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Evaluation of Criteria for Selection of Seed Coconuts (*Cocos nucifera L.*)

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"If you can look into the seeds of time and say which grain will grow and which will not, speak then to me" — *Shakespeare* (*MACBETH*)

ABSTRACT

Criteria for the selection of seednuts from selected coconut palms were investigated and found to be unsatisfactory. Nuts should not be rejected on the basis of size, quantity of nut water or shape. Identification of nuts as empty (devoid of nut water) or immature and therefore unlikely to germinate are also often inaccurate. None of the variables measured had a strong enough relationship with germination to enable them to be used as a basis for more efficient seednut selection. It seems advisable to dispense with seednut selection and lay all nuts harvested from the selected palms in the nursery. Selection of seedlings in the nursery should, of course, be carried out subsequently, as usual.

INTRODUCTION

In the production of seed coconuts (*Cocos nucifera L.*) for planting, it is customary to harvest the seed palms and then select seednuts using certain selection criteria. In the past, it was the practice to select only those nuts of uniform shape (nearly-round) and size (approximately 7 inches short axis and 9 inches long axis) which were dead ripe (Maceda, 1933; Patel, 1938; Liyanage and Abeywardena, 1957; Dc Silva and George, 1971 and CRI leaflet no. 1). Consequently only about 60 percent of the nuts were used as seednuts. Subsequently it was recommended (Liyanage, 1982 and pers. comm.) that only immature, empty, exceptionally small or outsized nuts should be rejected and all others used as seednuts. This method results in the use of approximately 80 percent of the harvest as seednuts and is the one presently in use in Sri Lanka.

Quality seednuts are those which sprout relatively early and produce vigorous seedlings that grow into high yielding adult palms. It has been shown in a study relating seednut and seedling characters to those of adult palms that early sprouting is related to early bearing and high yield and also that certain seedling characters used in nursery seedling selection are correlated with high yield of adult palms (Liyanage and Abeyawardena, 1957). The findings of Liyanage and Abeyawardena indicate that nuts are unsuitable for use as seednuts if they (1) never germinate or take a long time to sprout and (2) sprout but grow into weak and unthrifty seedlings. This investigation attempts to identify such unsuitable nuts, before laying in the nursery, using visual and other criteria easily gauged in the field.

MATERIALS AND METHODS

Unselected plus palm* nuts from Keenakelle estate, Mudukatuwa and unselected tall × tall (CRIC 60) nuts from the Isolated Seed Garden, Ambakelle** were used. In each case 600 nuts were obtained as 20 samples of 30 nuts each; after each sample of 30 nuts was drawn, 50 nuts from the heap were set aside in order to ensure that the samples totalling 600 nuts from each estate were truly representative of the heap of nuts harvested. Field staff usually engaged in large scale seednut selection for commercial production of seed coconuts identified the nuts they would normally reject in each sample and these were labelled and the reasons for rejection noted.

Measurements of various nut characters such as weight, circumference (girth) in both polar and equatorial directions, thickness of husk, colour etc. were recorded for both selected and rejected nuts. Nuts were sliced on the ridge opposite the broadest side and laid in a prenursery with sliced ridge uppermost, soon after picking (without period of seasoning) and tended in the usual manner. Sprouting dates were recorded and sprouted nuts were transferred weekly to conventional-nursery beds. Growth measurements of seedlings were taken at 5 months, 7 months and 9 months from laying and seedling rejection was carried out at about 9 months from laying. Records were maintained of seedlings suitable for issue and those rejected as weaklings.

RESULTS AND DISCUSSION

The initial analysis was to test the efficacy of the present methods of seednut selection. The second stage was an attempt to devise methods for identification of nuts which are not likely to germinate so that they may be rejected with a high degree of accuracy.

(i) Efficacy of seednut selection

Table 1 gives the number of germinations, deaths after germination, seedlings rejected and issued from selected and rejected nuts in 600 nut samples from (a) Keenakelle and (b) Ambakelle. It is clear that the present criteria of seednut selection permit a substantial number of unsuitable nuts to reach the nurseries and eliminate a not inconsiderable number of nuts which are capable of producing vigorous seedlings. Of the 600 nut samples from Keenakelle and Ambakelle, 66.5 and 69.5 percent, respectively, produced seedlings suitable for issue. Of the balance which did not produce seedlings suitable for issue 83 to 86% (i.e. 167 out of 201 from Keenakelle and 157 out of 183 from Ambakelle) were from selected seednuts. As much as 69—77% of the total non-germinations (i.e. 63 out of 91 from Keenakelle and 48 out of 62 from Ambakelle were from those selected as seednuts.

On the other hand, 54 to 57% of the nuts which were rejected as being unsuitable for use as seednuts (i.e. 40 out of 74 Keenakelle and 34 out of 60 from Ambakelle) produced seedlings suitable for issue. This shows that more than 50% of the nuts rejected as being unsuitable for use as seednuts are capable of producing vigorous seedlings. Vigorous seedlings generally grow into high yielding adult palms and it has been shown that seedling selection as carried out in the nursery results in a crop increase of about 10% (Liyanage, 1953). Hence, it is important to avoid rejection of nuts which can yield vigorous seedlings. An in-depth study of criteria for seednut selection is, therefore, indicated. This is emphasised by the findings listed in Table 2.

* Plus palms are specially selected elite palms.

** At the isolated seed garden at Ambakelle the weak palms are rogued, so the palms remaining are elite.

Table 1. *Number of germinations, deaths after germination, seedlings rejected and issued from selected and rejected nuts in 600 nut samples from (a) Keenakelle and (b) Ambakelle*

	(a) Keenakelle				(b) Ambakelle			
	Selected	Rejected	Total (selected + rejected)	%	Selected	Rejected	Total (selected + rejected)	%
(1) Total seednuts ...	526	74	600	100	540	60	600	100
(2) Not germinated ...	63	28	91	15.2	48	14	62	10.3
(3) Germinated ...	463	46	509	84.8	492	46	538	89.7
(4) Deaths after germination	43	3	46	7.7	11	2	13	2.2
(5) Seedlings rejected ...	61	3	64	10.7	98	10	108	18.0
(6) Seedlings issued ...	359	40	399	66.5	383	34	417	69.5
(7) Total not issued (nuts & seedlings) ...	167	34	201	33.5	157	26	183	30.5

Table 2. *Cause of rejection and fate of rejected nuts from (a) Keenakelle (b) Ambakelle*

Cause of rejection	*Total nuts*	*Not germinated*	*Deaths after germination*	*Seedlings rejected*	*Seedlings issued*
1. Small					
(a) ..	10	3	0	0	7
(b) ..	1	0	0	0	1
2. Small with reduced amount of nut water					
(a) ..	7	0	0	1	6
(b) ..	3	1	0	0	2
3. Reduced nut water					
(a) ..	24	5	2	1	16
(b) ..	13	0	1	2	10
4. Empty					
(a) ..	8	6	0	0	2
(b) ..	24	8	0	7	9
5. Immature					
(a) ..	17	12	0	1	4
(b) ..	10	3	0	0	7
6. *Kuruwal**					
(a) ..	1	0	0	0	1
(b) ..	4	1	1	0	2
7. Misshapen					
(a) ..	4	0	0	0	4
(b) ..	0	0	0	0	0
8. Damaged					
(a) ..	3	2	1	0	0
(b) ..	4	1	0	1	2
9. Fallen nuts from previous harvest					
(a) ..	0	0	0	0	0
(b) ..	1	0	0	0	1

*Kuruwal is the local term for immature fallen nuts.

Table 2 lists causes of rejection and fate of rejected nuts from each source. A large majority (72.4%) of nuts rejected because they were small, had a reduced amount of nut water or both were found to yield seedlings suitable for issue. This accounted for 31.3% of the seedlings issued out of those rejected as seednuts. All mis-shapen nuts produced seedlings suitable for issue while damaged nuts did so sometimes, probably depending on the extent of the damage. It seems therefore, advisable to exclude rejection on the basis of size, quantity of nut water and shape. Of those nuts classified as empty or immature, 75% and 70.6% respectively from Keenakelle did not germinate but from Ambakelle 37.5% of the former and 86% of the latter yielded seedlings suitable for issue. It appears that more definite criteria are required for identification of these types.

(ii) **Factors associated with viability of seednuts**

For the second stage of the analysis, each nut was classified as germinating (1) or non-germinating (0). The relationship of this 0—1 variable to the explanatory variables was then investigated with multiple logistic regression. The analysis showed no strong relationships between germination and any of the explanatory variables. There were small differences between the seednuts from the two sources and a small effect of colour. The weight of the nut was also possibly influential. The analysis was repeated with germination by day 100 taken as the dependent variable, with very similar results.

The results are displayed most clearly by repeating the analysis after recording the weight variable into 3 categories, small (<2.6 lb), medium (2.6—3.25) lb and large (>3.25lb) The viabilities for each combination of source, colour and weight are given together with estimated standard errors, in Table 3. The main differences are clear from this table. Nuts from Ambakelle have a higher germination than those from Keenakelle,. Dry nuts have the lowest viability. Green are better than reddish brown (*rathi*) at low weights but the reverse is true at high weights. Log-linear modelling methods may be used to show that these effects are 'statistically significant'.

However, statistical significance is not the same as practical importance: a difference in germination percent is of practical value if it allows increased efficiency of seednut selection. An example shows that the differences in Table 3 are not large enough to provide a useful selection strategy. The nuts with the lowest viabilities are large, dry from Ambakelle. These could be discarded. However, there were only 5 such nuts, so this will have no impact on germination percent. Since dry nuts generally performed least well we could discard all dry nuts (184). This would only increase the overall germination from 87.5% to 88.9%. Furthermore, it would involve discarding 147 (out of 1200) that would have germinated.

Time to germination

Liyanage and Abeywardena (1953) suggest that early germination is associated with higher yields in the adult palm. It is therefore of interest to determine whether germination time is related to any of the characteristics measured in the seednuts.

The analysis was carried out only on those that had germinated by 130 days using multiple regression. Statistically significant relationships were found, between germination time and weight, husk thickness and the shape of the nut.

However, once again the large sample size means that very small effects are 'significant'. The nut weight was the most important variable. The size of the effect of weight on germination time is shown in Fig. 1. Here the proportion of those nuts that eventually germinated that had germinated by day *n* is plotted against the day number.

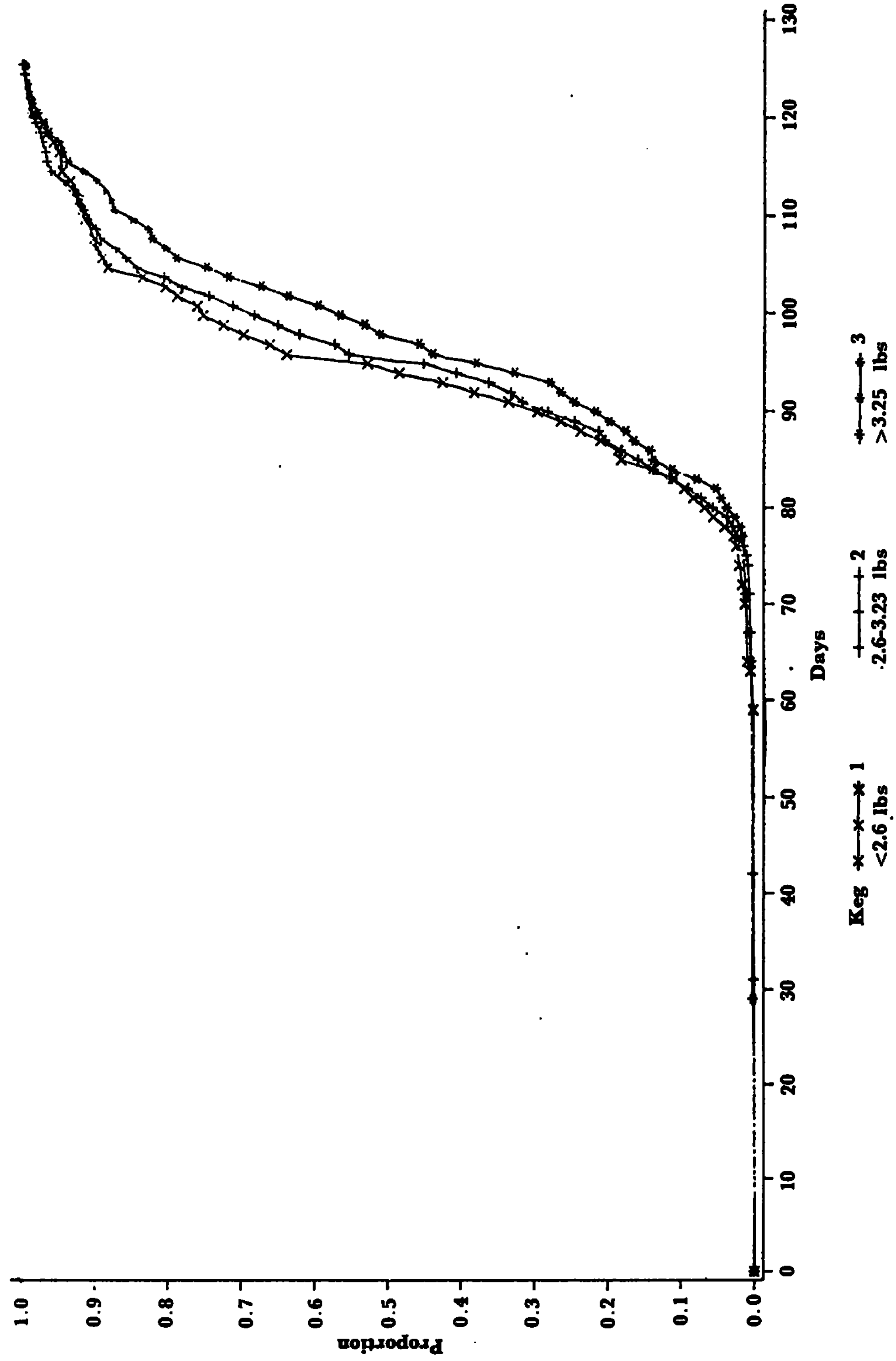

Fig. 1 Effect of weight of seednut on germination times

Thus less than 10% of the nuts have germinated by day 80 and nearly all by day 120. The curves plotted for each of the weight categories are very close together. The small nuts are the most rapidly germinating but the difference in median germination time for large and small nuts is only about 3 days. This is much less than the range of germination times for any one category of nut.Hence again we see a statistically significant effect which is too small to be of value in seednut selection.

Table 3. *Germination values for each combination of source, colour and weight of seednuts*

Source	*Colour*	*Weight* *Small*	*Medium*	*Large*
Ambakelle ..	Green	.96(.03)	.93(.02)	.84(.05)
	Dry†	.80(.04)	.84(.06)	.60(.22)
	Reddish brown (*rathi*)	.90(.04)	.94(.02)	1.00(.00)
Keenakelle ..	Green	.86(.05)	.89(.02)	.82(.03)
	Dry	.73(.09)	.84(.08)	.80(.18)
	Reddish brown (*rathi*)	.71(.09),	.87(.04)	.97(.03)

† Colour not clear as epicarp had turned brown due to drying out. Estimated standard errors for germination are given after each value, in parenthesis

CONCLUSION

The standard selection criteria have perhaps been based on the results of early studies on correlations of seednut, seedling and adult palm characters. However, it is important to note that the significance of a correlation depends on the sample size as well as on the size of the effect. Correlations are often not large enough to be of practical value. Liyanage and Abeywardena (1957) showed that volume and weight were not useful criteria for selection of seednuts. Our results indicate that polar and equatorial circumferences, the shape as measured by the ratio of these two and weight are all highly correlated. Although statistically significant relationships may be found between germination time and some seednut characters, they are too small to be of practical value in the selection of seednuts. Non-selection increases seedlings issued by about 10%. Seednut selection may, therefore, be dispensed with and all nuts harvested from the selected seed palms may be laid in the nursery. Non-germinations should be removed five months from laying and a rigid selection of seedlings carried out at seven months, in the nursery.

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