EVALUATION OF TWO CASSAVA CULTIVARS FOR STARCH AND CHIP PRODUCTION

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SUMMARY

Black Twig, the current commercial cultivar of cassava in West Malaysia, has a lower fresh weight yield (though not significantly so) than the Thai cultivar Bangkok No. 1 but a much higher dry matter yield (significant at P = 0.01) on account of 45 percent dry matter in Black Twig in comparison with 28 percent dry matter in Bangkok No. 1. The protein content of Bangkok No. 1 may be slightly greater than that of Black Twig. For the production of animal feed or starch it is the dry matter yield that is important.

The planting of cassava in cleared old rubber plantations is analyzed in terms of man-days and financial cost.

RESUME

Le "Black Twig", cultivar commercial du manioc actuellement en cours en Malaisie occidentale, a un rendement en poids frais plus bas (bien qu'il ne soit pas tout à fait ainsi) que le cultivar Bangkok No. 1 du Thai, mais un rendement en matière sèche beaucoup plus élevé (important a P = 0.01) à raison de 45 pour cent de matière sèche dans le "Black Twig" comparés à 28 pour cent de matière sèche dans Bangkok No. 1. La teneur en protéine du Bangkok No. 1 est peut–étre légèrement supérieure à celle du "Black Twig". Pour la production d'aliments du bétail ou de l'amidon, c'est le rendement en matière sèche qui est important.

La plantation du manioc sur terrain de caoutchouc défriché est analysée en termes de main-d'oeuvre journalière et des coûts de l'exploitation.

RESUMEN

Black Twig, el cultivar comercial de yuca común en Malasia Occidental, tiene un rendimiento en peso fresco mas bajo (si bien que no significativamente) que el cultivar Thai, Bangkok No. 1, pero mucho mas alto rendimiento de materia seca (significativo a P = 0.01). Black Twig tiene 45% de materia seca y Bangkok No. 1 28%. El contenido proteinico de Bangkok No. 1, puede ser algo mas alto que el de Black Twig. El rendimiento de materia seca es lo importante para la producción de alimento animal o almidón.

Se analiza la siembra de yuca en lo que fueron plantaciones viejas de hule, en términos de días-hombre y costos financieros.

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INTRODUCTION

Of the thirty-five cultivars listed by Templeton[3], one cultivar named 'Bangkok No. 1' was observed at the RRI Experiment station*, Sungei Bulch, to give as high a yield as 'Black Twig', which is currently planted in West Malaysia for starch and chip production. Little was known about 'Bangkok No. 1'. Its name implies that it was introduced from Thailand. Because it showed promising yield, it was selected for comparison of root yield and quality with Black Twig, which had been found to be the best yielding cultivar so far. The objective was to determine their relative suitability for the production of starch of tapioca chips in Malaysia.

MATERIALS AND METHODS

The two cultivars Black Twig and Bangkok No. 1 were each tested at two spacings, 90 cm x 90 cm and 90 cm x 120 cm. The harvested plot size was the same for each treatment, i.e. 720 cm x 720 cm, giving 48 plants per plot for spacing 120 cm x 90 cm and 64 plants for spacing 90 cm x 90 cm.

The trial was carried out at Serdang Estate, which was newly cleared from old rubber trees. The land is about 45 m above sea level and gently sloping. The soil type is sandy-clay-loam and pH 4.3. Total rainfall at Serdang in 1972 was 205 cm.

The land was ploughed, harrowed and rotavated. Stem cuttings, each 23 cm long, were planted in a flat position, about 2 cm – 3 cm below the soil surface. Twenty six days after planting, a fertilizer mixture of sulphate of ammonia, triple superphosphate and muriate of potash was applied around each plant at the rate of 66 kg N, 44 kg P_2O_5 and 88 kg K_2O per hectare. Twelve days later the plots were dressed with 85 kg of Kieserite (26% MgO) per hectare. About 26 weeks after planting the plots were manually weeded. The crop was harvested at fourteen months.

The weights of freshly harvested roots, stems and leaves, including leaf-stalks were separately determined for each plot. The number of roots per plot was also recorded. One root from each of twelve plants per plot was sampled from the first two rows (or replicates) of the Latin Square layout. The root samples were washed of dirt, dried superficially by the sun, and immediately sent to the laboratory. They were cut longitudinally into smaller pieces, and resampled for the determination of root composition in terms of moisture, starch, crude protein and crude fibre. The root samples taken from both the spacing treatments were bulked and analyzed only for differences between the cultivars.

RESULTS

The soil, where the two cassava cultivars were planted after the removal of old rubber trees, was observed in an adjacent maize crop to be deficient in some plant nutrients, particularly available phosphate, magnesium and zinc, despite the addition of fertilizers. Although the maize was severely stunted, the cassava appeared to grow normally.

The leaves of both cultivars were moderately attacked by small beetles, a fungal leaf spot disease caused by *Cercospora henningsii* and a bacterial disease, especially during a wet spell. No control measures were taken however.

Yield of freshly harvested roots (kg/ha)

At fourteen months the roots were harvested. Yields are given in Table 1.

The mean yields of fresh roots were high for both Black Twig and Bangkok No. 1, and between them the difference was not significant at 5%. There was slight evidence that Bangkok No. 1 produced higher yields at the spacing 90 cm x 90 cm than at the wider spacing.

Estimated dry matter yield of root and root composition

The dry matter yield of roots was estimated from the fresh root yield and the average dry matter content of each cultivar, which was sampled over the two spacings in each of the first two rows of the Latin Square. The dry matter contents of the roots are shown in Table 2.

Assuming that the difference in the dry matter content of the roots between the two spacing treatments is similar, the dry matter yields of Black Twig roots at 45.5% D.M. and Bangkok No. 1 roots at 28.1% D.M. were estimated as shown in Table 3.

Thus it appears that on a dry weight basis Black Twig yielded more than Bangkok No. 1.

The composition of starch, crude protein and crude fibre in the dry matter of root of the two cultivars

*The cassava collection at the Rubber Research Institute (RRI), later transferred to MARDI, Serdang.

is shown in Table 4. The root of Black Twig contained more starch and less fibre than the root of Bangkok No. 1.

Number of tuberous roots per hectare

The number of tuberous roots of each cultivar and spacing was recorded separately for these roots that exceeded 15 cm in length, and for those that were shorter. Table 5 shows the number of roots produced per hectare by Black Twig and Bangkok No. 1 at the two spacings.

The interaction between spacing and cultivar for root numbers was highly significant. Bangkok No. 1 at the spacing 90 cm x 90 cm, but not at the wider spacing, produced significantly more roots than Black Twig at either of the two spacings. Also, Bangkok No. 1, not Black Twig, produced significantly more roots at 90 cm x 90 cm than at 90 cm x 120 cm.

Table 6 shows a similar result, with the production of tuberous roots less than 15 cm long. Again Bangkok No. 1 at 90 cm x 90 cm produced significantly more roots than Black Twig at either spacing. There was also some evidence that Bangkok No. 1 produced more roots at 90 cm x 90 cm than at the wider spacing, when it was tested at 5% levels of significance.

Mean weight per freshly harvested root

Since Bangkok No. 1 produced numerically more roots than Black Twig without resulting in significant differences in total fresh weight, the mean weight per freshly dug root was analyzed for varietal difference. The result is shown in Table 7.

Black Twig produced heavier weight per fresh root than Bangkok No. 1. The difference between the spacings was not significant.

Comparison of total production of stems between Black Twig and Bangkok No. 1

The total production of stems by weight was compared between the two cultivars at the two spacings. Results are shown in Table 8.

There was no substantial evidence to suggest that Black Twig produced more stem materials than Bangkok No. 1. There was also no significant effect of spacing for either cultivar on the production of stem materials.

Varietal comparison of the total quantity of leaves remaining on the plants at fourteen months

Table 9 shows the total production of leaves and leaf-stalks by weight for the two cultivars planted at two spacings. Black Twig retained significantly more leaves and leaf-stalks than Bangkok No. 1 at fourteen months. The difference in total leaf harvest between the two spacings was not significant for either cultivar.

ECONOMIC ASPECTS OF GROWING CASSAVA AFTER OLD RUBBER

The expected cash returns from growing cassava after the removal of old rubber may be estimated from the result of this trial. The costs of production and returns from the sale of roots are estimated in Malaysian dollars (M$) on the basis of one acre (0.4047 ha).

Costs of production

These include the costs of clearing old rubber on a contract basis, fertilizers, and employed labour. A casual labourer is currently paid $4.33 per man day. One man day consists of 8 hours in which one hour is a break for a meal and seven are working hours.

	Cost items	Man day	Cost in M$
1.	Clearing old rubber, ploughing and harrowing		100.00
2.	Fertilizers:		
	Sulphate of ammonia		24.00
	Triple superphosphate		12.30
	Muriate of potash		12.00
	Kieserite		10.90
3.	Application of fertilizer	2	8.66
4.	Cutting sticks into 23 cm pieces for planting	1	4.33

5.	Lining, holing and planting	12	51.96
6.	Weeding: one round only	7	30.21
7.	Harvesting:		
	Cutting stems, pulling out roots and separating roots from stumps	22	94.26
	Total cost of production:		M$349.02

Price of roots

The current price of roots is $2.80 per pikul at the starch content of 17-18%. Some major starch producers vary the price according to the change in the starch content of roots as determined by the specific gravity method. There is a 10 ct. difference in the price per pikul for each 1% difference from the above starch content. The chemical analysis of roots in this trial shows that Black Twig had 36.1% starch and Bangkok No. 1 had 19.7%. Thus one pikul of roots of Black Twig would fetch about 16 ct. more than that of Bangkok No. 1 if sold to quality-conscious buyers.

Expected returns

Since there is no significant difference between Black Twig and Bangkok No. 1 in the yield of freshly harvested roots, it would clearly be more profitable to grow Black Twig because of its higher starch content in the root. Therefore, only the yield of Black Twig is used to estimate the net income per acre. However, the starch content analyzed by the chemical method has not been correlated with that determined by the specific gravity method. Therefore it is not used to estimate the price of roots here. The prices used for estimating income from the sale of roots are based on the current price of $2.00 per pikul and also on a conservative price of $2.00 per pikul, as shown in Table 10.

The estimates in Table 10 show that it is economically feasible to grow cassava after felling rubber. It may be added that a greater profit margin is expected form the sale of rubber wood which can bring a return of $30-$40 per acre.

DISCUSSION

Although the cultivar Bangkok No. 1 appeared productive of tuberous roots, it was disappointing in its dry matter yield. Perhaps the roots at fourteen months were over-mature for Bangkok No. 1 as observed in the relatively high fibre content in the root and the significantly fewer leaves retained compared to those of Black Twig. Further work is needed to evaluate its performance at its optimum period of growth.

The income estimated from the yield of roots which were harvested at fourteen months may be taken as income for a crop which is harvested at twelve months, since previous studies have shown that the difference in yield between these two growing periods is not likely to be significant.

To the tapioca producer who makes starch or tapioca chips out of tuberous roots, the percentage of starch or dry matter in the root is very important. Because the roots can differ greatly in starch content, the specific gravity method has already been mentioned, but the subjective method of visually examining moisture in a broken root is also commonly used. How reliable these methods are in fixing a fair price of the root is a question. The fact remains, however, that roots of truly different starch or dry matter content do differ in value as their effects on the rate of production of starch or animal chips are concerned.

ACKNOWLEDGEMENTS

The writer is grateful to Mr. Anuwar Mahmud, Director of MARDI, for useful comments on the paper, Mr. Lee Chong Soon for statistical analysis and Miss Chia Joo Suan for chemical analysis.

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TABLE 1

Mean yields of fresh roots (kg/ha) of Black Twig and Bangkok No. 1 at two spacings

Spacing	Black Twig	Bangkok No.1	Mean
90 cm x 90 cm	37,095	43,624	40,360
90 cm x120 cm	37,403	35,725	36,564
Mean	37,249	39,675	

L.S.D. (P = 0.05) between data in body of table = 7,036
L.S.D. (P = 0.05) between data in margins of table = 4,976

CV = 11%

TABLE 2

Dry matter content of roots (%) of two cassava cultivars

Replicate	Black Twig	Bangkok No.1
1	43.2	26.9
11	47.7	29.3
Average	45.5	28.1

TABLE 3

Estimated dry matter yield of roots in kg/ha for two cassava cultivars

Spacing	Black Twig	Bangkok No.1	Mean
90 cm x 90 cm	16,879	12,259	14,569
90 cm x120 cm	17,068	10,060	13,564
Mean	16,974	11.160	

L.S.D. (P = 0.01) between data in body of table = 4441
L.S.D. (P = 0.01) between data in margins of table = 3140

TABLE 4

Content of starch, crude protein and crude fibre as % of dry matter of roots of two cassava cultivars

Cultivar	Starch(%)	Crude protein	Crude fibre
Black Twig	79.4	3.9	2.6
Bangkok No.1	70.2	4.1	4.1

TABLE 5

Number of tuberous roots per hectare (roots > 15 cm)

Spacing	Black Twig	Bangkok No.1	Mean
90 cm x 90 cm	64,573	83,960	74,267
90 cm x120 cm	60,184	63,223	61,703
Mean	62,378	73,592	

CV = 7%
L.S.D. (P = 0.01) between data in body of table = 11,634
L.S.D. (P = 0.01) between data in margins of table = 8,228

TABLE 6

Number of tuberous roots per hectare (roots > 15 cm)

Spacing	Black Twig	Bangkok No.1	Mean
90 cm x 90 cm	29,996	44,415	32,206
90 cm x120 cm	30,430	34,963	32,697
Mean	30,213	39,689	

L.S.D. (P = 0.01) between data in body of table = 13,652
L.S.D. (P = 0.05) between data in body of table = 9,010
L.S.D. (P = 0.01) between data in margins of table = 9,655

CV = 15%

TABLE 7

Mean weight in gm per fresh, undried root

Spacing	Black Twig	Bangkok No.1	Mean
90 cm x 90 cm	394	344	369
90 cm x120 cm	413	363	388
Mean	404	354	

L.S.D. (P = 0.05) between data in body of table = 49
L.S.D. (P = 0.05) between data in margins of table = 35
CV = 8%

TABLE 8

Total weight of freshly harvested stems in kg/ha

Spacing	Black Twig	Bangkok No.1	Mean
90 cm x 90 cm	26,253	19,190	22,722
90 cm x120 cm	23,447	20,158	21,801
Mean	24,850	19,674	

L.S.D. (P = 0.05) between data in body of table = 7,780
L.S.D. (P = 0.05) between data in margins of table = 5,502
CV = 20%

TABLE 9

Weight of freshly harvested leaves and leaf-stalks in kg/ha

Spacing	Black Twig	Bangkok No.1	Mean
90 cm x 90 cm	1,148	733	941
90 cm x120 cm	1,109	599	834
Mean	1,129	646	

L.S.D. (P = 0.01) between data in body of table = 322
L.S.D. (P = 0.01) between data in margins of table = 228
CV = 14%

TABLE 10

Costs and returns from an acre of cassava grown after rubber

Price of root	Yield of roots/ac	Gross return	Cost of production	Net return per acre
$2.00/ pikul	248.6 pikul	$497.20	$349.02	$143.18
$2.80/ pikul	248.6 pikul	$696.08	$349.02	$347.06