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INFLUENCE OF SIZE AND MATURITY OF COCONUT SEEDNUTS ON THE RATE OF GERMINATION AND SUBSEQUENT GROWTH OF SEEDLINGS

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The effects of the size and maturity of coconut seednuts on the sprouting period and subsequent growth of seedlings were studied. Three categories of nut sizes (i.e. 15.0 cm. 17.5 cm. and 20.0 cm. short axis) and three degrees of fruit maturity (i.e. fallen overripe nuts, first bunch nuts and second bunch nuts) were tested in a 9 × 9 Latin Square experiment. The results showed that, (i) the fruits of the less mature second bunches were physiologically comparable and thus better suited for experimental work, (ii) the medium sized (17.5 cm. short axis) drupes of the ripe first bunch displayed the best performance with respect to rate of sprouting and growth of seedlings and (iii) the size of the husked nut was probably the more important drupe-component character influencing germination.

It is suggested that in a 3-stage seednut selection programme involving (a) a selection of mother palms, (b) a selection of seednuts according to degree of maturity and size of short axis, *viz.* first bunch nuts with a short axis diameter of about 17.5cm. and (c) a selection of seedlings, it is very likely that the rejections may not exceed 10 per cent of the total number planted in the nursery—hence effecting an appreciable saving on discards.

INTRODUCTION

During the past few decades considerable attention has been drawn towards the study and assessment of the various characters of coconut seednuts which determine early germination. Based on the results of such studies, revised selection criteria for coconut seednuts have been set out from time to time. The importance of such investigations need not be emphasised when one considers the recognised relationship between the character of early germination and the production potential of young bearing palms (Liyanage, 1955).

However, from a physiological and a nutritional stand point for studies on the progressive changes which take place in germinating seeds, it is essential to obtain material of greater uniformity and of comparable physiological age. This would necessitate determining criteria which would allow a more stringent selection of seed material. The present study, though primarily directed towards this objective has in the process provided information of basic importance for seednut selection.

Early investigations

In Ceylon coconuts are harvested at two monthly intervals, and at each pick two bunches on an average are plucked. Generally coconut palms are known to produce one inflorescence every four weeks, so that at each harvest one of the two bunches picked from each palm would be younger than the other by approximately four weeks. The older bunch is referred to as the first bunch and the other as the second bunch.

Pandittesekera (1914), observed that plants derived from very mature fruits were frequently "sickly" and that less mature nuts sprouted faster. Based on these observations, he advocated the use of second bunch nuts as seednuts. Subsequently, Pieris (1937) showed that seednuts taken from the first bunch were superior to those of the second bunch. In long term experiments however, he noted that young palms developed from first and second bunch seednuts showed no difference with respect to the flowering period, although surprisingly the total yield of nuts from the palms of the first bunch were somewhat lower during the 6th, 7th and 8th years of planting. This difference in yield was found to even out from the 9th year onwards (Pieris, 1948).

Liyanage (1952, 1956) found that though the embryo of a coconut remains dormant for about six weeks, successive ripe bunches from the same plant germinate more or less during the same period, even though the ages of the two bunches differ approximately by four weeks. On account of these findings, he did not consider it justifiable to discriminate between the 1st and 2nd bunch nuts in seednut selection.

A study on the size distribution of nuts by Nathanael (1958), showed that in the measure of the short axis of the drupe, the 7-inch (approx. 17.5 cm.) category constituted over 60% of the total, and was thus the dominant size. The 8-inch (approx. 20 cm.) and the 6-inch (approx. 15 cm.) categories came next in order, averaging about 27 per cent and 9.5 per cent respectively. Thus the drupes which fell within the 6-8 inch size range comprised over 96 per cent of the total. However, in order to minimize errors arising from size variability in experiments employing the unhusked fruit, he recommended the use of the 7-inch size of nut, which probably also represents the typical average size Ceylon Coconut (var. *Typica*).

Liyanage and Abeywardena (1957) illustrated the ideal form of seed coconut as one which measured 7″ × 9″ (short axis × long axis) and had a nut volume of approximately 4000 ml. It has also been shown that palms bearing large or heavy fruits tend to give offspring with fewer large fruits. However, since the total yield of copra is not affected and the outturn of nuts per candy is reduced, it could be considered somewhat advantageous to have palms of this type. Based on these observations Liyanage and Abeywardena (1957) recommended that apart from other criteria, it should be desirable to select palms that give large and heavy fruits, as mother palms for collection of seednuts.

More recently Foale (1968) investigated among other things, the effect of nut size on seedling growth. He classified the fruits into 3 size classes (large, medium and small) based on the weight of the husked nut, and found that the nut size had no sustained effect on seedling growth, although generally the small nuts commenced germination earlier than the others. He also suggested that under unfavourable conditions of moisture deficit and low fertility of soil, larger nuts may produce larger seedlings.

It is apparent from the evidence presented above that the degree of maturity and size of seednut are two factors which affect independantly the sprouting period, and hence the performance of seedlings.

Seed selection criteria evolved from such information however do not meet the requirements called for in experiments of the type referred to above. The present experiment was therefore designed to obtain more precise information on the influence of size and maturity of seednuts on germination, which would enable seednuts of physiologically comparable state to be chosen.

METHODS AND MATERIALS

Three categories of fruits representing three degrees of maturity (i.e. fallen overripe nuts, first bunch nuts and second bunch nuts) were collected from a 300 palm block at Bandirippuwa Estate, Lunuwila on 25.6.70. These were seasoned for four weeks and then classified further into 3 seednut size categories (i.e. 15.0 cm., 17.5 cm., and 20.0 cm. short axis).

Due to a delay in the preparation of the nursery, the seednuts had to be kept under storage for a period of 12 weeks from the date of pick, before laying out in beds on 25.9.70. Previous studies on the storage of seed coconuts for periods ranging from 4 to 18 weeks have shown that such storage of seednuts have had no bad effect on either the viability of seednuts or the quality of seedlings (Liyanage, 1956).

The experimental layout consisted of a 9 × 9 Latin Square with 81 plots of 9 seeds each. The seedbeds were watered as and when necessary, but were not fertilised.

The dates of sprouting were recorded, and on 25.3.71 (i.e. 6 months after planting), height and girth measurements were taken. On 25.4.71, all plants were uprooted and a seedling selection was carried out by two experienced nurserymen drawn from the Planting and the Plant Breeding Divisions of the Coconut Research Institute.

RESULTS

The percentage of seednuts germinated at specific intervals after planting in the nursery are given in Table I, and the rates of sprouting are illustrated graphically in Figure I. Analysis of variance has provided the following information for the 3 stages.

2-*month stage:* (1) The influence of drupe size and the degree of maturity of fruit on the percentage germination has been highly significant. (2) The interaction size × maturity has also been significant.

3-*month stage:* (1) The influence of drupe size on germination has continued to be significant, but not the effect of degree of maturity. (2) The interaction size × maturity continued to influence the percentage germination.

6-*month stage:* The degree of maturity of fruit emerges again as a factor influencing significantly the percentage germination, while the effect of drupe size and the interaction size × maturity are no longer significant.

Table II shows the influence of size and maturity of seednut on the mean height and mean girth of seedlings. The analysis of variance shows that the influence of both factors had been significant with respect to the mean height and mean girth of seedlings. The interaction on the other hand had been significant only with respect to the mean height per seedling.

Table III shows the responses and performances of seednuts and seedlings in relation to the different treatments at the seedling selection stage.

DISCUSSION

The data summarised in Table I and illustrated graphically in Figure I, show the pattern of sprouting as influenced by the 9 treatment combinations. It was noted that during the initial stages (2-month stage) the rate of germination was strongly influenced by both factors, with the 20.0 cm. nut size in each maturity class displaying superiority over their respective medium and smaller sizes. The influence of the degree of maturity could be expected, since the less mature fruits would require longer periods to reach the stage of dormancy break. However, the stage of dormancy break also appeared to be related to the size of nut.

Between the second month and the third month there was a rapid increase in the rate of sprouting of the two less mature categories of fruits, though the gaps amongst the 3 drupe sizes continued to exist. As a result of this any influence of maturity at this stage was masked and only the size-effects were apparent. However, since the interaction of these two factors has been significant, it is clear that the influence of size of fruit on germination varied with the maturity of fruit. In the more mature coconut, size of nut has had a profound influence on germination. It might be inferred from this that in the case of the more mature and drier drupes, the size of the short axis is a truer index of the size of the husked nut, with the latter probably representing the more basic component-character influencing germination.

At the end of the sixth month in the nursery (9 months after harvest), the nut size no longer appeared to be a factor influencing the rate of sprouting, but the significant effects of maturity on germination reappeared as a dominant factor, with the first bunch nuts now showing superiority over the more mature fallen nuts and the less mature second bunch nuts. Amongst the first bunch nuts, the 17.5 cm. nut size category displayed a peak sprouting performance of 95.1 per cent.

Seednuts for physiological studies

Although in general both factors have been shown to influence the period of sprouting, the trends in the sprouting rates unfortunately provides only a faint clue to the dormancy period of the embryo. It may therefore be considered very unlikely that the stage of dormancy break is determined by any of the treatment combinations used. However, as observed from the data summarised in Table IV, and also from Figure I, a fairly steep rise in the rate of sprouting has been recorded for seednuts of the second bunch between the 10th and 16th week after planting in the nursery; and this had occurred without regard to the size of the seednut. On this evidence it may be inferred that the nuts of the 2nd bunch represent material which are physiologically comparable and thus more suited for experimental work of the type referred to above.

Table I—Rate of germination in coconuts in relation to size of short axis and degree of maturity of seed nuts

TREATMENTS		*2 months after planting*		*3 months after planting*		*6 months after planting*	
		Total no. germinated	*Percentage germinated*	*Total no. germinated*	*Percentage germinated*	*Total no. germinated*	*Percentage germinated*
Fallen nuts	— 15.0 cm.	11	13.6	35	43.8	63	77.8
	— 17.5 cm.	17	21.0	55	68.8	72	88.9
	— 20.0 cm.	23	28.4	62	77.5	74	91.3
First bunch nuts	— 15.0 cm.	3	3.7	45	56.3	73	90.1
	— 17.5 cm.	9	11.1	55	68.8	77	95.1
	— 20.0 cm.	12	14.8	61	76.3	75	92.6
Second bunch nuts	— 15.0 cm.	2	2.5	46	57.5	68	83.9
	— 17.5 cm.	2	2.5	40	50.0	66	81.5
	— 20.0 cm.	2	2.5	48	60.0	73	90.1

Table II—Mean height and mean girth per seedling in relation to size of short axis and degree of maturity of coconut seednuts (nine months after the pick)

	Fallen nuts			*First bunch nuts*			*Second bunch nuts*		
	15.0 cm.	17.5 cm.	20.0 cm.	15.0 cm.	17.5 cm.	20.0 cm.	15.0 cm.	17.5 cm.	20.0 cm.
Mean height/seedling (cm.)	65.7	72.8	81.1	66.6	69.9	76.3	66.0	67.3	71.1
Mean girth/seedling (cm.)	8.16	8.97	9.19	7.82	8.47	8.81	7.76	8.10	8.28

Table III—Summary of the performances of coconut seednuts and seedlings in relation to size of short axis and degree of maturity of seednuts

Treatments		*Percentage germination*	*Percentage rejections*	*Percentage deaths*	*Percentage good seedlings*
Fallen nuts	— 15.0 cm.	77.8	45.7	0	54.3
	— 17.5 cm.	88.9	30.9	6.2	69.1
	— 20.0 cm.	88.9	32.1	4.9	67.9
First bunch nuts	— 15.0 cm.	90.1	29.6	3.7	70.4
	— 17.5 cm.	95.1	17.3	1.2	82.7
	— 20.0 cm.	92.6	23.5	1.2	76.5
Second bunch nuts	— 15.0 cm.	83.9	37.0	2.5	63.0
	— 17.5 cm.	81.5	35.8	7.4	64.2
	— 20.0 cm.	90.1	24.7	0	75.3

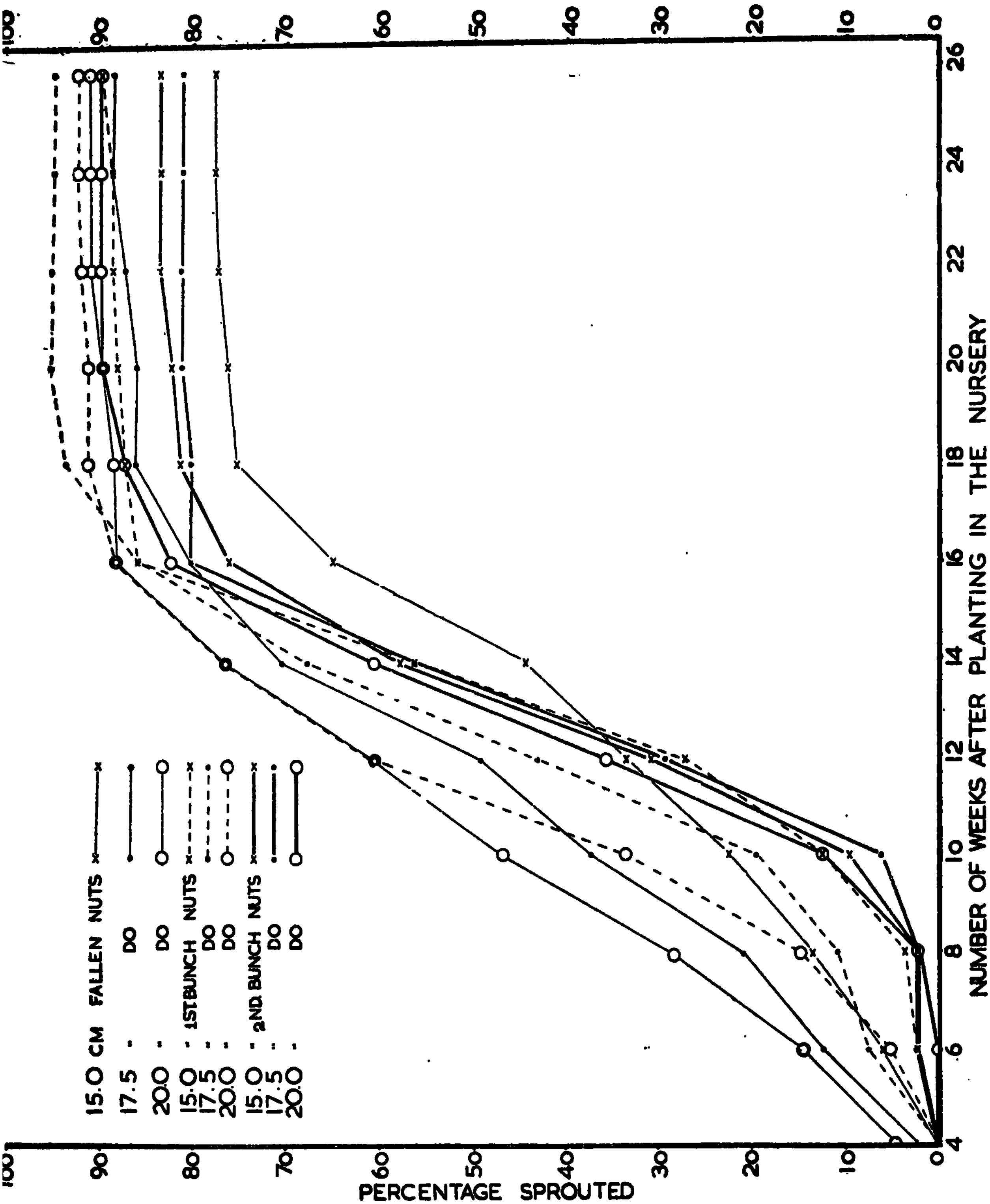

Fig. I. Influence of Size and Maturity of Coconut Seednuts on Rate of Sprouting.

Table IV—Percentage sprouted between the 10th to 16th week after laying out in the nursery

	Fallen nuts			*First bunch nuts*			*Second bunch nuts*		
	15.0 *cm.*	17.5 *cm.*	20.0 *cm.*	15.0 *cm.*	17.5 *cm.*	20.0 *cm.*	15.0 *cm.*	17.5 *cm.*	20.0 *cm.*
% Sprouted	43.2	43.2	42.0	74.1	69.1	55.6	66.7	74.1	70.4
Mean		42.8			66.3			70.4	

Seednuts for planting purposes

Examination of data for the measurements of height and girth of seedlings show that both factors had strongly influenced growth, and as could be expected seedlings from fallen nuts gave consistently higher values. As noted by Pieris (1937), and more recently by Foale (1968), it is likely that such differences would even out with time. However, the higher percentage of deaths and the higher percentage of rejections for seedlings from fallen nuts (as compared to those from first bunch nuts), was indicative of a weaker seedling for this category.

The seednut material taken for this investigation were from a block which had both high yielders and low yielders; but this fact did·not influence the choice of seednuts. Thus regardless of the genetic constitution of the parent palms, the 17.5 cm. nuts of the ripe first bunch emerged the outstanding gıoup, displaying the highest percentage of germination, the highest percentage of selected seedling and a very low percentage of deaths.

The rejections in the above category amounted to 17.3 per cent of the number planted. It is apparent therefore that if the choice of seednuts had been limited to carefully selected mother palms, the percentage of good seedlings could be appreciably higher. Although it has been observed by previous workers (Pieris, 1948) that the progeny from the first and second bunch nuts performed almost identically with respect to flowering period and yield, the present investigation has shown that at the nursery stage the number of rejections is relatively high for the less mature category of seednuts. Hence, in a 3-stage selection programme involving

(*a*) a selection of mother palms,

(*b*) a selection of seednuts according to degree of maturity and size of short axis, i.e. first bunch nuts with a short axis diameter of about 17.5 cm.,

and (*c*) a selection of seedlings,

it is highly probable that the rejections may not exceed 10 per cent of the total planted in the nursery—thus effecting an appreciable saving on discards.

In passing it may also be mentioned that the 20.0 cm. short axis category of the second bunch seednuts have performed reasonably well, and compared favourably with the 17.5 cm. category of the first bunch nuts. It was likely that the 20.0 cm. short axis diameter of a less mature (and probably less drier) drupe corresponded closely to the 17.5 cm. short axis diameter of the more mature (and probably drier) drupe, at the time of classification. This again supports the concept put forward earlier that the size of the husked nut was possibly the more basic drupe-component character influencing germination.

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