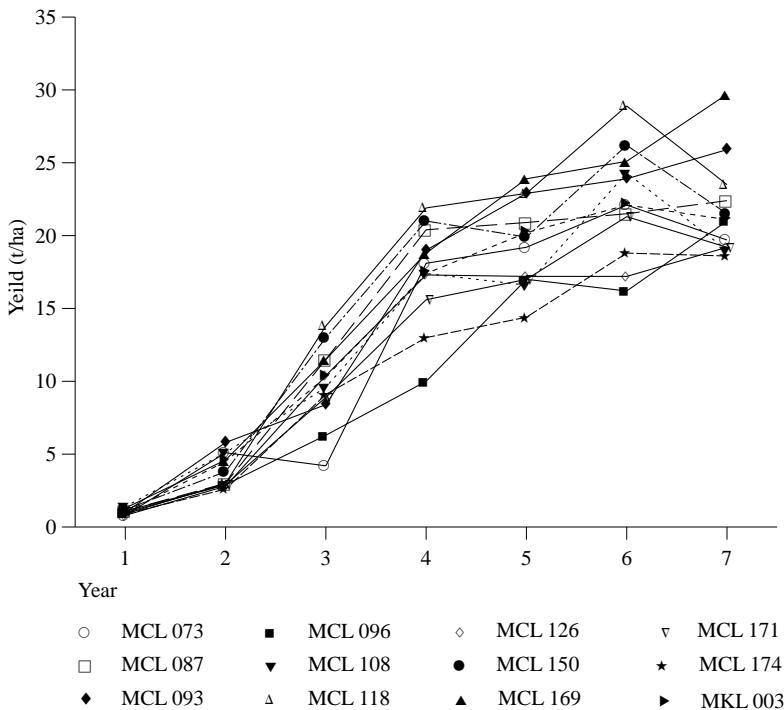


Figure 1. Yearly fresh berry production of 12 Liberica coffee clones

Table 1. Yearly fresh berry production (t/ha) of 11 Liberica coffee clones and a check (MKL 003)

	1st yr	2nd yr	3rd yr	4th yr	5th yr	6th yr	7th yr
MCL 073	0.8n.s*	5.1ab	4.2d	18.1abc	19.2cd	22.1de	19.7ef
MCL 087	1.1	3.0cde	11.5ab	20.4ab	20.9bc	21.5e	22.4cd
MCL 093	1.0	5.8a	8.4bcd	19.0ab	22.9ab	23.9cd	25.9b
MCL 096	1.0	2.9cde	6.3cd	10.0d	17.0de	16.2g	21.0gh
MCL 108	1.4	5.1ab	9.6abc	17.4abc	16.6de	24.3bc	19.0ef
MCL 118	0.9	3.0cde	13.8a	21.9a	22.9ab	28.9a	23.5ab
MCL 126	0.8	2.8de	10.4abc	17.3abc	17.2d	17.2fg	19.2h
MCL 150	1.2	3.8b-e	13.0ab	21.0ab	19.9c	26.2b	21.5c
MCL 169	1.3	4.6abc	11.5ab	18.8ab	23.9a	25.1bc	29.7a
MCL 171	1.1	2.9de	8.9a-d	15.6bc	17.0de	21.3e	19.2fg
MCL 174	0.9	2.6e	9.1abc	13.0cd	14.4e	18.8f	18.6h
Mean	1.0	3.8	9.7	17.5	19.3	23.3	21.8
MKL 003	1.0	4.5a-d	10.3abc	17.4abc	20.2c	22.1de	21.1de
SE	0.2	0.7	2.1	2.9	1.2	0.9	0.7
5% LSD	0.5	1.5	4.4	4.8	2.4	1.8	1.4

\*Mean values in the same column with different letters are significantly different ( $p < 0.05$ ) according to DMRT

Table 2. Mean (5th to 7th year) fresh berry and green bean yields, conversion percentages, weights of 100 fresh berries and green bean of 11 Liberica clones compared to a check (MKL 003)

	Fresh berry yield (t/ha)	Green bean yield (t/ha)	Conversion (%)	100-fresh berry wt. (g)	100-green bean wt. (g)
MCL 169	26.23a*	2.29c	8.73efg	717.7a	31.97cd
MCL 118	25.07ab	2.62a	10.47b	584.0de	33.22b
MCL 093	24.27b	2.45b	10.11c	556.3ef	31.36de
MCL 150	22.53c	1.93ef	8.55fg	615.2cd	28.72gh
MCL 087	21.61cd	2.00de	9.28def	515.1gh	28.40h
MCL 073	20.32ef	1.69h	8.32g	641.4bc	30.32g
MCL 108	19.97ef	2.27c	11.39a	550.9fg	33.03bc
MCL 171	19.16fg	1.80h	9.40cde	667.2b	38.55a
MCL 096	18.08gh	1.74gh	9.66cd	540.1fgh	29.78fg
MCL 126	17.63h	1.86fg	10.42b	532.5fgh	30.42b
MCL 174	17.28h	2.08d	12.03a	576.7e	33.95b
MKL 003	21.14de	2.03de	9.59cd	505.0h	27.19i
SE	0.56	0.06	0.35	16.29	0.53
5% LSD	1.16	0.12	0.72	33.78	1.10

\*Mean values in the same column with different letters are significantly different ( $p < 0.05$ ) according to DMRT

(25.07 t/ha), MCL 093 (24.27 t/ha) and MCL 150 (22.53 t/ha). For green bean production, MCL 169, MCL 118, MCL 093 and MCL 108 with respective yields of 2.29, 2.62, 2.45 and 2.27 t/ha gave significantly higher yields than the check (2.03 t/ha).

The conversion percentages of the potential clones ranged from 8.32–12.03%.

Four clones (MCL 118, MCL 108, MCL 126 and MCL 174) showed significantly higher percentages than the check (9.59%). The 100-fresh berry weights of these clones were 515.1–717.7 g. Eight of them (MCL 169, MCL 118, MCL 093, MCL 150, MCL 073, MCL 108, MCL 171 and MCL 174) were significantly heavier than the check (505.0 g).

The other three clones (MCL 087, MCL 096 and MCL 126) were not significantly different. On the other hand, the 100-green bean weights of all the potential clones (28.40–38.55 g) were significantly heavier than the check (27.19 g).

Based primarily on fresh berry and green bean yields as well as fresh berry and green bean sizes, three top clones were identified and selected for recommendation. They were MCL 093, MCL 118 and MCL 169. Their potential mean fresh berry yields of 24.27, 25.07 and 26.23 t/ha were equivalent to green bean yields of 2.45, 2.62 and 2.29 t/ha respectively. The average fresh berry yield of the three selected clones (25.19 t/ha) was about 16% higher than the check (21.14 t/ha). Likewise the equivalent average yield of green bean (2.45 t/ha) was 17% higher than the check (2.03 t/ha). Compared to the mean yields of fresh berry (23.97 t/ha) and green bean (2.18 t/ha) of the three CRC (MKL 002, MKL 003 and MKL 004) released in 1995, these selected clones gave higher fresh berry and green bean yields of 4.8% and 11.0%, respectively. The mean of conversion percentage of the three selected clones was 9.77% while the mean of CRC was 9.12%.

The 100-fresh berry weights of the three selected clones (MCL 093, MCL 118 and MCL 169) were 556.3, 584.0 and 717.7 g respectively. Their respective 100-green bean weights were 31.36, 33.22 and 31.97 g. These fresh berry and green bean weights were 9.2–29.6% and 12.9–18.2% higher respectively as compared to the check. Compared to the mean of the CRC, means of both 100-fresh berry weight (619.3 g) and green bean weight (32.18 g) of these three identified clones were 11.7% higher. Means of 100-fresh berry and 100-green bean weights of the CRC were 546.6 g and 28.4 g respectively. The physical qualities (berry and bean sizes) of the selected clones for recommendation were thus improved. The increase in berry size increases the physical characters of the clones like ease of harvesting.

Two clones (MCL 150 and MCL 108) were excluded from the selection because they were not significantly different in green bean yield (1.93 t/ha) and fresh berry yield (19.97 t/ha) as compared to the check. Furthermore, MCL 150 gave relatively smaller beans as compared to the sizes of the three selected clones. Uniformity in bean size is also an important factor to consider because this would enable even roasting of beans during processing to get high quality coffee powder.

### Conclusion

The evaluation was carried out for seven years with the objective of identifying and selecting superior clones as compared to the current recommended clones. From the evaluation of 11 clones, three clones (MCL 093, MCL 118 and MCL 169) were selected. Besides giving higher potential fresh berry and green bean yields, these three clones produced better physical qualities for berry and bean sizes. Recommendation of these clones could further increase the productivity of Liberica coffee in the country. Their production could partly fulfil the request of local raw materials for processing of coffee products.

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## Abstrak

Penilaian terhadap 12 klon kopi Liberica, termasuk klon yang sedang disyorkan, sebagai baka bandingan, menunjukkan perbezaan yang ketara bagi hasil dan parameter lain yang dikaji. Tiga klon iaitu MCL 093, MCL 118 dan MCL 169 yang menunjukkan kelebihan dari segi hasil, saiz buah dan biji telah dikenal pasti dan dipilih untuk pengesyoran. Potensi purata hasil kopi jambu masing-masing adalah sebanyak 24.27, 25.07 dan 26.23 t/ha bersamaan hasil kopi beras 2.45, 2.62 dan 2.29 t/ha. Purata hasil kopi jambu sebanyak 25.19 t/ha dan kopi beras 2.45 t/ha bagi tiga klon terpilih ini adalah masing-masing lebih kurang 16% dan 17% lebih tinggi daripada baka bandingan. Peningkatan purata hasil, saiz buah dan biji bagi tiga klon ini berbanding dengan purata baka-baka klon yang disyorkan masa kini turut dibincangkan.