Research Article

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Seed quality and germination in selected hybrids of oil palm (*Elaeis guineensis*, Jacq.)

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Abstract

Different indigenous oil palm hybrids were evaluated with an objective to assess their quality and to develop seed quality standards in commercial seed production centers. Majority of the indigenous hybrids had large proportion of small seeds and their percentage of distribution varied according to the hybrids. The different hybrid combinations recorded coefficient of variation of 11.70, 11.28 and 15.35 for seed weight, shell weight and kernel weight, respectively. Large seed group in all the crosses had high seed weight, shell weight, shell thickness and kernel weight. Though shell thickness had significant differences among crosses and size groups, the coefficient of variation recorded (6.38%) was low compared to other characteristics. Selected hybrids had low average kernel weight of 1.63, 1.05 and 0.74 g for large, medium and small seeds, respectively. In this study, high and low germination percentage was recorded in all the categories of seed groups irrespective of their sizes. All the seed physical parameters studied were positively correlated which are highly significant.

Keywords: Germination, oil palm, physical characteristics, seed size

Introduction

The main source of planting material for commercial planting of oil palm comes from the germinated seed. The relationship between the physical properties and germination characteristics of oil palm seeds are important to determine seed quality. In India, oil palm cultivation has been expanding tremendously. Till recently (2011-12) an area of 2, 06,000 ha have been planted under Oil Palm Development Programme (OPDP). Availability of high quality seed material is a key aspect for the sustainability of oil palm industry and high productivity. Government of India is giving major thrust to production of indigenous planting material to meet its growing demand in the country. The performance of adult palms largely depends on the quality of the planting material used for nursery raising (Corley and Tinker, 2003). Quality of seed is one of the crucial and important inputs required for exploitation of full genetic potential of a given variety. Size is widely accepted as a measure of seed quality and large seeds have better seedling quality, growth and establishment (Jerlin and Vadivelu, 2004) in many of the field as well as tree crops. The relationship between the physical properties and germination characteristics of oil palm seed are important to determine seed quality. Seed physical characteristics and germination of different hybrid combinations from African germplasm has been studied for assessing their seed quality (Murugesan *et al*., 2010). Similar evaluation was undertaken in different hybrid combinations of indigenous hybrids developed at Directorate of Oil Palm Research, Palode with an objective to assess their quality so as to develop seed quality standards in commercial seed production.

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Materials and Methods

Seed quality in terms of seed physical characteristics and germination was assessed for the different combinations of selected hybrids at Directorate of Oil Palm Research, Research Centre, Palode, Kerala during 2009-2011. Fresh fruits hybridized bunches of twenty five hybrid combinations (13 D×116P, 14D×66 P, 18 D×214 P, 20 D×214 P, 21 D×214 P, 22 D×214 P, 23 D×435 P, 25 D×435 P, 33 D×435 P, 36 D×435 P, 39 D×435 P, 49 D×66 P, 51 D×435 P, 59 D×435 P, 60 D×214 P, 62 D×66 P, 65 D×214 P, 75 D×66 P, 76 D×66 P, 87 D×66 P, 89 D×435 P, 108 D×214 P, 109 D×66 P, 124 D×214 P and 129 D×214 P) were separated and seeds extracted from the fruits were first manually graded into large, medium and small seeds and after taking weight of individual seeds from each group they were once again grouped and percentage distribution of three sizes were calculated. All the seeds from each bunch were equally divided based on single seed weight. Floaters and very small seeds were discarded in all the crosses. Ten seeds from each group were subjected to estimation of physical characteristics *viz*., seed weight (g seed^{-1}), shell weight (g seed^{-1}), shell thickness (mm), and kernel weight (g seed^{-1}). Seeds with multi-kernels were discarded and replaced with single kernel seeds wherever necessary. Germination test was conducted for all the seed size groups following procedure developed by Murugesan *et al*. (2008). A factorial design of CRD design was followed for statistical analysis with three seed weights categories (Large, medium and small as factor one) and twenty five hybrid combinations as factor two. Analysis of variance (ANOVA) was done to determine the statistical significance of mean difference of the variables. Means were separated using LSD at P = 0.01%. Seed physical characteristics *viz*., seed weight, shell weight, shell thickness and germination percentage of twenty five combinations were paired and correlation co-efficient and relationship of seed weight with shell thickness, shell weight, kernel weights and germination were studied. All the values of thirty seeds from each combination were used for correlation of physical characteristics. Mean values were used for correlation of germination with other seed parameters.

Results and discussion

Distribution of large, medium and small seeds among hybrids

The percentage distributions of large, medium and small seeds of different hybrid combinations are given in Figure 1. Distribution percentage of seed weight group and number of seeds of large, medium and small were found to be different among crosses. The cross number, 39D×435P had higher number of large seeds (44.5%) followed by 21D×214P (42%) whereas per cent of medium seed group was high in 60D×214P (42.83%) followed by 87D×66P (41.23%). The proportion of small category was high in 49 D×66P (69.54%) followed by 62 D×66P and 76 D×66P. The reasons for variation in seed size is mostly attributed to palm to palm variation resulted from genetic/environmental effects and inter fruit competition for light and nutrition (Harun and Noor, 2002). Corley and Tinker (2003) reported that there was variation in nut weight of different *dura* genotypes. Contrary to the report by Murugesan *et al*. (2010), the estimated average per cent distribution of small and medium seed groups are high in the indigenous hybrids, whereas hybrids of African germplasm had high proportion of large and medium sizes. Panyangnoi *et al.* (1997) recorded

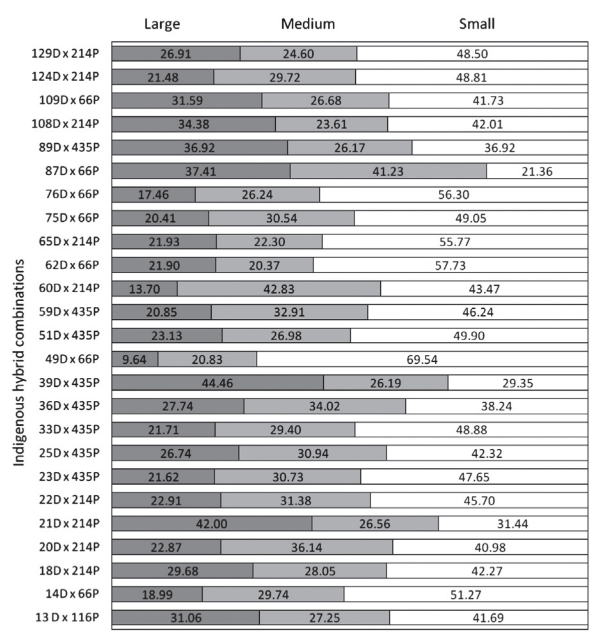

Fig. 1. Distribution of large, medium and small seeds in different hybrid combinations

largest number of seeds of medium size in *dura* bunches. In the present case, majority of the hybrids (21 out of 25) had large proportion of small seeds and the perentage of distribution varied according to crosses, because hybridization was made from different individual mother palms and seed traits are mostly contributed by maternal tissues.

Seed physical characteristics and germination

All the physical characteristics of seeds were found to be significantly different among different cross combinations (Table 1). The different combinations recorded coefficient of variation of 11.70, 11.28, 6.38 and 15.35 for seed weight, shell weight, shell thickness and kernel weight, respectively. Similar pattern has been reported by Murugesan *et al*. (2010) for the hybrids developed from African germplasm. In the present study, comparatively low level of seed variation has been recorded for different parameters due to advance nature of the hybrids which undergone two cycles of selection. It is revealed that cross numbers 87 D×66 P, 39 D×435 P and 21 D×214 P had bold nuts which recorded seed weights of 9.80, 5.08, 3.71; 9.59, 6.35, 4.81 and 9.46, 5.30, 3.90 for large, medium and small groups, respectively. Large seed group in all the crosses had high seed weight, shell weight, thick shell and kernel weight. The size of seed is affected by maternal character and the environment to which the mother plant has been exposed during seed maturation (Gutterman, 2000). Seed thickness is an important character and all the combinations had thick shell as it is a maternal character. However, thin shell *duras* are preferred

Table 1. Variation for seed traits among large (L), medium (M) and small (S) seed categories of different hybrid combinations

Hybrid	Seed weight (g seed^{-1})			Shell weight (g seed^{-1})			Shell thickness (mm)			Kernel weight (g seed^{-1})			Germination (%)		
	L	M	S	L	M	S	L	M	S	L	M	S	L	M	S
13 D×116P	7.16	3.91	2.91	5.22	2.90	2.02	3.79	2.98	2.27	1.50	0.79	0.52	63.89	55.00	56.11
14 D× 66 P	7.05	4.69	3.16	5.23	3.21	1.74	3.08	2.37	2.01	1.81	1.28	1.03	48.45	48.89	51.56
18 D×214 P	8.22	5.29	3.91	6.03	3.49	2.47	3.53	2.70	1.96	2.05	1.51	1.24	57.67	54.67	41
20 D×214 P	6.50	3.78	2.29	4.83	2.88	1.69	3.78	2.96	2.50	1.45	0.78	0.18	63.86	75.51	47.05
21 D×214 P	9.46	5.30	3.90	7.03	3.72	2.78	3.80	2.96	2.45	2.17	1.43	1.05	38.22	41.33	30.22
22 D×214 P	7.62	2.89	1.65	5.47	2.17	1.22	3.46	2.62	2.02	1.77	0.63	0.31	46.16	60.14	52.00
23 D ×435 P	4.77	3.14	2.36	3.71	2.38	1.64	3.50	2.88	2.17	0.99	0.56	0.38	80.00	76.41	63.33
25 D×435 P	7.16	3.57	1.77	5.09	2.18	0.96	2.55	1.89	1.41	1.84	1.12	0.69	54.67	42.33	39.67
33 D×435 P	7.55	4.58	2.73	5.73	3.44	1.93	3.73	3.07	2.30	1.62	0.79	0.62	46.33	27.00	38.67
36 D×435 P	9.23	6.09	4.80	6.71	4.39	3.29	3.80	3.21	2.54	2.44	1.61	1.29	65.34	58.33	38.00
39 D×435 P	9.59	6.35	4.81	7.29	4.55	3.30	4.45	3.45	2.58	2.13	1.68	1.38	51.85	58.06	52.00
49 D×66 P	6.26	4.04	3.00	4.47	2.81	1.95	2.85	2.36	1.86	1.58	1.07	0.80	37.67	30.67	28.67
51 D×435 P	5.52	3.09	1.72	4.40	2.35	1.33	3.71	2.85	2.18	1.08	0.62	0.40	60.67	36.45	31.39
59 D×435 P	5.04	4.09	2.47	3.66	2.97	1.74	2.91	2.51	1.94	1.30	1.06	0.69	76.00	52.50	82.66
60 D×214 P	4.74	2.42	1.11	3.42	1.64	0.74	2.64	2.25	1.77	1.07	0.44	0.19	70.83	68.83	54.00
62 D×66 P	6.52	3.34	2.31	5.19	2.49	1.69	2.91	2.39	2.01	1.33	0.78	0.49	34.67	38.00	52.45
65 D×214 P	6.98	4.52	3.30	5.40	3.25	2.24	3.20	2.64	2.05	1.33	1.03	0.81	45.00	58.00	37.08
75 D×66 P	7.36	3.37	2.41	5.55	2.44	1.67	2.99	2.45	1.96	1.47	0.86	0.49	57.78	43.33	24.17
76 D×66 P	4.27	2.86	1.55	3.35	2.25	1.05	2.56	2.15	1.74	0.90	0.58	0.37	16.67	25.42	25.24
87 D×66 P	9.80	5.08	3.71	7.04	3.56	2.55	3.48	3.01	2.37	2.05	1.24	0.80	50.83	41.67	71.67
89 D×435 P	4.62	3.58	1.91	3.32	2.35	1.20	3.35	2.52	1.72	1.22	0.74	0.47	73.78	58.00	38.22
108 D×214 P	8.25	6.20	4.08	5.79	4.20	2.70	3.28	2.70	2.17	2.22	1.66	1.13	50.22	36.67	45.00
109 D×66 P	5.82	4.32	2.93	4.21	2.98	1.91	3.15	2.57	2.05	1.48	1.08	0.92	81.67	68.33	61.34
124 D×214 P	7.00	3.94	2.05	5.04	2.57	1.60	3.75	2.85	2.27	1.89	1.37	1.06	25.33	15.00	19.33
129 D×214 P	7.90	4.79	3.67	5.57	3.19	2.39	3.72	2.88	2.19	2.17	1.48	1.13	31.67	35.00	35.67
CV %		11.70			11.28			6.38			15.35			15.75	
CD (0.01) for Hybrids (H)		0.34			0.22			0.11			0.11			9.88	
CD (0.01) for Seed Sizes (S)		0.12			0.08			0.05			0.05			3.42	
CD (0.01) for H × S		0.59			0.40			0.18			0.19			17.11	

to get high mesocarp in the progeny. The combinations namely 87 D×66 P, 39 D×435 P and 21 D×214 P had thick shell in all the size groups. Though shell thickness had significant differences among crosses and size groups, the coefficient of variation recorded (6.38%) was low when compared to other characteristics. This is significant with respect to quality of selected hybrids, as uniformity reflects advanced nature of the breeding stocks. Selected hybrids had low average kernel weight of 1.63, 1.05 and 0.74g for large, medium and small seeds as they were bred from Thodupuzha parental palm population with high variation in kernel content and mesocarp (Murugesan *et al*., 2011). Reduced variation of shell thickness in seven crosses was recorded by Myint *et al*. (2010). Corley and Tinker (2003) opined that if the kernel size is increased, the percentage of shell to fruit will also be increased. Murugesan *et al*. (2010) recorded high variation in kernel content and recorded average values of 2.30, 1.28 and 0.76 g kernel for large, medium and small seeds in African germplasm, respectively. There are several evidences of genetic differences in the germination behaviour of oil palm cross combinations. Among twenty five combinations evaluated, eleven combinations showed >50% germination. The combinations that showed good performance in terms of germination were 23 D×435 P, 59 D×435 P, 109 D×66 P and bad performers were 124 D×214 P, 76 D×66 P, 49 D×66 P. In this study, high and low germination per cent was recorded in all the categories of seed groups irrespective of their sizes. Variation in seed size did not affect the germination capacity of the seeds of hybrids which was reflected in correlation study. The high germination percentage recorded in some crosses might be due to independent maternal effect of the mother palm and experimental and environment condition. Myint *et al*. (2010) reported effect of experimental conditions and materials on germination and other physical characteristics of seeds. However, all the seed physical parameters *viz*., seed weight, shell weight, shell thickness and kernel weight were positively correlated which are highly significant (Table 2). This study also agrees with the report of Hartley (1988) that there is no difference between the germination of large and small seed. He stated that seeds from outer fruits on a bunch tend to be larger and many fruits were in the multi-kernel than those from inner fruits. According to Hartley (1988) and Corley and Tinker (2003) there were no difference in germination between seeds from outer and inner fruits and reported failure of germination in very small seeds. Differences in germination might be mainly contributed by genetic factors than food reserve of kernel. Those non-significant effects of seed size on germination and vigor may be due to the dominant effects of genotype over the effect of seed size (Naing, 2010). It was reported that the period during which seeds develop on the parent plant has been found to affect many seed characteristics, including dormancy, through interactions with the environment (Hoyle *et al*., 2008). Hence, behavior of oil palm seeds that developed in different environments need to be studied for the dormancy, germination and seed quality.

Table 2. **Correlation coefficient of different seed physical characteristics and germination of twenty five hybrid combinations**

	Seed weight	Shell weight	Shell thickness	Kernel weight	Germination
Seed weight	1.00	0.98 ***	0.85 ***	0.93 ***	0.11
Shell weight		1.00	0.88 ***	0.90 ***	0.11
Shell thickness			1.00	0.73 ***	0.21*
Kernel weight				1.00	0.013
Germination					1.00
Level of significance		0.05	0.01	0.00	
Stat table		0.20	0.25	0.32	

* and *** significance at 0.05 and 5% levels respectively

Low level of variations in seed traits especially for shell thickness has been reported for indigenously developed hybrids. Variations in seed size did not affect the germination capacity of the seeds of hybrids.

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