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EXPLOITATION OF HETEROSIS FOR YIELD AND NUT CHARACTERS IN DWARF HYBRIDS OF ARECANUT (*ARECA CATECHU* L.)

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ABSTRACT

Hybrids involving Hirehalli Dwarf and released varieties of Arecanut namely, Mangala, Sumangala, Sreemangala and Mohitnagar were wanted for yield performance and nut characters. The experiment was laid out with eight hybrids including reciprocals along with five parents at the CPCRI Regional Station, Vittal in 1992 in an RBD with three replications in a plot size of 8 plants. Yield traits *viz.*, number of nuts produced and fresh weight of nuts (kg) per palm were recorded for 4 consecutive years from 1996-97 to 1999-2000. Nut components traits namely fresh nut weight (g), length and breadth of nuts (cm), dry nut weight (g), dry kernel weight (g), kernel length and breadth (cm) were recorded in 1998-99 season and recovery of chali from fresh nut was also worked out for the same. Heterosis for the hybrids was also measured by taking mid parental value in respect of no. of nuts/palm, weight of nuts/palm and also nut characters. Analysis of the data revealed the significant differences among the hybrids and parents for the characters studied. Hybrid H. Dwarf x Sumangala showed high yielding tendency in the early years of bearing (349.25 nuts/palm/year) followed by crosses Mangala x H.Dwarf and H.Dwarf x Mohitnagar (269.67 and 267.05 nuts/palm/year, respectively). While the highest fresh nut yield of 12.08 kg per/palm/year was noticed in the parent Mohitnagar. Among the crosses, Hirehalli Dwarf x Sumangala and Mohitnagar x H.Dwarf showed promising trend in yield by recording 9.14 and 8.91 kg of fresh nut weight/palm/year, respectively. The maximum heterosis of 53.32 per cent and 96.18 per cent for the number of nuts/palm and fresh nut weight/palm was noticed in the cross Mangala x H.Dwarf. While Mohitnagar x H.Dwarf and Mangala x H.Dwarf exhibited higher heterotic effects for most of the nut characters. Over all, H.Dwarf x Sumangala and Mohitnagar x H.Dwarf were found to be promising in yield in the initial years of bearing. Parents Sumangala, Mangala and Mohitnagar have been the common parents with H. Dwarf for high yielding hybrids suggesting its usefulness as best combiners for exploiting heterosis for economically important traits of arecanut.

Key words: Arecanut, heterosis, dwarf hybrids, nut characters

INTRODUCTION

The Arecanut (*Areca catechu* L.) is one of the very important plantation crops of India since it is the most remunerative in terms of gross income. Crop improvement research in arecanut has been in progress for the last five decades in the country and contributed immensely to the remarkable increase in production and productivity in arecanut. Varieties released so far for commercial cultivation are tall in stature with high yield potential, which frequently prone to wind damage and sun scorching and also become difficult to manage. Most of the farm operations like spraying and harvesting will become easy with dwarf type of palm. The "Hirehalli Dwarf" a natural mutant identified earlier (Naidu, 1963) is being utilized in arecanut improvement. The yield of Hirehalli dwarf is quite low 4-5 kg ripe nuts/ palm/year (Ananda 1998). The nuts of H.Dwarf are smaller in size and round in shape and bunches positioned erectly on the stem (Anonymous 1993). Therefore, it is not only important to study the yield performances but also fruit component traits in inter- varietal crosses and also improve the yield performance

of H.Dwarf. Hence, an attempt was made to study the variability in yield and nut component traits in eight hybrids involving H. Dwarf and released varieties and five parents under evaluation for yield performance and dwarfness and also to estimate the heterosis in hybrids for yield and fruit component traits in order to identify the hybrids with high yield potential and dwarfness.

MATERIALS AND METHODS

The present investigation was carried out at CPCRI Regional Station, Vittal. A set of eight cross combinations obtained from crosses involving Hirehalli Dwarf (H.Dwarf) and released varieties along with five parents *viz.*, Mangala, Sumangala, Sreemangala, Mohitnagar and H.Dwarf planted in an randomised block design replicated thrice with eight seedlings/replication during 1992 with a view to evaluate for yield performance and dwarfness. Recording of yield traits *viz.*, number of ripe nuts produced per palm and fresh weight of nuts/palm (kg) was done for four consecutive years from 1996 to 2000 harvesting seasons. Twenty nuts each from the respective hybrids and parents have been sampled randomly for nut component studies during the harvesting season 1998-99. Nut characters, namely, fresh nut weight -whole fruit weighed in (g); length of nut - fruit measured in polar zone of the nut in cm; breadth of fruit – measured in equatorial zone of the nut in cm; dry nut weight – weighed in g after drying the whole nut; dry kernel weight –weighed in g after dehusking the dry fruit; kernel length and breadth measured in cm in polar and equatorial zone of the kernel, respectively. Besides, recovery of chali (dried kernel) from fresh nut yield was also worked out and expressed in terms of percentage in all the hybrids and parents under study. Yield data and nut component traits were subjected to statistical analyses. Heterosis for the eight hybrids was also measured by taking the mid parental values in respect of eight quantitative traits/yield and fruit characters.

RESULTS AND DISCUSSIONS

Yield components: The performance of eight hybrids involving Hirehalli Dwarf and released varieties and five parents for the yield traits namely, number of nuts produced/palm and fresh nut yield/palm has been eavaluated. The variations for both the characters were found statistically significant among the hybrids and parents in all the four years. The highest mean number of nuts produced/palm (349.25) was observed in the cross Hirehalli Dwarf x Sumangala, which also recorded maximum cumulative of 4191 nuts from first year to fourth of bearing followed by the cross Mangala x Hirehalli Dwarf and Hirehalli Dwarf x Mohitnagar with cumulative of 3236 and 3210 nuts/palm, respectively. With regard to the character freshnut yield/palm, the cross H.D. x Sumangala recorded maximum mean yield of 9.14 kg/palm/year followed by the cross Mohitnagar x H.D. (8.91 kg ripenut/palm) and Sumangala x H.D. (8.81 kg/ripenut/palm) among the crosses. The parents Mohitnagar and Sumangala exhibited their superiority for fresh nut yield by recording 12.08 and 9.67 kg/palm/year since these two varieties are high yielders (Ananda 1999). The poor yield performance was noticed in H. Dwarf as it was expected (Anonymous, 1993). The maximum mean range from 194 to 436 was observed in the H.D. x Sumangala in respect of no. of nuts produced/palm followed by the parent Mohitnagar which showed mean range between 216 and 367 nuts/palm. However, maximum range from 9.24 to 15.63 kgs in respect of the character freshnut yield was noticed in the high yield parental variety Mohitnagar. The potentiality of fresh nut yield in early years of bearing ranged from 5.73 – 11.95; 5.30 – 11.92; 6.39 – 11.56 and 4.99 – 11.38 kgs in Sumangala x H.Dwarf, Mangala x H.D., Mohitnagar x H.D. and H.D. x Sumangala hybrids, respectively. Regarding the consistency in the performance of dwarf hybrids in respect of yield the crosses Mohitnagar x H.Dwarf and H.Dwarf x Mohitnagar exhibited linear trend in recording consistently higher ripe nut yield per palm over the years. Similar results are also obtained by Ananda *et al.* (2000) in Mangala variety evaluated under Malnad region of Karnataka. While the alternate year *yielding* tendency was also noticed in the parents Sreemangala and Sumangala which corroborates the results obtained in earlier study (Rekha *et al.*, 1991).

Hybrid vigour in respect of the characters, number of nuts/palm/year and fresh nut yield was measured based on mid-parental value in order to assess the magnitude of heterosis for yield in eight hybrid combinations. The maximum heterosis of 53.32 per cent and 96.18 per cents for the number of nuts/palm/year and fresh nut yield /palm was observed in the cross Mangala x H.Dwarf. Crosses H.Dwarf. x Sumangala; Sumangala x H.Dwarf. and Mohitnagar x H.Dwarf. exhibited higher heterotic effects of 92.13 and 68.95; 43.13 and 62.85 and 38.06 and 34.80 per cents for production of nuts and fresh nut weight., respectively. Varying degrees of heterosis with respect to yield traits have been observed and reported by a number of workers in various crop plants (Rai,1979). The negative/low heterotic effect was measured in the parent H.Dwarf for the number of nuts/palm/year (-08.08%) and fresh nut yield (-20.24%).

Nut component studies: Wide significant variations noticed among the hybrids and parents for all the characters studied (Table 1 & 2). Overall high yielding parents recorded higher values for fruit traits compared to their hybrids except in H.Dwarf, which matintained its identity of small sized nuts. Among the hybrids, maximum fruit length was measured in Mangala x H.Dwarf. and Sumangala x H.Dwarf, while the crosses Mohitnagar x H.Dwarf. and H.Dwarf.x Sumangala showed higher values for fruit breadth. The fresh fruit weight was also high in case of Mohitnagar x H.Dwarf, and Sumangala x H.Dwarf, crosses. Dry fruit weight and dry kernel weight were also significantly higher in Mohitnagar x H.Dwarf. and Sumangala x H.Dwarf. palms. The high kernel length was observed in Mangala x H.Dwarf. cross followed by the parent Sumangala and the cross Sumangala x H.Dwarf, while the kernel breadth was maximum in parents Sreemangala, Sumangala and Mohitnagar. The cross H.Dwarf. x Sumangala also showed increased breadth. As expected H.Dwarf recorded low values for all the nut characters studied; however, the dwarf palms showed significantly higher recovery of chali/dry kernel 28.53 per cent from the fresh fruit compared to other parents and hybrids. The next highest recovery was noticed in the cross H.D. x Mohitnagar. This may be due to low content of husk in the nut of the parent Hirehalli Dwarf. Hence, nuts with less husk is always desirable and such palms could be used as donor parent for furthering the improvement of the crop.

Table 1. Nut characters of dwarf hybrids and parents

Hybrids/parents	Fruit length(cm)		Fruit breadth(cm)		Fresh fruit wt.(g)		Dry fruit weight (g)	
	Mean	Range	Mean	Range	Mean	Range	Mean	Mean range
Mangala x HD	5.47	5.30-5.70	3.65	3.4-3.9	32.33	28.0-34.0	10.80	08.6-12.10
HD x Mangala	4.20	3.90-4.50	3.63	3.4-3.8	22.47	20.0-24.0	08.00	07.2-8.90
Sumangala x HD	5.37	5.20-5.50	3.72	3.4-4.2	34.07	30.1-37.0	12.47	10.9-13.10
HD x Sumangala	4.89	4.50-5.20	4.09	3.9-4.3	28.00	26.6-30.3	11.67	09.9-12.40
Sreemangala x HD	4.70	4.50-4.90	3.75	3.4-3.9	26.87	23.7-30.8	09.67	08.6-11.20
HD x Sreemangala	4.22	3.90-4.50	3.98	3.6-4.3	28.47	25.0-31.0	10.00	09.1-10.80
Mohitnagar x HD	4.84	4.60-5.10	4.18	3.9-4.7	35.00	34.1-36.0	12.13	11.4-12.90
HD x Mohitnagar	4.49	4.10-4.80	3.77	3.6-4.1	29.00	26.8-32.4	12.13	10.2-13.80
H. Dwarf	3.66	3.40-4.30	2.73	2.5-2.9	10.53	09.6-11.8	04.73	04.4-05.10
Mangala	4.68	4.70-5.50	3.99	3.8-4.6	28.80	27.6-32.8	11.87	10.8-12.10
Sumangala	5.91	5.60-6.40	4.39	4.1-4.9	41.67	39.4-43.0	16.00	14.9-16.70
Sreemangala	5.63	5.30-6.10	4.64	4.3-4.9	43.93	41.0-47.2	15.73	13.6-16.50
Mohitnagar	5.12	4.90-5.30	4.30	4.1-4.8	43.40	38.4-46.2	15.13	14.0-15.90
GM	4.85**		3.91**		31.12**		11.56**	CV(%)
3.51		2.86		06.44		05.80		CD(0.05)
0.29		0.19		03.38		01.13		

Table 2. Nut characters of dwarf hybrids and parents.

Hybrids	Kernel weight (g)		Kernel length (cm)		Kernel breadth (cm)		Recovery(%)	
	Mean	Range	Mean	Range	Mean	Range	Mean	Mean range
Mangala x HD	6.93	5.9-7.8	2.13	2.0-2.3	2.32	2.0-2.4	21.43	20.65-22.42
HD x Mangala	5.07	4.8-5.3	1.64	1.5-1.7	2.22	2.0-2.4	22.56	21.74-23.42
Sumangala x HD	8.07	6.9-9.3	2.05	1.9-2.3	2.51	2.2-2.8	23.68	23.39-23.95
HD x Sumangala	7.40	6.5-8.6	1.72	1.4-1.9	2.61	2.5-2.8	26.45	25.70-27.74
Sreemangala x HD	4.47	3.9-5.4	1.58	1.4-1.9	2.37	2.2-2.6	16.58	16.27-17.22
HD x Sreemangala	5.80	5.4-6.2	1.66	1.5-1.8	2.36	2.1-2.6	20.33	20.00-20.78
Mohitnagar x HD	7.47	7.0-8.4	2.00	1.9-2.1	2.45	2.4-2.6	21.33	20.45-21.83
HD x Mohitnagar	8.20	6.7-8.9	1.99	1.8-2.1	2.60	2.4-2.8	28.20	25.74-29.48
H. Dwarf	3.00	2.8-3.3	1.58	1.3-1.8	1.99	1.7-2.3	28.53	27.58-29.16
Mangala	8.07	7.8-8.6	1.88	1.8-2.1	2.61	2.4-2.8	27.38	27.09-27.77
Sumangala	8.67	8.1-9.2	2.10	2.0-2.2	2.66	2.4-2.9	20.81	20.00-20.58
Sreemangala	9.00	8.1-10.2	1.88	1.8-2.0	2.78	2.5-3.0	20.47	19.18-21.39
Mohitnagar	8.07	7.2-8.6	1.80	1.6-1.9	2.65	2.4-2.8	18.64	18.19-19.47
GM	6.94**		1.85**		2.47**		22.80**	CV(%)
7.32		2.82				03.99		CD(0.05)
0.86		0.09				01.54		

Hybrid vigour in respect of the eight nut component traits estimated based on mid parental values (Table 3). The highest heterotic effect of 32.13% in respect of character, fruit length was observed in the cross Mangala x H.Dwarf. while Sumangala x H.Dwarf. and Mohitnagar x H.Dwarf. palms also showed fairly good vigour. H.Dwarf. x Sumangala cross palms exhibited highest vigour of 14.89 percent for the trait fruit length and also 12.01 per cent for kernel breadth. The cross Sumangala x H.Dwarf. also showed higher heterotic effects for fresh nut weight. Kernel weight and kernel breadth. Increased vigour for dry fruit wt., kernel wt., kernel length and kernel breadth was noticed in the cross H. Dwarf x Mohitnagar. The least/negative heterosis was observed in the crosses, Sreemangala x H. Dwarf. and H.Dwarf. x Sreemangala for the nut characters studied. However ,the cross H. Dwarf x Mohitnagar showed the maximum heterosis for the character per cent recovery of chali from the freshnut yield. This high recovery of chali might have come from the parent H.Dwarf which had the maximum recovery of dried kernel and probably combined well with the parent Mohitnagar.

Overall crosses H. dwarf x Sumangala and Mohitnagar x H. dwarf were found to be promising in the initial years of bearing. The crosses Mohitnagar x H.Dwarf and Mangala x HD

Table 3. Heterosis for nut component parameters

Hybrids	Fruit length (cm)	Fruit breadth (cm)	Fresh Fruit Weight(g)	Dry fruit Weight (g)	Kernel Weight (g)	Kernel length (cm)	Kernel breadth (cm)	Recovery (%)
Mangala x HD	32.13	08.63	64.36	30.12	25.09	23.12	0.87	-23.35
HD x Mangala	01.45	08.04	14.23	-3.61	-8.48	-5.20	-3.48	-23.94
Sumangala x HD	12.11	04.49	30.54	20.25	38.18	11.41	7.73	-15.31
HD x Sumangala	02.09	14.89	07.28	12.54	26.71	-6.52	12.01	-5.40
Sreemangala x HD	01.08	03.00	-1.32	-5.47	-25.50	-8.67	-0.84	-32.79
HD x Sreemangala	-9.25	07.86	04.55	-2.25	-3.33	-4.05	-1.26	-13.21
Mohitnagar x HD	10.25	13.28	29.77	22.16	34.83	18.34	5.61	-10.59
HD x Mohitnagar	02.28	07.10	07.53	22.15	48.01	15.08	12.07	19.54

exhibited higher heterotic effects for most of the nut component traits. Parents, Sumangala, Mangala and Mohitnagar have been the common parents with H.Dwarf for high yielding hybrids suggesting/ its usefullness as best combiners for exploiting hybrid vigour for economically important yield and nut component traits of Arecanut.

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