Agriculture Association of Textile Chemical and Critical Reviews Journal (2024) 328-334

AATCC Review

15 August 2024: Received
17 September 2024: Revised
24 October 2024: Accepted
25 November 2024: Available Online

https://aatcc.peerjournals.net/

Original Research Article | Open Access

Identification of anthocyanin rich okra hybrids through heterosis breeding

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ABSTRACT

The anthocyanin-containing purple or red okra varieties are found to be superior to green okra in terms of nutritive quality, medicinal properties, antibiotic as well as insecticidal properties and showed enormous health benefits from the different epidemiological studies. The present experiment on the development of anthocyanin-rich okra hybrids through heterosis breeding was conducted to incorporate the anthocyanin gene in the green podded varieties. For this,five green podded varietiesnamelyHariKranti, Pusa Sawani, Thakath, AKO107, and BidhanSahebmukta were selectively crossed with the two local anthocyanin gene containing purple cultivars and developed five anthocyanin-rich okra hybrids viz. HariKranti x L1, PusaSawani x L1, Thakath x L1, AKO107 x L1, L2 X BidhanSahebmukta by a specific crossing program. The anthocyanin rich okra hybrids were then evaluated with parents for the manifestation of heterosis for different growth, yield and quality characters in them. Three best-performing crossed namely HariKranti x L1, PusaSawani x L1 and L2 X BidhanSahebmuktahave identified as promising anthocyanin rich purple okra hybrids based on their per se performance.

Keywords: *Anthocyanin, Pigmentation, Hybrids, Heterosis, Red or Purple Okra*

Introduction

Okra is an important vegetable crop having enormous health benefits commercially grown for its economic, medicinal, and nutritive value. All the okra growing areas and export markets are dominated by green podded varieties which are more popular and predominant than purple or red colour okra in terms of consumer preferences, production and availability despite the superiority of purple okra varieties in terms of higher nutritive, medicinal and economic value.The purple pigmentation of okra mainly due to the presence of different types of anthocyanidins like Cyanidin 3-O-Sambubioside and Delphinidin 3-O-Sambubioside (1). The accumulation of anthocyanins combines with chlorophylls are responsible for different colour pigmentation ranges from organe, red to redish purple to purple in okra and other pigmented vegetables although chlorophyll is solely responsible for green colour in okra.The presence of different health-promoting substances like beta-carotene, anthocyanin and chlorophyll, phenolic compound and higher amount of other nutrient composition in purple okra itself a powerhouse of nutrients having immense health benefits or beneficial properties over green okra(2). Generally, okra has green to red pigmentation in stem, leaf, flower and fruit. The anthocyanin pigment plays pivotal role in nutritive value of purple or red-fruited okra. Anthocyanins are naturally occurring water and alcohol-soluble non-toxic flavonoids which are abundant in plants give protection against biotic stresses like UV radiation, cold, drought stress, and microbial agents (3,4, 5).

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DOI: https://doi.org/10.21276/AATCCReview.2024.12.04.328

Anthocyanins have health-promoting properties due to the high antioxidant activity (6, 7). Growing evidence reveal that the regular consumption of anthocyanins can lower the risk of inflammation, cardiovascular diseases, age-related degenerative diseases (such as diabetes, atherosclerosis), and certain types of cancers (8,9, 10, 11).

Hybrid breeding technology is most efficient breeding method for the development of elite breeding materials or hybrids with the objective of recombining the different genes in a variety in desired direction. Hence, the selection of parents is very important for having good combining ability from the inbred lines. Some morphological characters especially colour act as a marker characters for transferring of different genes present in the parents into offspring and that can be easily detected in the hybrids as well as subsequent generations and simple selection for desired characters may be made through visually as per phenotypic expression. The epistasis effects of some genes along with linkage drag have masking effects leads to the transfer of undesirable genes with desirable traits affecting the yield and quality of hybrids. Hence, heterosis breeding is more potential technique to mitigate the yield and quality gap of a crop variety as it produces hybrid vigour.

Much emphasis has been given in the development of green colour varieties of okra despite having immense nutritive value of purple colour variety of okra. Moreover, there is an increasing trend to the consumers for consumption of pigment-rich vegetables for their health benefits thus demand of purple okra is increasing everyday and even growers can fetchthe higher market price. Hence, there is scope for the development of anthocyanin rich okra hybrids, expansion of purple okra cultivation, and popularization of the purple variety amongst the growers, an efficient breeding strategy has been framed to develop anthocyanin rich okra hybrids with the objectives to study the heterosis expression of different characters of purple okra and to identify the promising anthocyanin rich okra hybrids.

Materials and Methods

The field experiment on developing anthocyanin rich purple okra hybrids through heterosis breeding was carried out at Horticultiral Research Station of Mondouri, Bidhan Chandra KrishiViswavidyalaya by employing five green podded genotypes namely HariKranti, PusaSawani, Thakath, AKO107, BidhanSahebmuktawhich were selectively crossed with the two local anthocyanin gene containing purple cultivars and developedfive anthocyanin-rich okra hybrids viz. HariKranti x L1, PusaSawani x L1, Thakath x L1, AKO107 x L1, L2 X BidhanSahebmukta by a specific crossing programme during Prekharif and Kharif season of 2022-2023. The 12 genotypes including 7 diverse parents and 5 hybrids were evaluated following randomized block design with three replications with the spacing of 30 cm × 50 cm in the plot size of 3 m × 0.5 m keeping 20 plants in each plot. The standard packages of practices were followed with the recommended dose of fertilizers for the management of the crops. Five plants from each replication were selected for recording the observations on morphological, quantitative and biochemical parameters. Expression of different prominent morphological characters viz. stem colour, leaf blade serration of margin, vein colour, flower petal colour, fruit colour, fruit surface between ridges, number of locules and different quantitative characters especially yield attributing characters including two important quality parameters like total chlorophyll content of fruit (mg/100g), total anthocyanin content of fruits were studied. The data were statistically analysed following strandard statistical methods.

Results and Discussion

Expression of important prominent morphological characters in the hybrids

The different prominent morphological characters of parents and their expression in hybrids were presented in the Table 1, Figure 1 and Figure 2.

Stem colour

Four hybridsregistered red colour pigment in stem except L2xBidhanSahebmukta which showed partially red tinge in stem. Several studies indicated that the red or purple colour pigment on okra stem is dominant over green colour pigment. Stem pigmentation in okra also characterized by other co-workers (12, 13) reported green with reddish tinge pigment in stem whereas, other workers (14) reported red stem colour in okra.

Serration of leaf margin

Three F1 hybrids namely HariKranti × L1, PusaSawani × L1 and L2 × BidhanSahebmuktaregistered strong serration in leaf margin and two crosses namely Thakath × L1 and AKO107 × L1 expressed as medium serration of leaf margin. Similar finding of different types of leaf margin serration in okra was also repoted(15).

Vein colour of leaf

Three crosses viz. HariKranti × L1, Thakath × L1 and PusaSwani × L1 were found purple colour vein and two crosses AKO107 × L1 and L2 × BidhanSahebmukta were registered light green colour vein.

It was revealed that the vein colour of leaf expressed in hybrids is a complex character, having a masking effect, though purple colour pigment is dominant over green or light green in most of the cases. Green leaf with red vein was also reported by some researchers (16, 15) in different places.

Petal colour of flowers

Four parents recorded yellow colour petals and two local collected cultivars recorded purple colour petal and all the resultant hybrids recorded purple colour. The researchers (like 15, 16) observed red colour on both sides except one found red colour inside of okra genotypes.

Fruit colour

The two hybrids viz.HariKranti × L1 and Thakath × L1 registered light red colour fruit whereas,another two cross combinations viz. PusaSawani × L1 and AKO107 × L1 registered red colour fruit and only onecross i.e. L2 × BidhanSahebmuktaregistered purplecolour fruits of okra. The colour intensity in okra fruit varies due to the presence of different types of anthocyanidins namely cyanindin and delphinidin (1). The present investigation revealed that to produce purple or red colour fruit in hybrids of okra one of the either parents must have purple colour as it is a dominant character over green colour. Similar finding of dominant of purple pigment over green pigment in F1 hybrids)was observed in okra (17, 18).

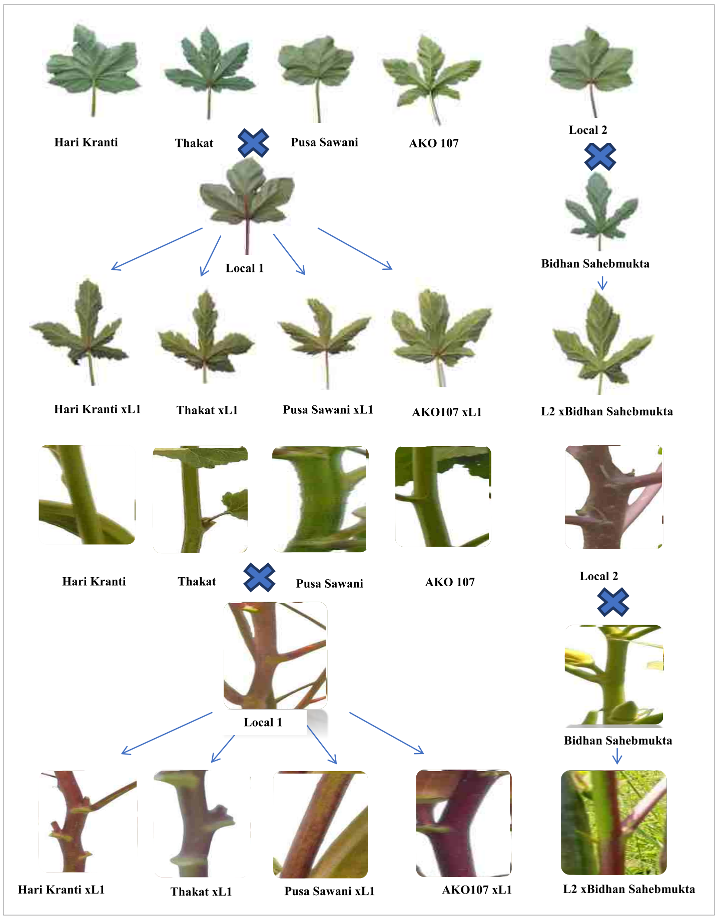

Fig.1: Expression of stem and leaf characters in hybrids

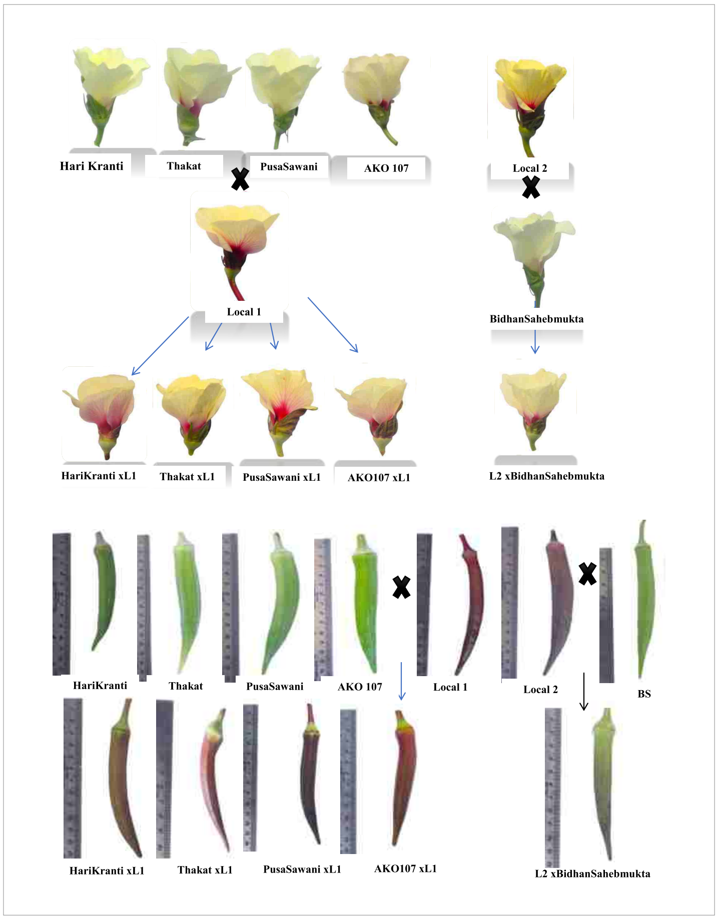

Fig.2: Expression of flower and fruit colour in hybrids

Analysis of heterosis for different characters

Mean sum of squares indicated that all genotypes including parents and hybrids showed significant differences among them for all the characters even at 1% level of significance (Table 2) for which manifestation of heterosis was calculated. Significant better parent heterosis or heterobeltiosis in desired direction is used for the selection of best hybrids.

The mean of different characters of the parental genotypes and hybrids for different characters have been presented in Table 3. The estimates of heterosis expressed in percentage increase or decrease for the concerned quantitative character over the parents have been presented in Table 4.

Plant height (cm)

The average plant height in the hybrids (22.28) was higher than the parents (19.90) value which indicated the dominance of plant height which played an important role for the expression of this character. For this reason, all the hybrids registered positive heterosis ranging from 6.86 to 19.18% over mid parent and 5.90 to 10.53% over better parent. Maximum positive heterosis over the mid parent (19.18%) was recorded in HariKranti × L1 and maximum better parent heterosis (10.53%) was recorded in PusaSawani × L1. A similar finding is in accordance with the result of heterosis in plant height in purple okraby earlier workers (19).

Primary branches per plant

Average primary branches per plant in the hybrids (4.54)were slightly higher than parents (4.02) value which indicated the dominance of primary branches per plant. Hence, out of five hybrids, only three hybrids registered positive heterosis ranging from 4.80 to 45.37% over mid-parent and 1.62 to 11.93% over better parent. Maximum positive relative heterosis (45.37%) was recorded in AKO107 × L1 and maximum better parent heterosis (11.93%) was recorded in PusaSawani × L1. Manifestation of heterosis for this character might have contributed in total yield.The earlier workers (20) considered primary branches per plant for assessment of genetic diversity of okra genotypes.

Internode length (cm)

Average internode length is higher in hybrids (2.41) than the parents (2.34). For this reason, two registered positive heterosis ranging from 13.65 to 34.61% over mid parent and 12.98 to 23.63% over better parent. Maximum positive relative heterosis (34.61%) and maximum heterobeltiosis (23.63%) was recorded in PusaSawani × L1.

Days taken to 1st flowering

The earliness in flowering is important in economic point of view and this character act as a selection index in breeding of any crops. An average number of days taken to 1st flowering in the hybrids (36.94) was lesser than the parents (39.48) which indicated the partial dominance of early flowering. Hence, all the hybrids registered negative heterosis ranging from -2.81 to -12.19% over mid parent and -3.46 to -15.52% over the better parent. Maximum negative mid-parent heterosis (-12.19%) and maximum better parent heterosis (-15.52%) was recorded in PusaSawani × L1 which indicated the earliness of okra. Similar findings also reported by earlier researchers (19, 20) and they found the highest mean performance for days to first flowering in KashiLalima (red podded variety).Some co-workers (21) reported the negative heterosis for days to first flowering is the conformity of the result.

Days taken to 50% flowering

Average number of days taken to 50% flowering in the hybrids (41.96) was lesser than the parents (44.64) which indicated the partial dominance of early flowering. Hence, all the hybrids registered negative heterosis ranging from -4.06 to -12.34% over mid-parent and -4.66 to -16.11% over better parent. Maximum negative mid parent heterosis (-12.34%) and maximum heterobeltiosis (-16.11%) was recorded in PusaSawani × L1.Heterosisexpression for the character indicated the earliness of okra.Earlier report (19, 20) revealed the highest mean performance for days to 50% flowering in KashiLalima (a red podded variety).

Fruit length (cm)

Average fruit length is higher in hybrids (11.26) than parental value (10.72) and for this reason three registered positive heterosis ranging from 5.63 to 15.92% over mid parent and 1.22 to 8.13% over better parent. Maximum positive mid-parent heterosis (15.92%) was recorded in L2 × BidhanSahebmukta and maximum heterobeltiosis (8.13%) was recorded in PusaSawani × L1.Earlier co-workers (19) reported the heterosisexpression in fruit length of okra.

Fruit diameter (cm)

The average fruit diameter in the hybrids (4.63) was higher than the parents (4.17) which indicated the dominance of fruit diameter. Hence, all the hybrids registered positive mid-parent heterosis ranging from 4.07 to 13.70% and out of five hybrids only four hybrids registered heterobeltiosis ranged from 1.31 to 18.15%. Maximum positive mid-parent heterosis (13.70%) was recorded in PusaSawani × L1 and maximum better parent heterosis (18.15%) was recorded in L2 × BidhanSahebmukta. Heterosisexpression for fruit diameter indicated the sidewise increase of fruit might have resulted in higher fruit weight and which otherwise contributed the total yield.Some researchers (19) also considered to the heterosis study for the characters.

Fruit weight (g)
Average fruit weight in the hybrids (15.14) is higher than parents (12.95). Hence, all the hybrids registered positive heterosis for both the parents where mid parent heterosis ranging from 6.17 to 29.53% and better-parent heterosis ranging from 2.87 to 18.57%. Maximum positive mid-parent heterosis (29.53%) for fruit weight was recorded in HariKranti × L1 and maximum better parent heterosis (18.57%) for fruit weight was recorded in AKO107 × L1. Heterosismanifestation for fruit weight might have resulted a higher yield. Previous co-workers (22)have given priority for selection of this character as a yield component and some researchers (19) also considered for heterosis study and found superior.

Number of fruits per plants
Average number of fruits is higher in hybrids (14.73) than the parents (13.44) and for this reason, all the hybrids registered positive heterosis ranging from 6.72 to 14.87% over mid parent and 5.85 to 11.59% over better parent. Maximum positive relative heterosis (14.87%) and heterobeltiosis(11.59%) were recorded in PusaSawani × L1. Heterosis manifestation for this character might have contributed the higher yield of the plants. Similar finding have been reported by earlier researchers (19) for the character.Some of the earlier co-workers (22) revealed the number of fruits registered a positive correlation with fruit yield.

Fruit yield per plant (kg)
Average fruit yield is higher in hybrids (223.86) than the parents (174.39) and hence, all the hybrids registered positive heterosis where relative heterosis ranges from 14.59 to 48.05% and heterobeltiosis ranging from 11.64 to 29.59%. Maximum positive mid parent heterosis (48.05%) was recorded in HariKranti × L1 and maximum better parent heterosis (29.59%) was recorded in PusaSawani × L1. Heterosisexpresion for fruit yield per plant is emerged as the high-yield performing hybrids. Several studies of positive heterosis in fruit yield per plant are the agreement with the present results(19, 21).

Number of seeds per fruit
The average number of seed per fruit is higher in hybrids (45.81) than the parents (47.73) and for this reason, three registered positive heterosis over mid parent ranging from 10.80 to 25.23% and 6.59 to 14.50% over the better parent. Heterotic depression indicated the partial dominance of a lesser number of seeds per fruit over higher number of seeds per fruit. Maximum positive mid-parent heterosis (25.23%) and maximum better parent heterosis (14.50%) was recorded in L2 × BidhanSahebmukta.

Total chlorophyll content (mg/100g FW)
Average total chlorophyll content in the hybrids (29.68) was lesser than parents (47.49) which indicated the partial dominance of low chlorophyll content over high chlorophyll content in fruits. Hence, all the hybrids registered negative heterosis ranging from -20.89 to -35.34% over mid parent and -35.98 to -49.20% over better parent. Maximum negative mid parent heterosis (-35.34%) and maximum negative better parent heterosis (-49.20%) was recorded in HariKranti × L1. Heterosis manifestation for this character might have resulted the higher anthocyanin content fruits.Earlier studies of negative correlation of chlorophyll with anthocyanin content in fruit were also reported (20, 22).

Anthocyanin content (mg/100g FW)
Average anthocyanin content in the hybrids (3.75) was higher than parents (2.24) which indicated the dominance of anthocyanin content in fruits. Hence, all the hybrids registered positive heterosis ranging from 20.64 to 53.36% over mid-parent and out of five hybrids four hybrids registered positive heterosis ranging from 2.24 to 24.95% over better parent. Maximum positive mid parent heterosis (53.36%) was recorded in HariKranti x L1 and maximum positive better-parent heterosis (24.95%) was recorded in PusaSawani × L1. Heterosisexpression for anthocyanin content might have resulted in the best promising hybrids in respect to high anthocyanin content in fruit and immensely contributed the quality of okra fruits and highly desirable. Several studies documented the anthocyanin content in okra registered a negative correlation with chlorophyll content in fruit (20, 22)
Anthocyanin content in fruits is inversely correlated with chlorophyll content in it. Initially, there was no anthocyanin synthesis occurred in fruit during fruit formation stage in 2-3 days after anthesis. However, the intensity of anthocyanin accumulation increases upto (8 -9 days of after anthesis) edible maturity stage of okra and later on it decreases during over mature stage and side-by-side chlorophyll content increases (Karmakar*et al.*, 2021). It revealed that the anthocyanin content fruit is inversely proportionate to chlorophyll content of fruit. The anthocyanin synthesis pathway might be blocked due to the synthesis of chlorophyll and on the other hand the degradation of anthocyanin may also trigger the synthesis of chlorophyll. Earlier findings was also in agreement with this proposition (20, 22).

Conclusion

Identification of promising anthocyanin rich hybrids
The present investigation revealed that there was a wide variation among the parental lines and hybrids for most of the characters under study. The presence of dominance, partial dominance type of gene action in yield and other important quality parameters like anthocyanin content and chlorophyll content of fruits indicates that the heterosis breeding would be more advantageous to produce anthocyanin-rich okra hybrids with higher yield.
Based on the *per se* performance of the hybrids and heterobeltiosis for different yield attributing characters in relation with anthocyanin content in fruits, the two top ranking anthocyanin rich okra hybrids namely PusaSawani x L1 and HariKranti x L1 performed better and found superior even L2 x BidhanSahebmukta also found promising for fruit quality and yield. Therefore, it is suggested that these parents and the two promising hybrids may be further exploited in hybrid breeding program for better yield and quality aspects of okra. The selected crosses can be directly utilized as promising anthocyanin-rich okra hybrids.

Table 1: Manifestation of heterosis for different prominent morphological characters of okra

	Stem colour			Leaf blade serration of margin			Vein colour of leaf			Petal colour of flowers			Fruit colour		
Hybrids	**P1**	**P2**	**F1**	**P1**	**P2**	**F1**	**P1**	**P2**	**F1**	**P1**	**P2**	**F1**	**P1**	**P2**	**F1**
HariKranti × L1	Green	Red	Red	Strong	Medium	Strong	Light green	Purple	Purple	Yellow	Purple	Purple	Green	Red	Light red
Thakath × L1	Green	Red	Red	Medium	Medium	Medium	Light green	Purple	Purple	Yellow	Purple	Purple	Green	Red	Light red
PusaSawani × L1	Green	Red	Red	Week	Medium	Strong	Light green	Purple	Purple	Yellow	Purple	Purple	Green	Red	Red
AKO107 × L1	Green	Red	Red	Medium	Medium	Medium	Light green	Purple	Light green	Yellow	Purple	Purple	Green	Red	Red
L2 × BidhanSahebmukta	Red	Green	Green with red tinge	Weak	Medium	Strong	Purple	Light green	Light green	Purple	Yellow	Purple	Purple	Green	Purple

L1=Local cultivar 1, L2=Local cultivar 2, P1=Parent 1, P2=Parent 2, F1=F1 hybrid

Table 2: Analysis of variance (ANOVA) for different plant characters of the parents and hybrids

Source	d.f.	Mean sum of squares													F- table 5%=2.259				
															F- table 1%=3.184				
		PH	PB	PL	IL	FW	FL	FD	FF	FTF	FP	FN	FFN	SP	FY	TC	TA	TS	PC
Genotypes	11	12.91**	2.22**	12.37**	0.35**	7.89**	1.75**	0.37**	14.66**	20.35**	2.30**	1.47**	21.80**	164.81**	3701.12**	459.89**	3.05**	0.02**	0.63**
Replication	2	0.00	0.01	0.03	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.16	0.60	0.02	0.00	0.00	0.00
Error	22	0.00	0.02	0.02	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.04	0.00	0.16	0.01	0.02	0.00	0.00	0.00
F Value		22981.05	107.39	677.56	49.44	11995.17	60.14	218.92	115117.84	98763.12	4920.26	37.96	26667.95	1014.65	25545.99	2738.66	5084.15	425.60	4742.97

*** Significant at 1% level*

PH= Plant Height (cm), PB= Primary branches/Plant, PL= Petiole Length (cm), IL= Internode Length (cm), FW= Fruit Weight (g), FL= Fruit Length (cm), FD= Fruit Diameter (cm), FF= Days taken to 1st flowering, FTF= Days taken to 50% flowering, FP= Number of Fruits / Plants, FN= Node at 1st flowering, FFN=Days taken to 1st harvesting, SP= Number of seeds /Fruit, FY= Fruit Yield/ Plant, TC= Total Chlorophyll content (mg/100g FW), TA= Total Anthocyanin content (mg/100g FW), TS= Total Sugar content (%FW), PC= Protein Content (g/100g FW).

Table 3: Mean performance of different quantitative characters in the parents and hybrids

Genotypes	Plant height (cm)	Primary branches/ plant	Internode length (cm)	Days taken to 1st flowering	Days taken to 50% flowering	Node at 1st flowering	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)
HariKranti	22.46	4.94	2.72	36.78	40.86	5.80	11.73	4.49	14.16
Thakath	18.22	4.07	2.03	41.02	47.04	5.60	10.00	4.10	12.32
PusaSawani	21.65	3.53	2.55	38.42	43.55	6.13	10.70	3.85	13.88
AKO107	20.13	2.27	2.44	38.74	43.68	5.87	11.46	4.41	13.26
BidhanSahebmukta	18.97	4.20	2.23	38.93	43.95	5.47	11.12	3.75	12.65
L 1	18.55	4.64	2.14	41.57	47.64	6.20	10.51	4.57	11.55
L 2	19.35	4.47	2.26	40.88	45.76	6.47	9.55	4.04	12.83
HariKranti × L1	24.44	5.02	2.33	35.41	40.10	5.33	10.93	4.75	16.65
Thakath × L1	19.65	3.31	1.96	40.13	45.42	4.47	10.23	4.51	12.67
PusaSawani × L1	23.93	5.19	3.16	35.12	39.97	4.47	11.57	4.63	16.12
AKO107 × L1	22.15	5.02	2.03	36.25	41.35	5.13	11.60	4.83	15.73
L2 × BidhanSahebmukta	21.22	4.18	2.55	37.82	42.97	4.47	11.98	4.43	14.53
SE(m)	0.014	0.083	0.049	0.01	0.01	0.14	0.10	0.02	0.02
C.D. at 5%	**0.04**	**0.245**	**0.144**	**0.02**	**0.02**	**0.34**	**0.29**	**0.07**	**0.04**

Contd...

Genotypes	Number of Fruits /Plants	Number of seeds /Fruits	Fruit yield/plant (Kg)	Total chlorophyll content (mg/100g FW)	Anthocyanin content (mg/100g FW)
HariKranti	14.25	47.07	201.78	58.00	1.83
Thakath	12.82	56.27	157.94	52.01	1.97
PusaSawani	13.75	50.60	190.90	43.61	2.26
AKO107	13.61	46.73	180.56	46.05	2.07
BidhanSahebmukta	13.23	40.00	167.27	62.25	1.17
L 1	12.97	45.20	149.81	32.17	3.42
L 2	13.45	48.27	172.48	38.34	2.97
HariKranti × L1	15.63	32.80	260.24	29.47	4.03
Thakath × L1	13.91	36.13	176.33	33.30	3.25
PusaSawani × L1	15.35	53.93	247.39	24.50	4.27
AKO107 × L1	14.53	50.93	228.46	26.36	4.14
L2 × BidhanSahebmukta	14.23	55.27	206.86	34.79	3.04
SE(m)	0.01	0.23	0.22	0.24	0.01
C.D. at 5 %	**0.04**	**0.69**	0.65	**0.70**	**0.04**

Table 4: Percentage of heterosis over mid parent and over better parent for different characters of hybrids

Genotypes	Plant height (cm)		Primary branches/plant		Internode length (cm)		Days taken to 1st flowering		Days taken to 50% flowering		1st fruiting node		Fruit length (cm)		Fruit diameter (cm)	
	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
HariKranti × L1	19.18	8.82	4.80	1.62	-3.91	-14.22	-9.60	-14.81	-9.38	-15.83	-11.11	-13.98	-1.66	-6.79	4.93	3.94
Thakath × L1	6.86	5.90	-24.04	-28.74	-6.16	-8.42	-2.81	-3.46	-4.06	-4.66	-24.29	-27.96	-0.20	-2.60	4.07	-1.31
PusaSawani × L1	19.04	10.53	27.08	11.93	34.61	23.63	-12.19	-15.52	-12.34	-16.11	-27.57	-27.96	9.12	8.13	10.06	1.31
AKO107 × L1	14.53	10.03	45.37	8.19	-11.29	-16.80	-9.73	-12.81	-9.45	-13.21	-14.92	-17.20	5.63	1.22	7.50	5.54
L2 × BidhanSahebmukta	10.75	9.68	-3.61	-6.56	13.65	12.98	-5.23	-7.49	-4.19	-6.09	-25.14	-30.93	15.92	7.73	13.70	18.15

Contd...

Genotypes	Fruit weight (g)		Number of fruits / plants		Fruit yield/ plant (g)		Number of seeds /fruits		Total chlorophyll content(mg/100g FW)		Anthocyanin content(mg/100gFW)	
	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
HariKranti × L1	29.53	17.61	14.85	9.69	48.05	29.00	-28.90	-30.31	-34.65	-49.20	53.36	17.74
Thakath × L1	6.17	2.87	7.91	7.30	14.59	11.64	-28.78	-35.78	-20.89	-35.98	20.64	-4.87
PusaSawani × L1	26.76	16.14	14.87	11.59	45.22	29.59	12.60	6.59	-35.34	-43.82	50.47	24.95
AKO107 × L1	26.74	18.57	9.31	6.71	38.30	26.53	10.80	8.99	-32.60	-42.75	50.91	21.05
L2 × BidhanSahebmukta	14.11	13.31	6.72	5.85	21.77	19.93	25.23	14.50	-30.83	-44.11	46.70	2.24

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