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Short communication

Selection of *pisifera* parents based on progeny performance of D × P oil palm hybrids

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ABSTRACT

Proper selection of *dura* (female) and *pisifera* (male) parents is very important in the oil palm improvement programme for producing superior *tenera* hybrids. Unlike *dura*, it takes 8-10 years or sometimes even more, to select a *pisifera* parent based on field testing. Hence, it is imperative to select the parents at an early stage to save time and resources. Nursery performance is often considered as an indication of the future performance of a genotype in oil palm. Twelve *pisifera* parents were employed in crossing several *dura* mother palms and the progenies were evaluated in order to identify better male parents. The present study revealed that the *pisifera* parents P71 and L379 were the most promising and are closely related. These were followed by P82, P331 and P370 and which could be considered to be better male parents with respect to the progeny performance and could be employed as male parent in future breeding and hybrid seed production.

Key words: Growth parameters, oil palm hybrids, *pisifera*.

Commercial plantation of oil palm (*Elaeis guineensis* Jacq.) is raised using *tenera* palms, hybrid obtained by crossing *dura* and *pisifera*. Proper selection of both *dura* (female) and *pisifera* (male) is very important in the oil palm improvement programme for producing superior *tenera* hybrids. *Dura* parents are selected based on various morphological and yield components. However, such criteria could not be imposed on *pisifera* mainly because *pisifera* parent is mostly female sterile and its utility could be evaluated through the performance of D × P progeny only. Identification and evaluation of superior *pisifera* parent assumes more significance as pollen from asingle male inflorescence (50-100 g) would produce hybrid seeds required for raising 5,000 ha of plantation or in other words a single *pisifera* can influence the plantation performance in such a large area. Usually it takes up to 8 years or more, to select a *pisifera* parent based on field testing. This requires huge investment of resources like time and other resources. This necessitated development of criteria for early selection of *pisifera* parent palms, possibly at nursery stage, there by the burden of maintaining palms with inferior performance could be avoided.

Nursery performance is considered as an indication of the future performance of a genotype in oil palm (Ibrahim *et al.*, 4). Vigorous and healthy oil palm planting materials should be used for transplanting to main field to ensure low mortality rate, better accumulation of biomass and yields up to 25 years. Since, expected environmental variation may be less in a polybag nursery; a positive association could be expected between the performance in nursery and main field. Reports suggested that leaf production of immature field palm was positively correlated with early yield of 5-6 years and there exist a positive correlation between nursery leaf area and early growth in the main field. Breure (1) demonstrated reliable estimation of area of mature individual leaves before canopy attains its final size, using a logistic growth curve (fitted through the area of the youngest leaf plotted against the number of years after planting). Breure (2) showed that oil palm progenies descending from three *pisifera* male parents markedly differed in the rate of leaf expansion and L_{max} (maximum area of individual leaf). Association of leaf area with the measurements of leaflet was established for mature palms and Corely and Tinker (3) showed that leaf dry weight could be estimated from the width and depth of petiole. In coconut, the number of leaves and girth of seedlings are important criteria considered while practicing selection in nursery (Nampoothiri, 5) and seedling vigour is correlated with adult palm characters such as early flowering and high nut content and copra yield. In this background, the present work on evaluating 12 *pisifera* parents through progeny performance of D × P crosses in nursery was taken up.

Twelve selected *pisifera* parents were used in crossing different *dura* mother palms following NCM-1

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design. The hybrid seeds were harvested, processed and germinated following standard procedures (Corely, 3).The sprouts were then raised in primary nursery and then transplanted to secondary nursery. Observations were recorded first at 20 months and subsequently at 25 months of age. The data recorded in nursery included height of plants in cm, girth (cm), height increment (cm), No. of leaves, width and depth (cross section) of petiole, rachis length and number of leaflets. The mean length and width of six leaflets from the middle of rachis were also recorded. Leaf area and leaf dry weight were calculated according to the formulae given below.

Leaf area = -0.25 + 0.455*nlw*, where *n* = No. of leaflets, *lw* = the mean of length × mid width for a sample of six of the largest leaflets. Leaf dry weight = 0.04 P + 0.21, where P is the petiole cross section (width × depth). The statistical analysis of data for ANOVA and correlation were carried out in SPSS version 17.

Multivariate analysis was conducted for grouping the palms based on proximity with respect to characters such as height, height increment, girth, number of leaves, leaf area, leaf dry weight and specific leaf weight using SAS Enterprise guide version 4.2. Analysis of the mean performance revealed (Table 1) significant differences among *pisifera* parents with respect to all the seedling characters recorded.

Leaf dry weight indicates the extent of photosynthesis and dry matter accumulation, which in turn reflects the growth performance of seedlings. The carbohydrate produced in the process of photosynthesis is first used for maintenance of the existing biomass (maintenance respiration) and the remaining will be converted to vegetative dry matter in case of immature palms. The leaf dry weight of different *pisifera* progenies varied from 0.365 to 0.521 kg/palm. The pollen parent P71 recorded the maximum leaf dry weight, which was followed by P82, P331 and L379 which were on par with each other and statistically superior to rest of the palms. The specific leaf weight was the maximum in P82 (1.670 kg cm^{-2}) followed by P331, P71 and L379.

Progenies were evaluated with respect to petiole cross section, which is the determinant of leaf dry weight. The values of petiole cross section varied from 3.048 to 1.520 cm^2. The petiole cross section was the maximum in P71 (3.05 cm^2) followed by P82, P82, P331 and L379.

The leaf area is the important determinant of light interception, which in turn is the major driving factor for physical growth and development of the plant. Leaf area is related to the accumulation of dry matter, plant metabolism and yield. The length and width of leaf lets, which in turn contributed to leaf area, varied significantly among the progenies. The highest leaflet length was observed in hybrids involving *pisifera* L379 followed by P370, P82 and L47. At the same time the width of leaflet was maximum in P435 followed by P71, L90 and L47. The

Table 1. Progeny performance of *pisifera* parents in oil palm D × P crosses.

pisifera parent	Height (cm)	Height increment (cm)	Girth of plant (cm)	No. of leaves	Length of rachis (cm)	Petiole cross section (cm^2)	No. of leaflets	Leaf area (m^2)	Leaf dry weight (kg)	Rachis length/ LLN	Specific leaf area (m^2 kg^{-1})	Specific leaf weight (kg m^{-2})
P71	143.05	41.602	34.244	13.458	109.800	3.048	70.810	0.269	0.327	1.965	0.843	1.486
L90	126.69	37.437	29.584	11.885	96.148	2.01	118.116	0.431	0.290	0.845	1.483	0.696
L47	129.32	43.787	28.323	11.823	101.212	2.086	126.208	0.477	0.292	0.806	1.635	0.618
L379	153.66	47.347	33.317	10.692	118.947	2.395	62.429	0.242	0.306	2.149	0.773	1.421
P66	120.20	42.372	24.136	10.708	93.756	1.520	115.532	0.335	0.271	0.811	1.232	0.831
P82	158.85	56.010	41.500	13.704	119.733	2.930	55.246	0.211	0.327	2.316	0.641	1.670
P435	128.09	43.646	24.516	11.744	99.820	2.094	117.081	0.473	0.294	0.853	1.608	0.633
P214	115.36	41.135	22.245	11.311	89.915	1.624	112.748	0.365	0.275	0.799	1.327	0.787
P331	159.97	57.384	40.340	13.324	118.524	2.473	59.363	0.208	0.309	2.095	0.685	1.574
P370	161.23	55.132	38.500	11.457	120.358	2.287	62.965	0.240	0.302	1.936	0.799	1.309
L132	127.27	39.760	26.220	11.790	97.070	1.937	130.750	0.423	0.288	0.724	1.466	0.692
P167	119.84	37.925	27.265	11.835	90.328	2.039	113.868	0.381	0.292	0.836	1.314	0.795
$CD_{(0.05)}$	15.68	8.13	5.24	1.16	11.79	0.745	21.88	0.10	0.44	0.726	0.343	0.451

length of leaflets varied from 30.95 to 35.87 cm and the width from 2.14 to 2.66 cm. The leaf area was the maximum for L47 followed by P435 and L132, whereas, the lowest was in P71.

Specific leaf area, which indicated the extent of dry matter produced, was calculated for all the progenies. The SLW varied from 0.641 to 1.635 m^2kg^{-1}. The pollen parents, which required lesser leaf area for unit dry matter production ranged from minimum in P82 (0.641 m^2 kg^{-1}), P331 (0.685 m^2 kg^{-1}), P370 (0.779 m^2 kg^{-1}), L379 (0.773 m^2 kg^{-1}) and P71 (0.843 m^2 kg^{-1}). The mean girth of plants varied from 22.25 to 41.5 cm, maximum girth being recorded in the progenies of P82 which was on par with P331 and P370. The P370 was in turn on par with P71 for girth of the seedlings. Whereas, the plant girth was the lowest in P214, followed by P66 and P435. Plants with higher values of girth could be expected to perform better in field as in reports suggested in case of coconut (Nampoothiri, 5).

The plant height of progenies varied from 115.36 to 161.23 cm. Progenies of P370 recorded the maximum plant height, which was followed by P331, P82 L379 and P71, which were on par with each other and significantly different from the rest. The plant height was the lowest in P214, followed by P167 and P66. The rate of increase in height (height increment), a measure that indicate the vigour of seedlings was studied to distinguish between slow growers and fast growers. The mean height increment varied from 37.43 to 57.38 cm.The height increment was the maximum in P331 and was followed by P82 and P370, which were on par with each other. The P370 was followed by L379 which in turn was on par with L47, P435 and P66. The height increment of seedling was the lowest in L90 followed by P167 and L132, which can be an indication of the slow growing nature of these palms subsequently in the field. This could lead to identification of shorter palms, which in turn would reduce the drudgery in palm maintenance/ harvesting and enhance economic life of the crop.

The number of leaves produced by progenies of different *pisifera* parents varied from 11.83 to 14.05. The maximum number of leaves was recorded in the progeny of P82, followed by P71 and P331, all of which were statistically on par with each other and better than the rest. The inter leaflet distance was calculated from the mean length of rachis as well as the number of leaflets. This parameter has been considered as an indicator of the compact nature of the palm upon field planting and is of significance for development of compact palms. The mean inter leaflet distance varied was the lowest in L-132 (0.724 cm) followed by P 214 (0.799 cm) and L47 (0.806 cm) and these could be considered, while breeding for compactness. The leaflets were comparatively sparsely arranged in P82, L379 and P331.

Correlation study was conducted to establish the relation between various growth parameters of progenies (Table 2). The leaf dry weight was strongly correlated with petiole cross section (0.997). The leaf dry weight was further strongly associated with inter leaflet distance (0.843), girth of plants (0.829) and plant height (0.780). Whereas, the leaf dry weight had

Table 2. Pearson correlations of growth parameters of ocl palm D × P progenies.

	Height	Ht increment	Girth	No. of leaves	Rachis length	Petiole cross section	No. of leaf lets	Leaf area	Leaf dry weight	RL / LLN€	Specific leaf area
Height											
Ht. increment	.881**										
Girth	.947**	.830**									
No. of leaves	.459	.401	.638*								
Rachis length	.991**	.865**	.913**	.415							
Petiole cross section	.752**	.505	.805**	.781**	.755**						
No. of leaf lets	-.916**	-.806**	-.890**	-.463	-.910**	-.761**					
Leaf area	-.804**	-.747**	-.800**	-.375	-.784**	-.596*	.940**				
Leaf dry weight	.780**	.544	.829**	.775**	.780**	.997**	-.782**	-.616*			
RL/LLN	.939**	.792**	.910**	.507	.941**	.824**	-.987**	-.908**	.843**		
Specific leaf area	-.850**	-.757**	-.847**	-.435	-.832**	-.683*	.967**	.993**	-.703*	-.948**	

*, ** Significant at the 0.05 and 0.01 levels
RL/LLN = Rachis length/Leaflet number

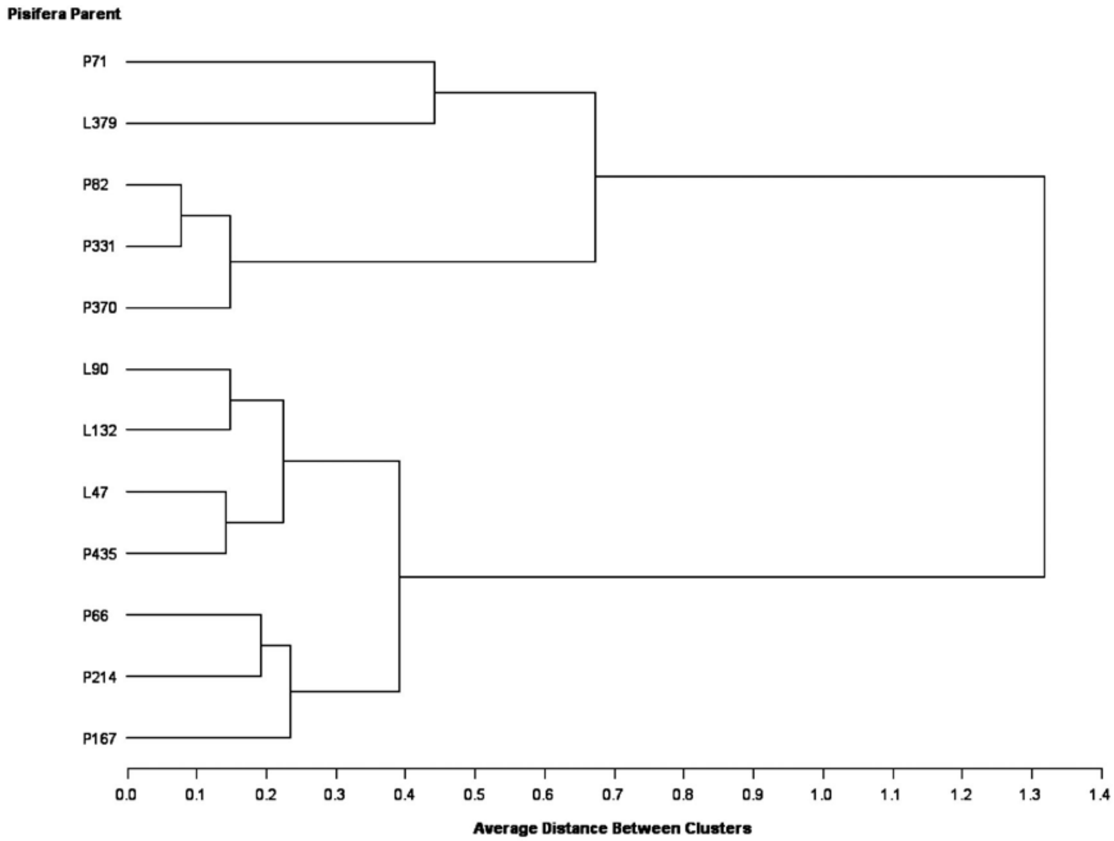

Fig. 1. Clustering pattern of *pisifera* oil palm parents.

significantly negative correlation with the number of leaves (-0.782) and leaf area (-0.616). With respect to the specific leaf area, it had positive significant association with leaf area (0.993) and number of leaflets (0.967). The association of specific leaf area with rest of the parameters were significantly negative.

Multivariate analysis and clustering the palms indicated that (Fig. 1) the *pisifera* parent P71 was the most promising and was closely related to L379. They were in turn close to the palms P82, P331 and P370, indicating the superior performance of these palms. Hence, these five palms could be considered to be better performers with respect to the potential to produce superior progenies and could be employed as male parent in breeding and hybrid seed production.

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