

EXPLOITATION OF A DWARF MUTANT IN ARECANUT BREEDING*

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An attempt was made to study the genetics of dwarfism in arecanut (*Areca catechu* L.) and its exploitation in breeding using natural mutant, "Hirehalli Dwarf". Maximum number of dwarfs and intermediates were recovered from the crosses of Sumangala and Hirehalli Dwarf followed by Mohitnagar and Hirehalli Dwarf, among the twelve hybrid combinations involving Hirehalli Dwarf and released varieties/promising cultivars. The segregation indicates monogenic pattern and the absence of pure homozygous materials of released varieties is a handicap in studying the genetics of arecanut. Biometrical observations recorded in eight cross combinations since 1992 showed intermediate height as compared to tall parents and produced more or less equal number of leaves. However, stem girth of hybrids was more in Hirehalli Dwarf and Sumangala/Mohitnagar and Hirehalli Dwarf. Maximum number of palms flowered (67%) in the parent, Mangala and the cross, Mangala x Hirehalli Dwarf, since the variety, Mangala early in bearing might have transmitted the genes responsible for earliness to its crosses. Hirehalli Dwarf x Sumangala cross found to be promising in yield (2.65kg chali/palm) in the first year of bearing and retaining the dwarfness.

INTRODUCTION

Arecanut (*Areca catechu* L.) palms normally attain a height of 18 to 20 m. Such tall palms are not only difficult to manage but also prone to frequent wind damage. Various farm operations like spraying and harvesting become relatively easy with dwarf palms. "Hirehalli Dwarf", a natural mutant identified earlier (Naidu, 1963) has not been utilised in arecanut improvement. Its short stature and relative tolerance to yellow leaf disease (Bavappa and Nair, 1982) are indicative of its use as a good genetic source for crop improvement. The yield of Hirehalli Dwarf is quite low (4-5kg ripe nuts/palm/year). Therefore, it is not only important

to study the genetics of dwarfness but also to improve its yield potential by effecting inter-varietal hybridization to incorporate the dwarfness into high yielding varieties.

MATERIALS AND METHODS

Crosses were made between Hirehalli Dwarf and released varieties/promising cultivars of arecanut to generate large population for studying the genetics of dwarfism and yield performance in 1994, at Central Plantation Crops Research Institute, Regional Station, Vittal. Seednuts of the 12 combinations were produced as stated in the results. Seednuts were sown and the seedlings were raised. Ten month old

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seedlings were grouped into three distinct categories namely, dwarfs, intermediates and tall based on vigour, colour intensity and height of the seedlings and accordingly segregation pattern and distribution ratios were worked out.

Another set (eight cross combinations) of hybrid seedlings obtained from crosses involving Hirehalli Dwarf and released varieties along with seedlings of five parents viz., Mangala, Sumangala, Sreemangala, Mohitnagar and Hirehalli Dwarf were planted in randomised block design with three replications (8 seedlings/replication) during October 1992 in order to evaluate their yield performance and dwarfness. At fifth year of planting morphological characters viz., plant height, number of leaves produced/palm, stem girth and appearance of nodes on the stem were recorded and analysed statistically.

Flowering was recorded in palms which have started flowering and yield data recorded for the palms which had started bearing in the same experiment. Yield data recorded in Hirehalli Dwarf x Sumangala cross in the first year of bearing was compared with the stabilized yield of all the released varieties of arecanut and calculated per unit area production on the basis of spacing (2.2 x 2.2 m) and plant density (2057 plants/ha).

RESULTS AND DISCUSSION

Segregation pattern of hybrid seedlings and their distribution ratios are presented in Table 1. Maximum recovery of dwarfs and intermediates was noticed in Sumangala x Hirehalli Dwarf (76.61%) followed by Mohitnagar x Hirehalli dwarf. Recovery of dwarfs ranged between 16.36 and 36.79 per cent while intermediates registered from 33.02 to 49.26 per cent.

Height of classified dwarf seedlings ranged from 30.6 to 39.8 cm with a mean of 36.0 cm; intermediates from 42.0 to 52.8 cm with a mean of 47.0 cm and tall from 56.6 to 73.2 cm with a mean of 63.2 cm (Table 2). Segregation indicates monogenic pattern and in the absence of pure homozygous materials of released varieties hindered the studies on genetic characterisation of arecanut. However, this is a first attempt in this direction.

Significant difference in terms of plant height and number of nodes was observed between hybrid seedlings and the parents (Table 2). In general, hybrids were intermediate in height as compared to parents except the dwarf parent and produced more or less equal number of leaves. However,

Table 1. Segregation pattern and distribution ratio in hybrid seedlings

Hybrid combination	Total No. of seedling	Dwarfs Number of seedlings	Inter-mediate	Talls	Dwarfs Per cent recovery	Inter-mediate	Talls	Dwarf+ inter mediate	Dwarfs Inter-mediate Talls Distribution ratio
Mangala X H.D	84	21	40	23	25.00	47.62	27.38	72.62	1 2 1
H.D X Mangala	55	9	27	19	16.36	49.09	34.55	65.45	1 3 2
Sumangala X H.D	543	149	267	127	27.44	49.17	23.39	76.61	1 2 1
H.D X Sumangala	146	45	53	48	30.82	36.30	32.88	67.12	1 1 1
Sreemangala X H.D	69	14	34	21	20.29	49.26	30.43	69.55	2 5 3
H.D X Sreemangala	92	25	37	30	27.17	40.22	32.60	67.39	2 3 2
Mohitnagar X H.D	46	15	19	12	32.60	41.30	26.09	73.90	3 4 2
H.D X Mohitnagar	273	90	103	80	32.96	37.73	29.30	70.69	1 1 1
H. Tall X H. D	436	114	197	125	26.15	45.18	28.67	71.33	2 3 2
H. D X H. Tall	176	25	79	62	19.89	44.89	35.23	64.78	1 2 2
S.K. Local X H. D	106	39	35	32	36.79	33.02	30.19	69.81	1 1 1
H.D X S.K.Local	114	24	46	44	21.05	40.35	38.60	61.40	1 2 2

Table 2. Classification of parents and hybrid seedlings on the basis of height (cm)

Cross/ Parent	Tall		Height Intermediate		Dwarf	
	Mean	Range	Mean	Range	Mean	Range
Mangala	-	-	51.0	47.0-55.0	-	-
Sumangala	65.2	58.0-68.6	-	-	-	-
Sreemangala	71.4	66.1-82.3	-	-	-	-
Mohitnagar	75.7	69.0-83.0	-	-	-	-
H. Tall	73.5	65.0-81.5	-	-	-	-
S.K Local	65.8	59.2-70.2	-	-	-	-
H. Dwarf	-	-	-	-	24.4	22.9-26.0
H.D X Mangala	62.9	54.3-71.5	42.6	39.5-52.0	36.5	27.5-38.8
Mangala X H.D	57.6	48.9-65.8	41.0	35.4-46.3	31.5	25.8-33.4
H.D X Sumangala	66.2	58.0-72.7	50.5	39.0-58.0	32.9	23.0-38.0
Sumangala X H.D	62.4	53.0-67.9	45.4	43.0-51.6	37.3	35.4-41.0
H.D X Sreemangala	59.2	55.5-72.2	49.3	45.0-53.7	36.5	32.8-43.6
Sreemangala X H.D	68.3	66.3-78.6	51.7	48.0-59.0	43.3	35.7-45.1
Mohitnagar X H.D	71.7	62.2-83.0	49.0	43.4-54.9	36.9	34.0-38.4
H.D X H. Tall	63.1	56.0-74.6	44.4	39.0-48.9	33.4	28.7-35.2
H.Tall X H.D	65.2	61.6-77.0	50.6	45.2-57.2	38.3	31.4-42.0
H.D X S.K. Local	58.1	53.9-69.2	43.7	36.5-48.0	34.4	30.0-39.6
S. K. Local X H.D	61.8	55.0-72.1	46.9	48.1-52.6	35.0	31.8-43.0
Mean	63.2	56.6-73.2	47.0	42.0-52.8	36.0	30.6-39.8

significantly higher collar circumference was observed in Hirehalli Dwarf x Sumangala (16.81 cm) cross followed by Mohitnagar x Hirehalli dwarf (14.94 cm). Appearance of nodes on the stems was comparatively wider as far as hybrids are concerned (12.07 in Sumangala x Hirehalli Dwarf to 17.64 in Sreemangal x Hirehalli Dwarf).

Out of 24 palms in each hybrid variety, more number of palms flowered (67.0%) in the parent Mangala and the cross Mangala x Hirehalli Dwarf followed by Hirehalli Dwarf x Mangala and Hirehalli Dwarf x Sumangala (Table 3). Since the variety Mangala is a precocious bearer (Bavappa, 1977), it is likely that genes responsible for precocity of flowering have been transmitted to Mangala x Hirehalli Dwarf cross and Hirehalli Dwarf x Mangala cross. Thus, reduced plant height, increased stem girth and earliness (precocity) are desirable characters as for dwarf hybrids.

Hirehalli Dwarf x Sumangala cross started bearing and showed promising trend in yield by recording 10.2 kg ripe nuts per palm in the first year (fifth year after planting) of bearing (Table 4). Average yield of Hirehalli Dwarf is 4.5kg ripe nut/palm/year (Anon., 1993; Naidu, 1963) and Sumangala 12.93 kg ripenut/palm/year (Anon., 1991). About 126.66 per cent increase in yield over the Hirehalli Dwarf was recorded which is a very significant improvement especially with Hirehalli Dwarf palm. Canopy spread is very less in dwarf hybrids and occupy less area, hence, further reduction in spacing (2.2 x 2.2 m) is suggested to accommodate 2057 palms/ha. Though the yield of dwarf hybrid, Hirehalli Dwarf x Sumangala is only 10.20 kg ripenuts/palm/year (initial trend only), the total production of ripenut will be around 20,982 kg per hectare with a yield increment of 28.06, 17.50, 22.03 and 7.69 per cent over Mangala, Sumangala, Sreemangala and Mohitnagar, respectively.

Table 3. Growth parameters of parents and dwarf hybrids in evaluation trial (fifth year after planting)

Hybrid/Parent	Plant height (m)	Stem girth (cm)	No. of leaves	No. of nodes	No. of palms flowered	Per cent palms flowered
H. Dwarf	2.00	14.99	9.40	14.55	12	50.00
Mangala	2.70	13.38	8.06	15.04	16	67.00
Sumangala	4.31	13.50	8.67	17.33	11	45.83
Sreemangala	4.20	13.12	7.80	16.17	9	37.50
Mohitnagar	4.68	14.13	9.21	16.40	12	50.00
Mangala X H.D	2.16	13.07	8.74	12.89	16	67.00
H.D X Mangala	2.43	14.34	9.14	13.68	15	62.50
Sumangala X H.D	2.47	13.71	8.73	12.07	8	33.33
H.D X Sumangala	2.27	16.81	9.19	16.31	15	62.50
Sreemangala X H.D	3.08	13.52	9.64	17.64	7	29.16
H.D X Sreemangala	2.20	14.38	9.58	13.19	8	33.33
Mohitnagar X H.D	2.20	14.94	9.64	14.59	12	50.00
H.D X Mohitnagar	2.19	13.39	9.21	12.64	10	46.67
CD (± 0.05)	0.79	NS	NS	3.61	-	-
CV (%)	16.8	9.42	8.42	14.95	-	-

Table 4. Preliminary yield performance of dwarf hybrid H.D x Sumangala in comparison with released varieties

Varieties	Stabilized yield of					First year bearing of Hybrid*
	Mangala	Sumangala	Sreemangala	Mohitnagar	HD	
No. of palms/ha	1371	1371	1371	1371	2057	2057
Yield/ palm/yr (kg fresh nut)	11.80	12.93	12.82	15.08	4.5	10.20
Mean yield/ palm/yr (Kg chali)	2.86	3.28	3.10	3.67	1.17	2.65
Yield/ha (Kg fresh nut)	16,178	17,727	17,576	20,675	9257	20,982
% increase in yield over released varieties/ H.Dwarf	28.06	17.50	22.03	7.69	126.66	-

* H.D X Sumangala hybrid

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