Pertanika 1(2), 70–81 (1978)

Observations on Growth and early Production of some Durian (*Durio zibethinus* Murr) Clones at Universiti Pertanian Malaysia Orchard

OTHMAN YAACOB, MOHD. NOOR ISMAIL[1] and AWALUDDIN HAJI TALIB[2]
Department of Soil Science, Faculty of Agriculture, Universiti Pertanian Malaysia

Key words: Durian growth, Early yield, Research needs.

RINGKASAN

Penyata mengenai tanaman durian diatas kawasan tanah bekas getah tua seluas 22 ekar adalah dibentangkan bersama dengan rekod-rekod sukatan hujan, kadar membaja dan lain-lain kawalan amali yang dibuat dalam kawasan itu semenjak 1969.

Kadar tumbohsaran semua jenis klon durian yang ditanam, keadaan membunga dan membuah serta dengan sebab-sebab kekurangan buah-buah bagi klon D2 dan D96 juga di bincangkan. Dengan adanya keadaan saperti itu, penyelidikan untuk mengatasi setengah daripada masalah masalah tertentu telah pun dicadangkan untuk masa hadapan.

SUMMARY

The establishment of a 22 acre durian orchard on an oxisol soil formerly under old rubber is recorded outlining the nature of the environment and the cultural practices adopted since 1969.

The growth pattern of all clones planted, early flowering and fruiting patterns are also discussed together with possible causes of poor fruiting habits of D2 and D96. Some possible areas for research are suggested for future work based on these observations.

INTRODUCTION

The object of this paper is to provide background information which may be required for any future detailed study on durian at Serdang.

The 22-acre site under study was at one time a part of the Air Hitam Forest Reserve. It was cleared for planting with rubber probably in the 1940's by Serdang Estate which at that time owned most of the land on which the University Farm is now situated. The area was purchased with other land by the University in 1966; and in late 1968 it was mechanically cleared. The trees were felled and the trunks were sawn up for wood and removed from the site. The remaining roots and stumps were collected into large heaps and burnt after which the area was ploughed and rotovated three times. Remaining roots were hand removed and burnt; and after a short period of dry weather, planting holes measuring $2' \times 2' \times 2'$ and spaced $40' \times 40'$ apart were prepared. This spacing allowed for 27 trees to be planted per acre. In each planting hole about 20 pounds of rotted cattle and poultry manure were placed three weeks prior to planting.

In July 1969, during the wet season, the recommended durian clones were planted. During the first four years, watering was carried out during dry periods, or as and when necessary.

The general maintenance consisted of regular weeding and spraying against pests and diseases, carried out by the Farm Division and by the Plant Protection Department respectively.

DURIAN CLONES PLANTED AND FERTILIZER PROGRAMME USED

Durian clones

The known clones planted were D2, D7, D8, D10, D24, D66, D84, D88, D96, and an unidentified clone designated as DR. The num-

1 Farm Director, Universiti Pertanian Malaysia.
2 Senior Field Assistant, Universiti Pertanian Malaysia.

ber of trees planted for each clone and the percentage composition of each clone in the area is given in Table 1. The actual distribution on the ground is shown in Fig. 1. From the time planting began in 1969 until 1973, virtually all clones were replaced at various growth stages, mainly because of disease.

TABLE 1

Durian clones planted at the Universiti Pertanian Malaysia Orchard, Serdang.

Clone	Number of trees planted	Percentage of total stand
D2	36	6.2
D7	9	1.6
D8	274	47.4
D10	2	0.3
D24	105	18.1
D66	26	4.5
D84	18	3.1
D88	26	4.5
D96	41	7.1
DR	41	7.1
Total	578	100.0

Fertiliser programme

The fertiliser programme followed the 'standard' practice recommended by Whitehead (1959). The rates of application over the years are shown in Table 2.

NATURE OF SOILS AND THE ENVIRONMENT

Topography and soils

The orchard can be divided into two broad sites based on the general topography of the area and these are conveniently designated as the 'valley' and the 'hill'. A rise resulting in a slope of more than 10° is designated the 'hill' and a slope below this angle is designated the 'valley' (Fig. 2).

The mechanical and chemical composition of the two soil types found in the designated sites are given in Table 3.

A portion of the valley is made up of collovial soil while the hill is almost entirely of Malacca soil with a varying depth of lateritic layers, the nutrient content decreasing with depth. At the intermediate site, however, the nutrient content is high in the upper layer 60 cm deep, where most of the feeding roots are located. In the valley site the soil is relatively lighter in texture with nutrient contents comparable to the hill site (Table 3). This is somewhat unexpected as soils on the lower sites normally have high nutrient contents. It is probable that during the eight year period, (1969–1978), the nutrients applied may have leached down the slope as suggested by the high nutrient contents of soil at the intermediate site. Details of this possibility occurring are being studied as part of the current research on durian.

Rainfall

The monthly and annual rainfall at Serdang from 1968 to 1977 are given in Table 4.

The average rainfall for the 10 year period (1969–1977) was 2131 mm although the annual rainfall for 1974 and 1975 was below average. The two dry years adversely affected the general yield of durian throughout the country (Anon., 1976).

AGRONOMIC OBSERVATIONS

Growth pattern

There are several parameters by which growth can be measured. In this study, growth was measured by taking the height of the tree from the base of the trunk at ground level to the top of the canopy, and the total spread of the canopy from left to right. A specially constructed light alluminium frame was used for this purpose (Plate 1).

The growth shape of durian trees appeared to differ slightly among clones. The average range of height of trees varied from 5.5 for D88 to 7.8 m for the unidentified (DR) clone. The spread of the canopy was narrow in D88, being 1.8 to 1.9 m, and wider in D24, from 3.1 to 3.0 m. The average height of the remainder of the clones ranged between 5.8 to 7.5 m for height; and 2.3 to 2.4 or 2.9 to 2.8 for canopy spread (Table 5). At Serdang the growth shape characteristics of each clone remain constant (Plates 2a – 2e) but these characteristics vary slightly in other parts of the country because of different environmental conditions. However, no information on this variable characteristic is available at the present.

Flowering pattern

First flowering of certain clones was observed in September 1974. Flowering from all trees

Fig. 1 Distribution of durian clones planted on the Universiti Pertanian orchard.

TABLE 2

Fertiliser programme and rate (oz/tree) for durian at the Universiti Pertanian Malaysia: 1969–1978.

Year	Season/month of application	Fertiliser type*/ grade	Amount/rate (oz/tree)
1969	July	CCM 12	4.0
	September	CCM 12	4.0
	December	CCM 12	4.0
1970	January	Nitro 26%N	4.0
	March	CCM 24	10.0
	June	CCM 22	12.0
	July	Nitro 26%N	4.0
	September	CCM 22	14.0
	December	CCM 22	16.0
1971	January	Nitro 26%N	8.0
	March	CCM 44	20.0
	June	CCM 22	22.0
	September	CCM 22	24.0
	December	CCM 66	24.0
1972	January	Nitro 26%N	8.0
	June	CCM 66	32.0
	December	CCM 25	40.0
1973	April	CCM 22	80.0
	September	CCM 22	80.0
1974	April	CCM 25	96.0
	September	CCM 25	96.0
	December	CCM 25	96.0
1975	April	CCM 25	112.0
	September	CCM 25	112.0
	December	CCM 25	112.0
1976	September	CCM 44	80.00
1977	July	Muriate of Potash	80.00
	October	CIRP	80.00
1978	February	CCM 44	88.00

* The range of compound formulations in the ferilisers used is given below:

Fertiliser compound no.	% N	% P2O5	% K2O	% MgO	Total nutrients
CCM 12	11	18	4	3	36
CCM 22	10	16	9	2½	37½
CCM 24	11	18	11	4	39
CCM 25	14	13	9	2½	38½
CCM 44	12	6	22	3	43
CCM 66	14	14	14	–	42
Nitro-26	25	–	–	–	–
Christmas Is. (CIRP) Rock Phosphate m	–	–	–	–	–
Muriate of Potash	–	–	46	–	–

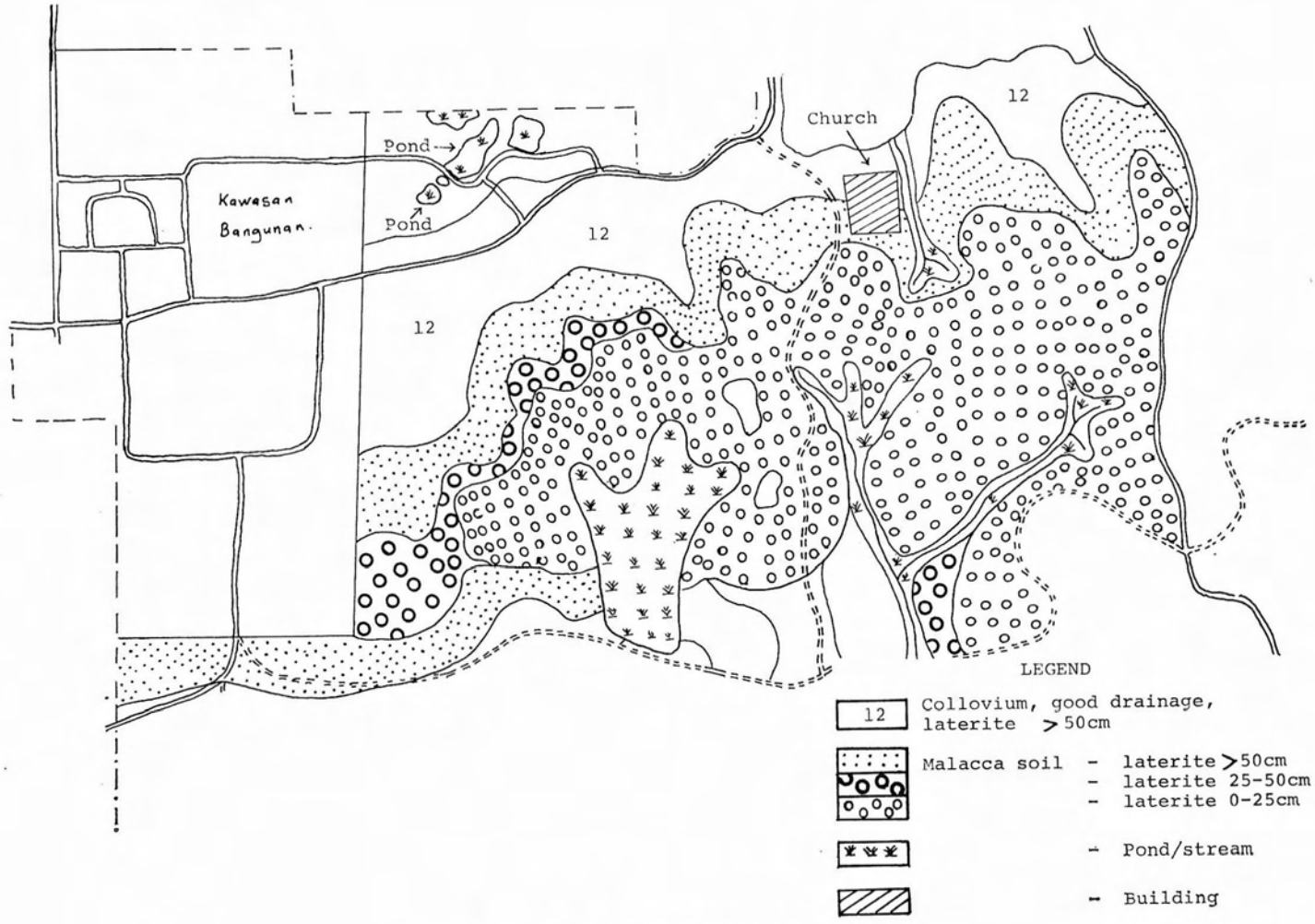

Fig. 2 Soil map of the orchard.

TABLE 3

Mechanical and chemical composition of soils at three sites located on the 22-acre orchard at the University Orchard

Site	Depth (cm)	Mechanical analysis (%)					Nutrients Available (ppm)				Total (%)		
		CS	FS	S	C	pH	P	K	Ca	Mg	N	C	OM
'Hill'	0–30	11	28	18	43	4.5	10.6	47.0	6.8	28.4	0.15	1.4	2.6
	30–60	10	23	21	46	4.3	7.6	32.0	6.4	24.8	0.23	1.0	1.9
	60–90	16	24	17	43	4.4	2.2	33.0	4.0	21.6	0.12	0.7	1.3
	90–120	19	22	19	40	4.6	0.3	38.0	6.4	20.8	0.11	0.	1.0
'Intermediate'	0–30	12	24	10	54	5.1	4.0	142.0	31.4	49.6	0.24	52.1	3.9
	30–60	15	21	10	54	5.2	23.1	105.0	20.4	40.6	0.19	1.4	2.7
'Valley'	0–30	21	39	7	33	5.0	3.1	36.0	9.6	31.2	0.15	1.1	2.1
	30–60	19	36	7	38	4.9	1.3	34.0	4.6	23.4	0.15	0.9	1.7
	60–90	20	32	6	42	5.0	0.5	27.0	6.0	22.0	0.12	0.7	1.4
	90–120	20	30	7	43	5.1	0.4	24.0	5.2	19.8	0.12	0.5	0.9
	120–150	20	33	6	41	5.3	0.2	16.0	6.2	20.8	0.12	0.4	0.8

TABLE 4

The monthly and annual rainfall: (mm) at Serdang: 1968–1977.

Year	J	F	M	A	M	J	J	A	S	O	N	D	Total
						(mm)							
1968	114	161	241	272	234	167	169	137	114	353	278	171	2411
1969	98	129	304	166	–	219	106	106	133	386	289	234	2170
1970	200	60	277	163	283	112	117	145	247	130	279	177	2190
1971	422	124	244	316	38	80	180	352	92	109	144	244	2345
1972	56	186	135	363	169	145	55	99	141	266	263	172	2050
1973	172	212	211	555	423	30	116	177	191	282	232	230	2831
1974	102	150	151	284	183	9	83	10	90	40	20	152	1274
1975	95	126	156	183	48	62	166	124	18	98	166	119	1361
1976	–	112	341	382	130	203	58	214	170	371	287	247	2525
1977	283	113	106	176	104	195	81	170	160	372	245	165	2170
10 yr. average	171	137	217	286	179	122	113	153	137	241	220	191	2131

TABLE 5

Growth pattern of durian clones at the Universiti Pertanian Malaysia Orchard

Clone	No. of trees measured	Range for Height	Range for Canopy Left	Range for Canopy Right	Mean Height	Mean Canopy Left	Mean Canopy Right
		meter					
D 2	13	5.2 – 7.0	1.8 – 3.3	1.9 – 3.1	6.1	3.8	2.7
D 8	74	3.7 – 6.3	1.1 – 4.0	1.5 – 4.0	5.8	2.9	2.8
D 24	20	6.3 – 8.3	2.7 – 4.1	2.7 – 4.1	7.5	3.1	3.0
D 66	10	6.0 – 8.9	2.2 – 2.8	3.0 – 2.8	7.3	2.5	2.4
D 88	9	4.1 – 6.6	1.4 – 2.3	1.3 – 2.4	5.5	1.9	1.8
D 96	11	6.0 – 7.8	1.9 – 3.0	1.8 – 3.1	6.5	2.3	2.4
DR	15	6.3 – 8.4	2.5 – 3.3	2.6 – 3.0	7.8	2.9	2.8

Other clones were not measured as they formed only a small percentage of the total (Table 1).

beginning in February 1977 was subsequently recorded and expressed as a percentage of the total number of trees for each clone. Numbers of fruits obtained were also recorded (Table 6).

It is clear that under the environmental conditions recorded and the cultural and manual practices adopted at Serdang, virtually all clones derived from budded planting materials flowered five years after planting. Except for D2 and D88, the number of clones flowering later than five years of age was less than fifteen per cent for the first four seasons in 1974 and 1975 (Table 6).

In 1975, the year following the drought when the annual rainfall recorded for 1974 and 1975 was below the ten years average, three flowering seasons were recorded. The first was in February, the second in May and the third in November. Except for D88, all other clones showed a low percentage of trees flowering in the February fruit season. Clone D2, for example, showed 16% of trees flowering as compared to the 23% recorded for D88 in the May season. In the November season all clones except D88 showed a low percentage of trees flowering with no fruits being recorded at all. Premature dropping and

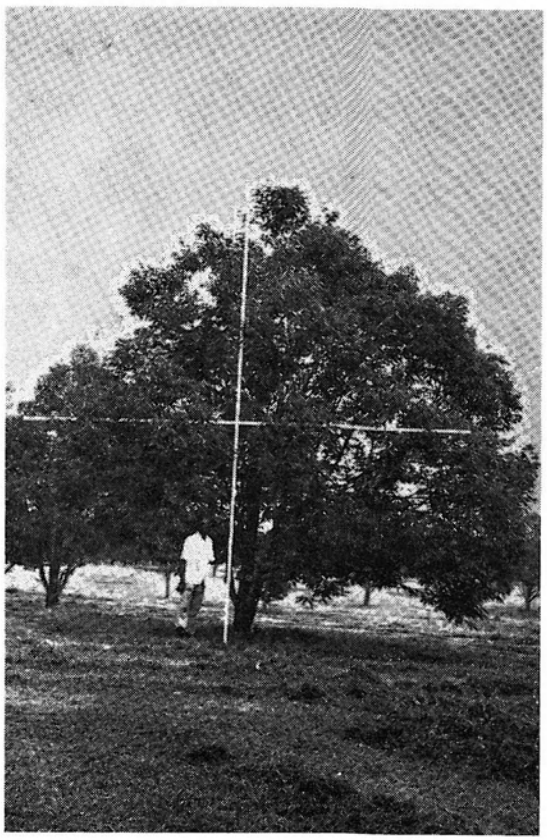

Plate 1. Technique for measuring the height and canopy spread of a mature durian tree.

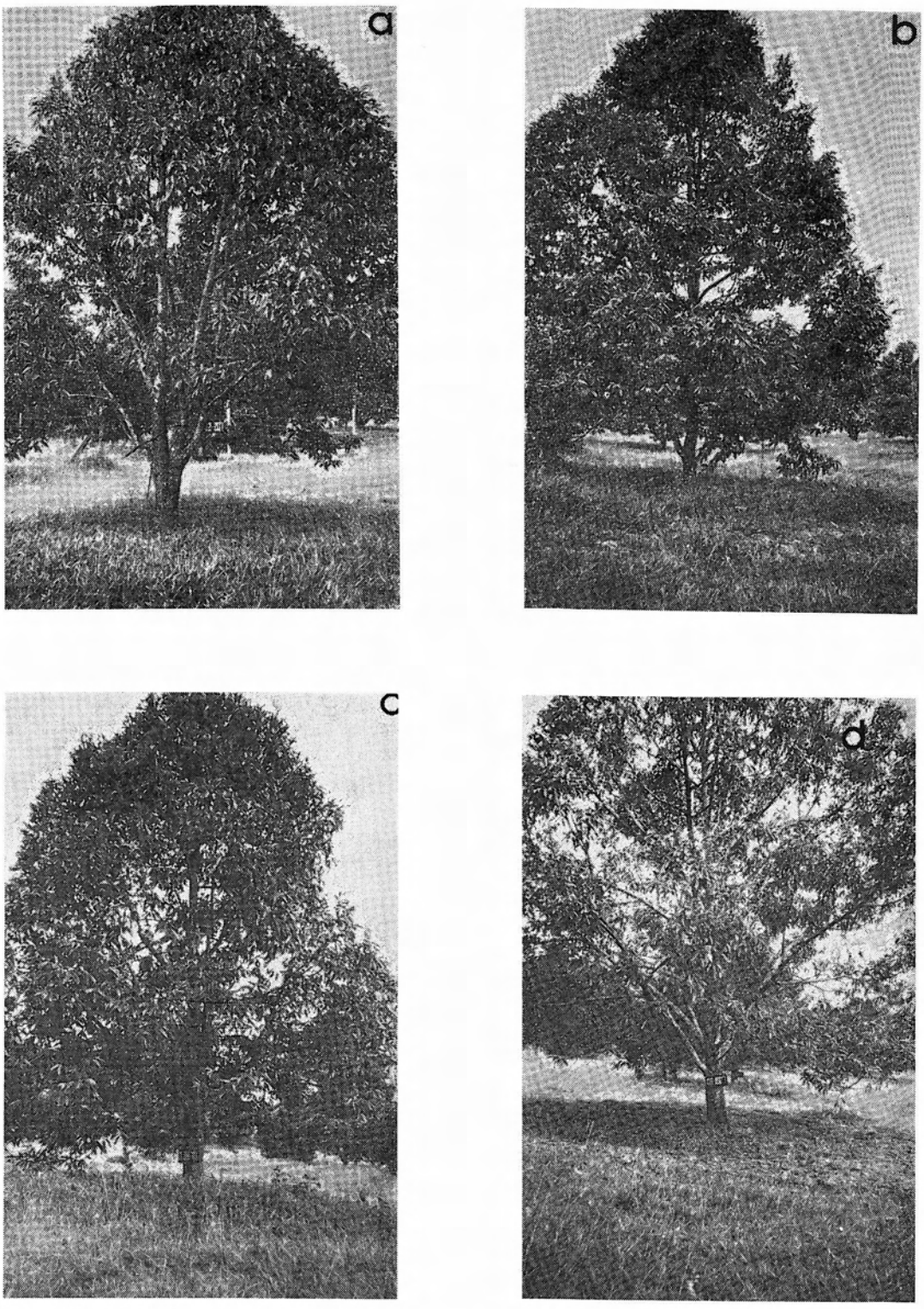

Plate 2a–2e Clonal characteristics of some durian trees at the Universiti Pertanian Malaysia Orchard.

theft accounted for the poor fruit recordings. In the following dry year (annual rainfall for 1975 was 1361 mm), all clones showed a high percentage of trees flowering in February and July of 1976 and some fruits were recorded (Table 6).

Observations and recordings indicated that the dry years of 1974 and 1975 stimulated the production of a large number of fruits throughout the country. It has been suggested that durian trees bear fruit biannually; the 1975/1976 seasons were peak years for the crop (Anon., 1976). The peak periods may have coincided with the dry weather as was the case for 1975/1976 seasons. It is possible that during a peak period, the developing fruits use up a great deal of stored nutrients; and before another large quantity of fruits can be produced, time is needed to replace the stored materials; this results in high yields occurring in alternate years. The preliminary data on the flowering pattern of the clones appear to support this contention, although it is a too early as yet to confirm this theory.

TABLE 6

Relationship between the percentage flowered and number of fruits harvested.

Year and season	% Flowered						No. of fruits						
	D2	D8	D24	D66	D88	D96	D2	D8	D24	D66	D84	D88	D96
1974 Sept	22	0.4	7	8	30	8	–	–	–	–	–	–	–
1975 Feb)	–	1	10	11	23	14	–	–	–	–	–	–	–
1975 May)	16	1	4	–	23	–	–	–	–	–	–	–	–
1975 Nov)	–	0.5	4	8	3	9	–	–	–	–	–	–	–
1976 Feb)	64	25	39	–	50	73	–	72	–	–	–	–	–
1976 Jul)	–	3	2	63	3	4	–	67	–	30	–	81	–
1977 Feb)	61	25	19	42	7	9	–	37	57	58	–	98	–
1977 Jul)	–	–	–	–	–	–	–	35	58	27	10	83	–

Clones D2 and D96 did not retain fruits at all under Serdang conditions, although they did well during the early years (1948–1968) at the Federal Experimental Station Serdang (Lee and

Loh, 1966). Fruit drop is also common among various clones. Generally, fruit of the size of golfballs dropped prematurely suggesting that some kind of physiological disorder may have been prevalent to cause premature fruit drop. During the two seasons when flowers and fruit yields were recorded, only D88, which bears large-size fruits weighing between 2.4 – 3.6 kg, indicated good fruit numbers. The other clones did not give high yields (Table 6). The phenomenon of flower and fruit drop at various stages is being investigated in conjunction with very poor fruiting habits of clones D2 and D96.

RESEARCH CONSIDERATIONS

Our observations of the performance of durian clones in the Serdang environment suggest that it would be worthwhile undertaking similar studies of other fruit trees grown in the University Farm. Such studies should incorporate:

Clonal characteristics and crown shape

Although in this study the characteristics of all clones were measured and pictorally recorded (Plates 2a – 2e), it would be desirable to extend the research to incorporate a study of the genetic sources of the clones and a detailed morphological study of their differences. Furthermore, research should also include a comparative study of the performance of the same clones in different environments. A comparison of crown shape by the techniques outlined earlier in this paper may require further verification and possible modification for wider use.

Furthermore, there is a need for characterisation of individual clones giving details on fruit and vegetative description, supported by pictorial illustration. Other descriptions useful for identification would include enzyme essays, etc.

Fertiliser requirements

The basic fertilizer requirements of durian, originally a jungle tree, need to be determined if optimum results are to be obtained. Such a study should be extended to include the requirements of other fruit trees. Although in the 22-acre orchard a general fertilizer programme exists (Table 2), a portion of the orchard has been fenced off for detailed experimental research (Fig. 1).

The type and amount of fertilizers exert a strong influence on the production of fruits. Information on fertiliser effect on durians is limited. Future research should focus on soil fertility, fertilizer recommendation, suitable methods of fertilizer placement, time of application, relationship between fertilizer amount and water regimes on yield and more efficient means of fertilizer application.

Flower and fruit drop

Despite the high percentage recorded of trees having flowered (Table 6), the fruit retaining ability of almost all clones, particularly D2 and D96, is generally poor. A close look at the planting pattern of durian clones (Figure 1) may suggest certain lines of investigation. For example, a large tract of D8, clustered in one area may induce self-incompatibly within the clone and a detailed study on the pollen viability is required. Over and above these, the conspicious absence of arboreal life, so characteristic of a 'dusun' at flowering times, may be a limiting factor in the pollination of durian flowers. For example, bats which pollinate the flowers are virtually absent even at midnight. Bees, another group of efficient pollinators, are also absent as there are no alternative hosts during the durian off-seasons. In the absence of such natural pollinating agents, it may be desirable to carry out hand-pollination similar to that done with oil palm using a few selected trees of all clones; but the economic aspects of adopting this practice need further study.

Weeding

Under the natural 'dusun' ecosystem, weeding is not carried out except during the fruiting season when the base around each tree is cleared to facilitate easy collection of fruits. However, under an orchard system, weeding with implements driven by heavy tractors is carried out regularly, eventually causing heavy compaction of the top 15 cm soil where the most active feeding root system is located (Othman Yaacob *et al.*, 1977). These procedures affect the surface soil as well as the entire microclimate under each tree.

Accordingly, a part of this 22 acre was fenced and used as a research plot (Figure 1) where basic quantitive recordings were carried out. Some areas of investigation using this fenced area include: (a) reduction of fertilizer application; (b) reduction of weeding.

The effects of these practices on the relative humidity and air temperature in weeded and unweeded plots, with and without fertilizer, are being monitored. As the trees of all clones are now fully developed at seven years of age, and their vegetative growth is satisfactory, fertilizers may not be needed in large quantities. Further-

more, as the amount required for fruit production is relatively small (Ng and Thamboo, 1967) and pruning is minimal, any fertilizer applied would only be for 'fruiting' and not for 'growth'. The effect of fertilizer on young durian trees with and without weeding to approximate 'natural' conditions commonly found in the 'dusun' would be a part of this programme. The effects of these combinations of treatment on the flowering percentage and fruit set are being studied as part of the basic research on durian at the University Farm.

ACKNOWLEDGEMENTS

We would like to thank all field and laboratory personnel in the Soil Science Department for their technical assistance during the course of this study and Prof. I.C. Enoch for his valuable comments in the preparation of this paper.

REFERENCES

ANON., (1976): "A Feast of Durian – Thanks to the Weather," *Malay Mail,* 13th July, 1976.

LEE, C.S. and LOH, C.L. (1966): Durian varietal trial. Information paper No. 52 Dept. Conf. Min. Agric. Co-op. Kuala Lumpur, (cyclostyled memograph).

NG, S.K. and THAMBOO, S. (1967): Nutrient removal studies on Malaysian fruits: Durian and rambutan. *Malay. Agric. J.* **46:** 164–183.

OTHMAN YAACOB, KHANIF YUSOF and MOKHTARUDDIN MANAN (1977): Rainfall pattern and food- crop production on old-rubber soils at Serdang. In "Proceedings on Food-Agriculture Malaysia 2000". (Ed) H.F. Chin, I.C. Enoch and Wan Mohamad Othman pp. 101–111. Faculty of Agriculture, Universiti Pertanian Malaysia.

WHITEHEAD, C. (1958): The establishment and maintenance of fruit trees. *Malay. Agric. J.* **42:** 163–184.

(Received 19 July 1978)