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EFFECT OF CROSS-COMPATIBILITY ON QUALITY PARAMETERS IN MANGO CV. KESAR

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ABSTRACT

An investigation was conducted at Fruit Research Station, Sakkarbaug, Junagadh Agricultural University, Junagadh, during the years 2021-22 and 2022-23. The experiment was laid out in Randomized Block Design (RBD) with comprising ten treatments with three replications. Result reveled that maximum pulp to stone ratio (4.02) was noted in Kesar × Dashehari (T_9) and minimum (3.03) was noticed in Kesar × Amrutang (T_2) during pooled, while it was found non-significant for both the years. Significantly the highest TSS (24.13 ^{0}Brix) was noted in Kesar (OP)-Control (T_{10}) and the lowest (13.43 ^{0}Brix) was reported in Kesar × Rajapuri (T_4) during the year 2021-22, while, it was found non-significant for 2022-23 year and pooled. Significantly the lowest acidity (0.23 and 0.27%) was noted in Kesar × Jamadar (T_3) during the year 2021-22 and pooled, respectively; while, (0.28%) was noticed in Kesar × Sonpari (T_8) during the year 2022-23. The highest acidity (0.49, 0.55 and 0.52%) was recorded in Kesar × Khodi (T_7) during both the years as well as in pooled, respectively. The highest total sugar (16.58 and 16.18%) and reducing sugar (4.36 and 4.30%) were noted in Kesar × Sonpari (T_8) in the year 2021-22 and in pooled, respectively. During the year 2022-23, highest total sugar (16.46%) and reducing sugar (4.61%) was noticed in Kesar × Vanraj (T_5). However the lowest total sugar (12.40, 12.73 and 12.56%) and reducing sugar (2.57, 2.44 and 2.51%) were reported in Kesar × Amrutang (T_2) during both the years as well as in pooled, respectively. The highest non-reducing sugar (12.22%) was recorded in Kesar × Sonpari (T_8) in the year 2021-22 and (12.07%) was noted in Kesar × Dashehari (T_9) during pooled. The lowest (9.83 and 10.06%) was noticed in Kesar × Amrutang (T_2) during the year 2021-22 and in pooled, respectively. Significantly maximum shelf life (14.67, 15.00 and 14.83 days) was reported in Kesar × Dudhpendo (T_6) during the year 2021-22, 2022-23 and pooled, respectively. Whereas, minimum (9.00, 9.20 and 10.60 days) was reported in Kesar (OP)-Control (T_{10}) during the year 2021-22 and in Kesar × Vanraj (T_5) during the year 2022-23 and pooled, respectively.

Key words : Cross-compatibility, Kesar, Mango, Quality.

Introduction

Existence of post-zygotic sporophytic self-incompatibility in mango needs to compatible pollen for increased production. It is known fact that pollen parent have strong impact on physical and biochemical quality of fruits as reported in some fruit crops like date, aonla and custard apple. Using compatible pollen source is one of the most efficient and environmentally friendly agricultural practices to improve the yield and fruit quality of self-incompatible varieties. The major appealing trait of Kesar cultivar is its unique flavour and colour of flesh like saffron besides good appearance. There is no report so far available on Kesar as female parent for further improvement of desirable characters to use in further breeding program through to study the effect of different pollen donors. The aim of the study was to find the compatibility behavior of the cultivars which will be helpful for the breeders in deciding the parental combinations where hybridization can be achieved successfully.

Materials and Methods

An investigation was conducted at Fruit Research Station, Sakkarbaug, College of Horticulture, Junagadh Agricultural University, Junagadh during the year 2021-

22 and 2022-23. The experiment was laid out in Randomized Block Design (RBD) with comprising ten treatments with three replications. The traditional method involving the continued hand pollination of flowers on a panicle over several days when the flowers were open.

In selfing treatment, selection of healthy panicles at lower branches of cv. Kesar as female parent. These panicles were bagged with muslin cloth bags to prevent unwanted cross pollination by insects or wind by foreign pollen. Selection of hermaphrodite flowers which open on preceding evening anthesis were emasculated and kept for pollination. All other flowers, male flowers and unopened buds were removed. After that panicles were bagged carefully. On the next day, for self-pollination, opened flowers were collected from panicles of same tree or different tree in the morning before dehiscence of their anthers in separate petri dishes. They were kept in sunlight for dehiscence of anthers. As soon as they dehisced, they were taken for pollination. The bags from panicles of female parent were removed. Pollination was done by brushing the dehisced anthers of the flowers on the stigma of female parent. After pollination, panicles were rebagged immediately. The bags were removed after fruit set. Emasculation and pollination were performed continuously until majority of flowers in panicle were pollinated.

In case of bad weather re-pollination was also done. In case of cross pollination, opened flowers were collected from panicles of different pollen parent in the morning before dehiscence of their anthers in separate petri dishes.

In open pollination treatment of parent varieties, five healthy panicles per tree were tagged in four different direction of the tree before anthesis of the flowers were allowed for natural pollination by action of pollinators such as insects or wind.

Selected plants were maintained under uniform cultural practices such as application of manure and fertilizers, irrigation and plant protection was followed as per recommendation.

Pulp and stone weight was measured through electrical weighing balance after extraction of stone and pulp from ripened fruits. The pulp: stone ratio was calculated with the help of following formula.

$$\text{Pulp: stone ratio} = \frac{\text{Pulp weight (g)}}{\text{Stone weight (g)}} \qquad (1)$$

The percentage of total soluble solids of the pulp was determined with digital hand refractometer. The refractometer was calibrated with distilled water before use. The readings were recorded for each sample by putting a drop of pulp on the prism and value was recorded and expressed in degree brix (^{0}Brix).

To obtain acidity (%), 0.5 g of pulp was taken in 50 ml volumetric flask and volume was made up with distilled water to 10 ml and titrated against 0.1 N NaOH by using 2 drops of phenolphthalein as an indicator. Appearance of yellow to pink colour denotes the end point. The reading of burette was noted. Acidity was calculated by using following formula and expressed in percentage.

$$\text{Acidity (\%)} = \frac{\text{Reading} \times \text{Normality NaOH} \times \text{Eq. wt. of acid}}{\text{Wt. of sample (0.5 g)} \times 1000} \times 100 \qquad (2)$$

Total sugar was determined by following procedure:

Sample of 0.1 g was mixed and crushed with 10 ml of 80% methanol. Then 0.1 ml aliquot was taken and added 0.9 ml distilled water to make final volume of 1.0 ml. 1.0 ml of phenol 5% and 5.0 ml of 96% H_2SO_4 were added one by one. Then all samples were put in ice bath for 10-15 minutes. Spectrophotometer reading was taken at 490 nm wavelength (Rangana, 1986). Total sugar was calculated by using following formula and expressed in percentage.

$$\text{Total sugar (\%)} = \frac{\text{Graph value (mg)} \times \text{Total volume (10 ml)}}{\text{Aliquat used (0.1 ml)} \times \text{Weight of sample (100 mg)} \times 1000} \times 100 \qquad (3)$$

Reducing sugar was determined by following procedure:

Sample of 0.1 g was mixed and crushed with 10 ml of 80% methanol. Then 0.1 ml aliquot was taken and added 0.9 ml distilled water to make final volume of 1.0 ml. 3.0 ml of dinitrosalicylic acid was added. Then all samples were put in water bath for 10-15 minutes. Spectrophotometer reading was taken at 565 nm wavelength. Reducing sugar was calculated by using following formula and expressed in percentage.

$$\text{Reducing sugar (\%)} = \frac{\text{Graph value (mg)} \times \text{Total volume (10 ml)}}{\text{Aliquat used (0.1 ml)} \times \text{Weight of sample (100 mg)} \times 1000}$$

Non-reducing sugar was determined by following procedure:

Non-reducing sugar was calculated by subtracting reducing sugar from total sugars.

The shelf life of fruits was recorded under room temperature as the days required from harvesting to optimum eating stage and expressed in days.

Various characters under study were statistically analysed by using analysis of variance technique for Randomized Block Design (RBD) as described by Panse and Sukhatme (1985). All characters were studied for significance by "F" test. Standard error of mean (SEm.±) and critical differences (CD) were worked out at 5% level of significance. The statistical analysis was carried out in Computer Cell in Department of Agricultural Statistics, College of Agriculture, Junagadh Agricultural University, Junagadh.

Results and Discussion

Pulp to stone ratio

In pooled analysis, maximum pulp to stone ratio (4.02) was noted in Kesar × Dashehari (T_9), which was at par with Kesar × Jamadar (T_3), Kesar × Rajapuri (T_4), Kesar × Dudhpendo (T_6), Kesar × Sonpari (T_8) and Kesar (OP)-Control (T_{10}). Whereas, minimum pulp to stone ratio (3.03) was noticed in Kesar × Amrutang (T_2). The data showed that it was found non-significant for both the years (Table 1). This variation might attributed due to different fruit size.

Total soluble solids (TSS) (^{0}Brix)

Significantly the highest TSS (24.13 ^{0}Brix) was noted in Kesar (OP)-Control (T_{10}) and the lowest TSS (13.43 ^{0}Brix) was reported in Kesar × Rajapuri (T_4) during the year 2021-22. While, it was found non-significant for 2022-23 year and pooled (Table 1). Similar results were demonstrated by Singh *et al.* (2001) in aonla.

Acidity (%)

Significantly the lowest acidity (0.23 and 0.27%) was noted in Kesar × Jamadar (T_3), it was at par with Kesar × Sonpari (T_8) during the year 2021-22 and pooled, respectively. During the year 2022-23, lowest acidity (0.28%) was noticed in Kesar × Sonpari (T_8) which was at par with Kesar × Jamadar (T_3) and Kesar × Vanraj (T_5). The highest acidity (0.49, 0.55 and 0.52 %) was recorded in Kesar × Khodi (T_7) during both the years as well as in pooled, respectively (Table 2). These might be due to genetic behaviour of parents also influenced by soil and environmental conditions.

Total sugar (%)

The highest total sugar (16.58 and 16.18%) was noted in Kesar × Sonpari (T_8) in the year 2021-22 and in pooled, respectively; which was at par with Kesar × Rajapuri (T_4), Kesar × Vanraj (T_5), Kesar × Khodi (T_7) and Kesar × Dashehari (T_9) during 2021-22 year; also with Kesar × Rajapuri (T_4), Kesar × Vanraj (T_5) and Kesar × Dashehari (T_9) in pooled, respectively. For the year 2022-23, highest total sugar (16.46%) was noticed in Kesar × Vanraj (T_5)

Table 1 : Effect of cross compatibility on pulp to stone ratio and total soluble solids (TSS).

Treatments	Cross combinations	Pulp to stone ratio			Total soluble solids (TSS) (^{0}Brix)		
		2021-22	2022-2023	Pooled	2021-22	2022-2023	Pooled
T_1	Kesar × Kesar	3.50	3.64	3.57	16.73	17.93	17.33
T_2	Kesar × Amrutang	3.07	2.99	3.03	15.67	16.30	15.98
T_3	Kesar × Jamadar	3.85	3.48	3.67	17.63	16.95	17.29
T_4	Kesar × Rajapuri	3.63	3.71	3.67	13.43	14.03	13.73
T_5	Kesar × Vanraj	3.72	3.33	3.53	17.72	18.26	17.99
T_6	Kesar × Dudhpendo	3.66	3.58	3.62	18.53	16.87	17.70
T_7	Kesar × Khodi	3.50	3.56	3.53	15.57	15.20	15.38
T_8	Kesar × Sonpari	3.60	3.75	3.67	19.33	16.89	18.11
T_9	Kesar × Dashehari	4.00	4.05	4.02	19.70	18.75	19.23
T_{10}	Kesar (OP)-Control	3.60	4.04	3.82	24.13	17.57	20.85
S.Em. ±		0.18	0.22	0.14	0.73	1.10	1.14
C.D. at 5 %		NS	NS	0.40	2.16	NS	NS
C.V. %		8.73	10.31	9.56	7.04	11.29	9.30
Year							
S.Em. ±		–	–	0.06	–	–	0.29
C.D. at 5 %		–	–	NS	–	–	0.85
Y × T							
S.Em. ±		–	–	0.20	–	–	0.93
C.D. at 5 %		–	–	NS	–	–	2.67

Table 2 : Effect of cross compatibility on acidity (%) and total sugar (%).

Treatments	Cross combinations	Acidity (%)			Total sugar (%)		
		2021-22	2022-2023	Pooled	2021-22	2022-2023	Pooled
T_1	Kesar × Kesar	0.42	0.45	0.44	13.53	14.41	13.97
T_2	Kesar × Amrutang	0.40	0.38	0.39	12.40	12.73	12.56
T_3	Kesar × Jamadar	0.23	0.31	0.27	15.11	14.95	15.03
T_4	Kesar × Rajapuri	0.41	0.44	0.42	16.08	15.40	15.74
T_5	Kesar × Vanraj	0.43	0.32	0.37	15.48	16.46	15.97
T_6	Kesar × Dudhpendo	0.38	0.37	0.37	14.72	14.76	14.74
T_7	Kesar × Khodi	0.49	0.55	0.52	15.40	14.79	15.09
T_8	Kesar × Sonpari	0.29	0.28	0.28	16.58	15.78	16.18
T_9	Kesar × Dashehari	0.40	0.40	0.40	15.37	15.44	15.41
T_{10}	Kesar (OP)-Control	0.39	0.41	0.40	14.39	14.68	14.53
S.Em. ±		0.02	0.03	0.02	0.49	0.45	0.33
C.D. at 5 %		0.07	0.08	0.05	1.45	1.34	0.95
C.V. %		10.68	12.04	11.39	5.67	5.24	5.46
Year							
S.Em. ±		–	–	0.01	–	–	0.15
C.D. at 5 %		–	–	NS	–	–	NS
Y × T							
S.Em. ±		–	–	0.03	–	–	0.47
C.D. at 5 %		–	–	NS	–	–	NS

Table 3 : Effect of cross compatibility on reducing sugar (%) and non-reducing sugar (%).

Treatments	Cross combinations	Reducing sugar (%)			Non-reducing sugar (%)		
		2021-22	2022-2023	Pooled	2021-22	2022-2023	Pooled
T_1	Kesar × Kesar	2.97	2.97	2.97	10.56	11.44	11.00
T_2	Kesar × Amrutang	2.57	2.44	2.51	9.83	10.29	10.06
T_3	Kesar × Jamadar	3.19	4.20	3.70	11.92	10.73	11.32
T_4	Kesar × Rajapuri	4.00	3.96	3.98	12.08	11.45	11.76
T_5	Kesar × Vanraj	3.95	4.61	4.28	11.53	11.85	11.69
T_6	Kesar × Dudhpendo	3.04	3.08	3.06	11.68	11.68	11.68
T_7	Kesar × Khodi	3.88	3.94	3.91	11.52	10.85	11.18
T_8	Kesar × Sonpari	4.36	4.23	4.30	12.22	11.55	11.88
T_9	Kesar × Dashehari	3.30	3.37	3.34	12.07	12.07	12.07
T_{10}	Kesar (OP)-Control	3.97	3.74	3.86	10.41	10.93	10.67
S.Em. ±		0.32	0.25	0.21	0.42	0.43	0.30
C.D. at 5%		0.97	0.75	0.59	1.24	NS	0.86
C.V. %		15.97	12.01	14.06	6.33	6.58	6.45
Year							
S.Em. ±		–	–	0.09	–	–	0.13
C.D. at 5 %		–	–	NS	–	–	NS
Y × T							
S.Em. ±		–	–	0.29	–	–	0.42
C.D. at 5 %		–	–	NS	–	–	NS

which was at par with Kesar × Rajapuri (T_4), Kesar × Sonpari (T_8) and Kesar × Dashehari (T_9). Lowest total sugar (12.40, 12.73 and 12.56%) was reported in Kesar × Amrutang (T_2) during both the years as well as in pooled, respectively (Table 2).

Table 4 : Effect of cross compatibility on shelf life (Days).

Treatments	Cross combinations	Shelf life (Days)		
		2021 -22	2022 -2023	Pooled
T_1	Kesar × Kesar	12.33	13.00	12.67
T_2	Kesar × Amrutang	11.50	11.83	11.67
T_3	Kesar × Jamadar	13.00	13.50	13.25
T_4	Kesar × Rajapuri	13.67	13.00	13.33
T_5	Kesar × Vanraj	12.00	9.20	10.60
T_6	Kesar × Dudhpendo	14.67	15.00	14.83
T_7	Kesar × Khodi	10.50	11.00	10.75
T_8	Kesar × Sonpari	12.33	12.83	12.58
T_9	Kesar × Dashehari	12.83	12.00	12.42
T_{10}	Kesar (OP)-Control	9.00	13.00	11.00
S.Em. ±		0.76	0.87	0.58
C.D. at 5%		2.26	2.58	1.66
C.V. %		10.82	12.10	11.49
Year				
S.Em. ±		–	–	0.26
C.D. at 5%		–	–	NS
Y × T				
S.Em. ±		–	–	0.82
C.D. at 5%		–	–	NS

Reducing sugar (%)

The highest reducing sugar (4.36 and 4.30%) was recorded in Kesar × Sonpari (T_8) in the year 2021-22 and in pooled, respectively; which was at par with Kesar × Rajapuri (T_4), Kesar × Vanraj (T_5), Kesar × Khodi (T_7) and Kesar × Dashehari (T_9) during the year 2021-22 in pooled, respectively. During the year 2022-23, highest reducing sugar (4.61%) was noticed in Kesar × Vanraj (T_5), which was at par with Kesar × Jamadar (T_3) Kesar × Rajapuri (T_4), Kesar × Khodi (T_7) and Kesar × Sonpari (T_8). The lowest reducing sugar (2.57, 2.44 and 2.51%) was reported in Kesar × Amrutang (T_2) during both the years as well as in pooled, respectively (Table 3).

Non-reducing sugar (%)

The highest non-reducing sugar (12.22%) was recorded in Kesar × Sonpari (T_8) in the year 2021-22 which was at par with all other treatments except Kesar × Kesar (T_1) and Kesar (OP)-Control (T_{10}). In pooled data, highest non-reducing sugar (12.07%) was noted in Kesar × Dashehari (T_9), it was found at par with all other treatments except Kesar × Kesar (T_1), Kesar × Khodi (T_7) and Kesar (OP)-Control (T_{10}). The lowest non-reducing sugar (9.83 and 10.06%) was noticed in Kesar × Amrutang (T_2) during the year 2021-22 and in pooled, respectively (Table 3). The similar kind of findings were recorded by Usman *et al.* (2013) and Singh *et al.* (2017) in guava; Bhat *et al.* (2019) in sweet cherry.

Shelf life (Days)

Significantly maximum shelf life (14.67, 15.00 and 14.83 days) was reported in Kesar × Dudhpendo (T_6) during the year 2021-22, 2022-23 and pooled, respectively. However, it was at par with Kesar × Jamadar (T_3), Kesar × Rajapuri (T_4) and Kesar × Dashehari (T_9) during the year 2021-22; also with Kesar × Kesar (T_1), Kesar × Jamadar (T_3), Kesar × Rajapuri (T_4), Kesar × Sonpari (T_8) and Kesar × Dashehari (T_9) during the year 2022-23; also with Kesar × Jamadar (T_3) and Kesar × Rajapuri (T_4) in pooled data. Whereas, minimum shelf life (9.00, 9.20 and 10.60 days) was reported in Kesar (OP)-Control (T_{10}) during the year 2021-22 and in Kesar × Vanraj (T_5) during the year 2022-23 and pooled, respectively (Table 4). These might be due to genetic behaviour of parents also influenced by prevailing environmental conditions.

Conclusion

In case of cross combinations, all varieties found cross compatible however, with respect to quality parameters Kesar × Sonpari indicated that good cross compatibility.

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