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Short Communication

Studies on crossability in cashew (*Anacardium occidentale* L.) genotypes

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ABSTRACT

Successful hybridization primarily depends on the crossability of the parents involved as well as development of the F_1 hybrids and their derivatives. In the present study, 12 crosses were attempted to study the crossability relationship among cashew genotypes. Among the crosses, the highest crossability was recorded in the cross H-303 x VTH 711/4 (17.16%), whereas, high rate of abscission of young fruits was observed in crosses involving NRCC Selection -2 as female parent. The genotype VTH 711/4 has shown substantially high per cent of crossability and better nut set with different genotypes of cashew.

Keywords: Cashew, crossability, hybridization, genotypes

The cashew (*Anacardium occidentale* L.), is an economically important fruit crop which has been witnessing steady internal demand in addition to its export potential in the recent years and hence, it is imperative to increase production and productivity. Its cultivation is now being extended to non-traditional areas like Bastar plateau and Northern hills of Chhattisgarh (Ramteke et al., 2020). Besides production management, the other feasible approaches of achieving this is to intensify crop improvement programmes and development of high yielding varieties needs regular attention as the risk of production is increasing under the scenario of climate change which has association with biotic and abiotic factors (Saroj and Mohana, 2016). Broadening the genetic base of existing germplasm by hybridization and systematic exploitation of heterosis could pave the way for overcoming the problem of low productivity (Masawe, 1994). Bolder cashew kernels fetch premium price in the international markets. Hence, emphasis is being given to develop new improved cashew varieties with bold nut size and high yield potential. Currently, the concept of high density planting using dwarf genotypes with compact canopy is gaining more acceptances in cashew cultivation.

Crossability is thus a pre-requisite for generating genetic variability and also to transfer genes in the form of hybrids. An understanding of crossability relationship among the species had been helpful not only in choosing methods for producing F_1 hybrids, but also useful in tracing phylogenic relationship among the related species. Successful hybridization primarily depends on the intercrossing potential/ crossability of the parents involved as well as development of the hybrid embryos including fertility of the F_1 hybrids and their derivatives (Sethi et al., 2016). Hybrid vigour is best manifested in crosses involving parents with greater genetic diversity. Hybridization work carried out at Vengurla, Bapatla and Vridhachalam also confirms expression of hybrid vigour in cashew (Saroj and Mohana, 2016). Therefore, an attempt was made to develop and identify suitable parents for crossing, and heterotic hybrids with high nut yield potential and semi-tallness suitable for agro-climatic conditions of south Chhattisgarh region.

The experiment was conducted under All India Co-ordinated Research Project on Cashew, S.G. College of Agriculture and Research Station, Indira Gandhi Agricultural University, Jagdalpur, Chhattisgarh during 2020. The basic experimental materials comprised of eight cashew genotypes *viz.*, V-4, VTH 711/4, H-303, CARS-7, VRI-3, VRI-1, CARS-8 and NRCC Selection-2, which were used as parents in hybridization, with an objective to transfer economic traits like bold nut, cluster bearing and compact canopy in popular cultivars/promising genotypes/strains of the region. Paper-roll method of hybridization was used for pollination among the

Table 1 : The parental lines of cashew used in the study

Parental line	Source	Character
V-4	RFRS, Vengurle	Cluster bearing, medium size nut, high shelling percentage
VTH 711/4	ICAR-DCR, Puttur	Jumbo nuts
CARS-7	SG CARS, Jagdalpur	Cluster bearing, medium size nut, semi spreading canopy, early bearing
VRI-3	RRS, Vridhachalam	Compact canopy, medium size nut, late bearing, responsive to pruning
VRI-1	RRS, Vridhachalam	Compact canopy, medium size nut, early bearing, responsive to pruning
H-303	RFRS, Vengurle	Cluster bearing, medium size nut, high shelling percentage, compact canopy
CARS-8	SG CARS, Jagdalpur	Jumbo nuts, good shelling percentage
NRCC Sel. 2	ICAR-DCR, Puttur	Medium size nut, high shelling percentage, compact canopy, responsive to pruning

desired parent as suggested by Bhat et al. (1998). The observations on crosses attempted are successful crosses, nuts produced, crossability and other related parameters were recorded as suggested by Basavraja et al. (2018). Intervarietal hybridization was attempted through direct crosses to study the extent of crossing, pollen fertility, seed viability, hybrid lethality and hybrid breakdown per cent in hybrids. The analysis of variance was performed considering mean values to compare the results. To test whether the mean difference of crossability, simple t-test was performed. The data were analyzed using OPSTAT software (Sheron et al., 1998). The details of parents used are given in Table 1.

Total twelve cross combinations were made utilizing eight genotypes from different research stations and desirable crosses for characters like bold nut, cluster bearing and compact canopy were obtained. Before attempting crosses, the emasculated flower twigs were sprayed with plain water followed by spray of 2-3 per cent of glucose water to retain maximum flower and then pollinated with the desired male flowers.

The highest emasculated flower drop was recorded in cross VRI-1 x VTH 711/4 (57.77 %) followed by NRCC Sel. 2 x V-4 (56.01%)) and VRI-3 x V-4 (46.29%). The highest per cent of successful crosses were obtained in NRCC Sel. 2 x V-4 (61.11%) followed by NRCC Sel. 2 x CARS-8 (51.61%), VRI-3 x V-4 (48.27%), V-4 x H-303 (44.23%) and CARS-8 x H-303 (44.00%), whereas, the lowest successful crosses were recorded in V-4 x VTH 711/4 (25.42%), VRI-1 x V-4 (29.52%) and VTH 711/4 x H-303 (31.14%) (Table 2).

In the present study, the highest crossability was recorded in the crosses H-303 x VTH 711/4 (17.16%), VRI-1 x VTH 711/4 (10.52 %), VRI-3 x V-4 (10.34 %) and CARS-7 x VTH 711/4 (9.61%), which, were considered as successful cross combination as well as diverse compatible and adapted parents or combiners (Table 3). This suggests that VTH 711/4 may be considered as ideal parent for transfer of useful genes for the character like bold nut in genotypes to broaden the genetic base of intervarietal hybrids. The similar results were also reported by Sethi et al. (2016).

Moderate crossability was recorded in V-4 x H-303 (7.69 %), V-4 x VTH 711/4 (7.14%) and VTH 711/4 x H-303 (6.55%), whereas, low crossability was observed in NRCC Sel. 2 x CARS-8 (3.22%), CARS-8 x H-303 (5.13%), NRCC Sel. 2 x V-4 (5.55%), VRI-1 x V-4 (5.71%) and H-303 x CARS-8 (6.12%), which may imply that parents of these cross combinations might be originated from diverse secondary gene pool. These cultivars might have cross compatibility problems.

The high rate of abscission of young fruits between 3 to 30 days after pollination and low nut set was observed in crosses of NRCC Sel. 2 x V-4, NRCC Sel. 2 x CARS-8, VRI-3 x V-4 are suggestive for the presence of some genetic and compatibility barriers.

Table 2 : Number of crosses attempted, successful crosses, nut produced and other related parameters in cashew

Cross combination	Emasculated flowers (Nos.)	Emasculated flowers drop (Nos.)	Emasculated flower drop (%)	Crosses attempted (Nos.)	Successful crosses (Nos.)	Successful crosses (%)	Nut set at pea stage	Nuts obtained (Nos.)
V-4 x VTH 711/4	81	25	30.86	56	15	25.42	7	4
VTH 711/4 x H-303	89	28	31.46	61	19	31.14	6	4
H-303 x CARS-8	63	14	22.22	49	17	34.69	5	3
CARS-8 x H-303	72	22	30.55	50	22	44.00	7	4
VRI-1 x VTH 711/4	45	26	57.77	19	8	42.20	5	2
CARS-7 x VTH 711/4	90	38	42.22	52	20	38.46	9	5
H-303 x VTH 711/4	178	44	24.72	134	57	42.53	38	23
NRCC Sel. 2 x V-4	41	23	56.01	18	11	61.11	8	1
V-4 x H-303	70	18	25.71	52	23	44.23	10	4
NRCC Sel. 2 x CARS-8	49	18	36.74	31	16	51.61	6	1
VRI-3 x V-4	54	25	46.29	29	14	48.27	9	3
VRI-1 x V-4	141	36	25.53	105	31	29.52	11	6
Mean	81.08	26.42	35.84	54.66	21.08	41.10	10.08	5.00
SE ±	11.28	2.45	3.36	9.15	3.54	2.78	2.48	1.62
SD	39.08	8.51	11.65	32.63	12.25	9.62	8.61	5.61
CV (%)	48.19	9.31	9.37	59.69	58.11	92.58	85.42	112.20
Skewness	1.33	0.63	0.72	1.21	1.96	0.27	2.77	2.66
Kurtosis	0.83	-0.52	-0.81	0.69	3.35	-0.42	6.21	5.87

Table 3 : Crossability, germination and hybrid lethality in crosses of cashew

Cross combination	Crossability (%)	Seed sown (Nos.)	Seeds germinated (Nos.)	Germination (%)	Plants died (Nos.)	Hybrid lethality (%)
V-4 x VTH 711/4	7.14	4	3	75.00	0	0
VTH 711/4 x H-303	6.55	4	4	100.00	0	0
H-303 x CARS-8	6.12	3	2	66.66	0	0
CARS-8 x H-303	5.13	4	3	75.00	0	0
VRI-1 x VTH 711/4	10.52	2	2	100.00	0	0
CARS-7 x VTH 711/4	9.61	5	5	100.00	1	20.00
H-303 x VTH 711/4	17.16	23	21	91.03	1	4.76
NRCC Sel. 2 x V-4	5.55	1	1	100.00	0	0
V-4 x H-303	7.69	4	4	100.00	0	0
NRCC Sel. 2 x CARS-8	3.22	1	1	100.00	0	0
VRI-3 x V-4	10.34	3	3	100.00	0	0
VRI-1 x V-4	5.71	6	5	83.33	0	0
Mean	7.89	5.00	4.50	90.92	0.17	2.06
SE ±	1.01	1.62	1.48	3.46	0.11	1.61
SD	3.50	5.61	5.14	12.01	0.37	5.56
CV (%)	44.36	112.20	114.22	13.20	217.64	266.99
Skewness	1.13	2.66	2.70	0.84	1.79	2.76
Kurtosis	1.47	5.87	5.90	-0.89	1.20	6.02

The failure of endosperm nuclei to divide or the delayed endosperm nuclear divisions is responsible for abortion of embryo and the subsequent abscission of young fruits. The failure of embryo to reach maturity might be the probable cause of the production of shriveled seeds from these crosses. These results are in accordance with the earlier reports (Manoj & George, 1993; Sethi et al., 2019; Eradasappa et al., 2020).

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