

HETEROISIS IN BLACK PEPPER (*PIPER NIGRUM*L.)

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Abstract: A study was conducted to estimate heterosis in F_1 hybrids of black pepper with respect to yield and three reproductive characters using 45 hybrids belonging to eight different intervarietal combinations of crosses planted at the Pepper Research Station, Panniyur. One of the hybrids, viz. Culture 4968 belonging to the cross Uthirenkotta x Balankotta was found to exhibit high heterosis with respect to all the characters. Promising parental combinations were, Uthirenkotta x Cheriyanakkiadan and Karivilanchy x Cheriyanakkiadan. The combinations Uthirenkotta x Kottanadan, Uthirenkotta x Kuthiravaly and Panniyur 1 x Karimunda were found least promising.

Key words: Black pepper, heterobeltiosis, *Piper nigrum* L., relative heterosis, standard heterosis

INTRODUCTION

Due to the wide genetic diversity and vegetative mode of propagation, there is immense scope for exploiting heterosis in black pepper. In spite of the fact that pepper is one of the oldest and most important spice crops, efforts to produce unproved material started only in 1960's (De Waard, 1969). The studies conducted by Ibrahim *et al.* (1985) and Pillai *et al.* (1987) revealed the extensive scope for heterosis breeding in pepper. The advantage of this crop is that, once a promising hybrid is produced, heterosis can be fixed as it is vegetatively propagated. In this study, an attempt is made to estimate the heterosis in F_1 hybrids of eight different crosses with respect to yield.

MATERIALS AND METHODS

Forty-five hybrids belonging to eight different inter-varietal combinations of crosses planted during 1982-83 at the Pepper Research Station, Panniyur, were made use of in the study (Table 1). They have all been receiving uniform management practices as recommended by the Kerala Agricultural University.

Heterosis was assessed over the better parent (heterobeltiosis) (Fonesca and Patterson, 1968), midparental value (relative heterosis) and standard variety (standard heterosis). Variety Karimunda was used for estimating standard heterosis.

Estimations of these three types of heterosis were done for dry berry yield per vine and the three reproductive characters viz. number of spikes per vine, number of developed berries per spike and length of spike which were having highly significant correlation with dry berry yield per vine (Table 2).

RESULTS AND DISCUSSION

Dry berry yield per vine

One of the hybrids of cross Uthirenkotta x Balankotta (C 4968) and the hybrid of the cross Karivilanchy x Cheriyanakkiadan (C 406) showed high heterobeltiosis, relative heterosis and standard heterosis (Table 3). The hybrid of Uthirenkotta x Cheriyanakkiadan (C 331) showed high heterobeltiosis and relative heterosis but the standard heterosis was found low. Out of the remaining three crosses in which Uthirenkotta, a cultivar possessing predominantly pistillate flowers (Martin and Gregory, 1962), was used as female parent, the combination with Kottanadan and that with Kuthiravaly exhibited high negative values for all the three types of heterosis. The performances of the hybrids in both the crosses were almost similar. This indicates that for these combinations, the potential for production of high yielding hybrids is poor. In the combination with Karimunda, all the hybrids showed negative heterobeltiosis and standard heterosis. But one of the 21 F_1 s (C 468) studied showed a positive and good relative heterosis. Performances

Table 1. Parental combinations of the hybrids selected for the study

Sl. No.	Parental combinations	No. of hybrids	Culture No. of the hybrids
1	Uthirenkotta x Karimunda	21	468, 4958, 4961, 4962, 4963, 4967, 5095, 5096, 5097, 5098, 5099, 5210, 5212, 5213, 5220, 5224, 5896, 5898, 6153, 6154, 6159
2	Uthirenkotta x Balankotta	3	4968, 4970, 4971
3	Uthirenkotta x Cheriakaniakkadan	1	331
4	Uthirenkotta x Kottanadan	4	6160, 6173, 6174, 8175
5	Uthirenkotta x Kuthiravaly	2	4551, 5208
6	Karivilanchy x Cheriakaniakkadan	1	406
7	Panniyur-1 x Kuthiravaly	1	1297
8	Panniyur-1 x Karimunda	12	341, 5101, 5106, 5109, 5921, 5925, 5995, 6001, 6521, 6616, 6629, 6638

Table 2. Range, mean, CV and correlation of 45 hybrids belonging to eight intervarietal crosses of pepper

Character	Range	Mean	CV	Correlation with yield
Dry berry yield per vine, g	16 - 1950	437.45	113.45	--
Number of spikes per vine	16 - 2222	340.88	126.84	0.937**
Number of developed berries/spike	3 - 61	30.24	48.98	0.335**
Length of spike, cm	7 - 18	10.55	24.80	0.305**

** Significant at 1% level

of the two crosses in which Panniyur 1, a promising hybrid, was used as the female parent, were poor. With Karimunda, none of the 12 hybrids showed a positive heterosis. Fig 1 shows the performance of the best hybrid with respect to yield in each parental combination.

Number of spikes per vine

Here also, C 4968 of the cross Uthirenkotta x Balankotta had high heterobeltiosis, relative heterosis and standard heterosis (Table 4). With respect to this character, C 331 (cross 3) and C 406 (cross 6) showed negative heterosis, whereas C 468 (cross 1) had high relative

heterosis. The combinations Uthirenkotta x Kottanadan and Uthirenkotta x Kuthiravaly exhibited negative heterosis and as before their performances were identical. Panniyur 1 x Kuthiravaly (C 1297) showed positive but small heterobeltiosis and relative heterosis. But all the hybrids of Panniyur 1 x Karimunda showed negative heterosis. Fig 2 shows the performance of the best hybrid with respect to number of spikes per vine in each parental combinations.

Number of developed berries per spike

With respect to this character also, the hybrid from the cross Uthirenkotta x Balankotta

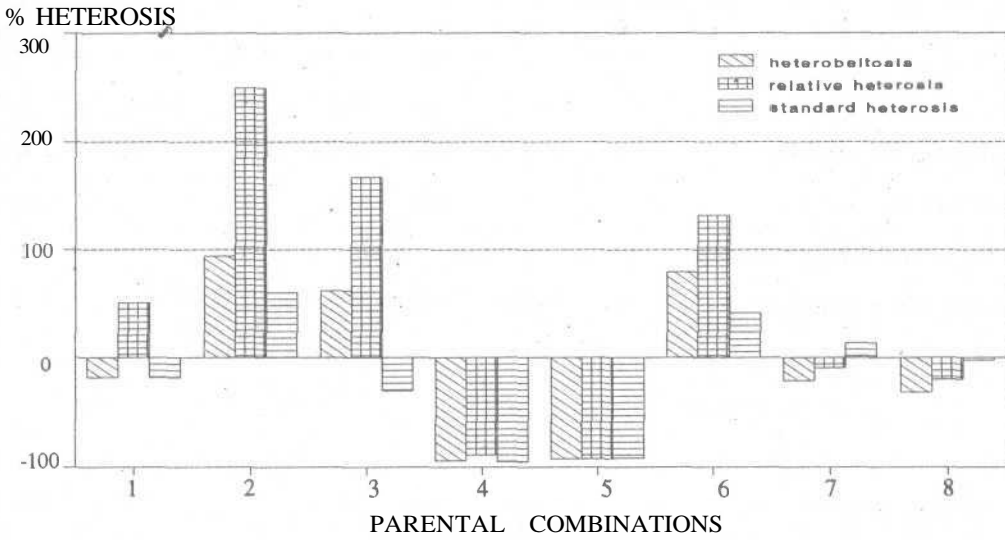


Fig 1. Heterosis for yield in different hybrids

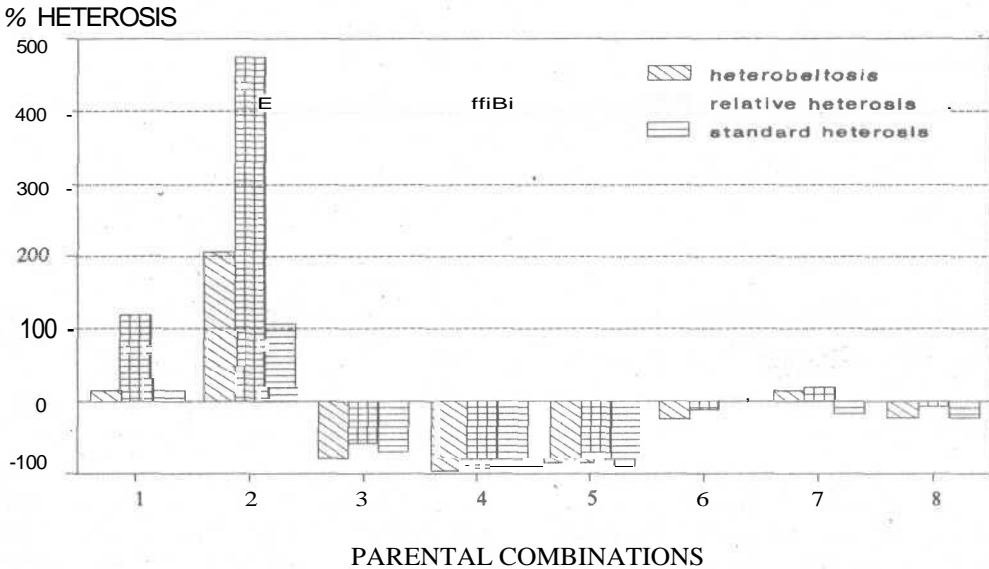


Fig 2. Heterosis for number of spikes per vine in different hybrids

showed high heterobeltosis, relative heterosis and standard heterosis (Table 5). But the maximum values were obtained for another

hybrid of the cross (C 4970). C 4968, which was found promising with respect to the other two characters also showed positive and high

Table 3 Per cent heterosis for dry berry yield per vine

Sl. No	Parental combinations	No. of hybrids	Heterobeltiosis		Relative heterosis		Standard heterosis	
			Mini.	Maxi.	Mini.	Maxi.	Mini.	Maxi.
1	Uthirenkotta x Karimunda	21	-98.68	-25.00	-96.99	50.38	-98.68	-25.00
2	Uthirenkotta x Balankotta	3	-67.16	94.03	-40.81	249.78	-72.95	59.85
3	Uthirenkotta x Cheriya kaniakkadan	1	61.52		167.09		-30.49	
4	Uthirenkotta x Kottanadan	4	-96.26	-93.80	-93.80	-88.90	-97.13	-95.25
5	Uthirenkotta x Kuthiravaly	2	-97.55	-92.34	-95.47	-92.33	-97.38	-91.80
6	Karivilanchy x Cheriya kaniakkadan	1	79.17		131.65		40.98	
7	Panniyur-1 x Kuthiravaly	1	-20.79		-9.34		13.36	
8	Panniyur-1 x Karimunda	12	-97.42	-31.84	-96.97	-19.76	-96.31	-2.46

Table 4. Per cent heterosis for number of spikes per vine

Sl. No	Parental combination	No. of hybrids	Heterobeltiosis		Relative heterosis		Standard heterosis	
			Mini.	Maxi.	Mini.	Maxi.	Mini.	Maxi.
1	Uthirenkotta x Karimunda	21	-19.81	14.33	-97.97	118.88	-99.81	14.33
2	Uthirenkotta x Balankotta	3	-66.80	206.06	-37.73	474.16	-77.58	106.70
3	Uthirenkotta x Cheriya kaniakkadan	1	-78.50		-58.32		-69.95	
4	Uthirenkotta x Kottanadan	4	-97.08	-96.41	-94.33	-93.05	-95.91	-94.98
5	Uthirenkotta x Kuthiravaly	2	-97.97	-84.41	-96.18	-70.61	-95.81	-88.56
6	Karivilanchy x Cheriya kaniakkadan	1	-24.10		-11.35		6.05	
7	Panniyur-1 x Kuthiravaly	1	13.56		18.75		-16.65	
8	Panniyur-1 x Karimunda	12	-97.58	-22.79	-97.10	-7.52	-97.10	-22.79

heterosis (heterobeltiosis 25.93%, relative heterosis 70.33%, standard heterosis 66.17%). C 331 (cross 3) showed high positive heterosis but for C 406 (cross 6) this character also had negative heterobeltiosis and relative heterosis. C 468 (cross 1) also showed positive and good heterosis.

The cross Uthirenkotta x Kottanadan produced one hybrid with positive though small values

for all the types of heterosis. The cross Uthirenkotta x Kuthiravaly also had a hybrid with positive relative heterosis and standard heterosis, but heterobeltiosis was negative. C 1297 (cross 7) showed positive standard heterosis but heterobeltiosis and relative heterosis were negative. One of the hybrids of Panniyur 1 x Karimunda had a positive relative heterosis and positive high standard heterosis. But in general, the performances of

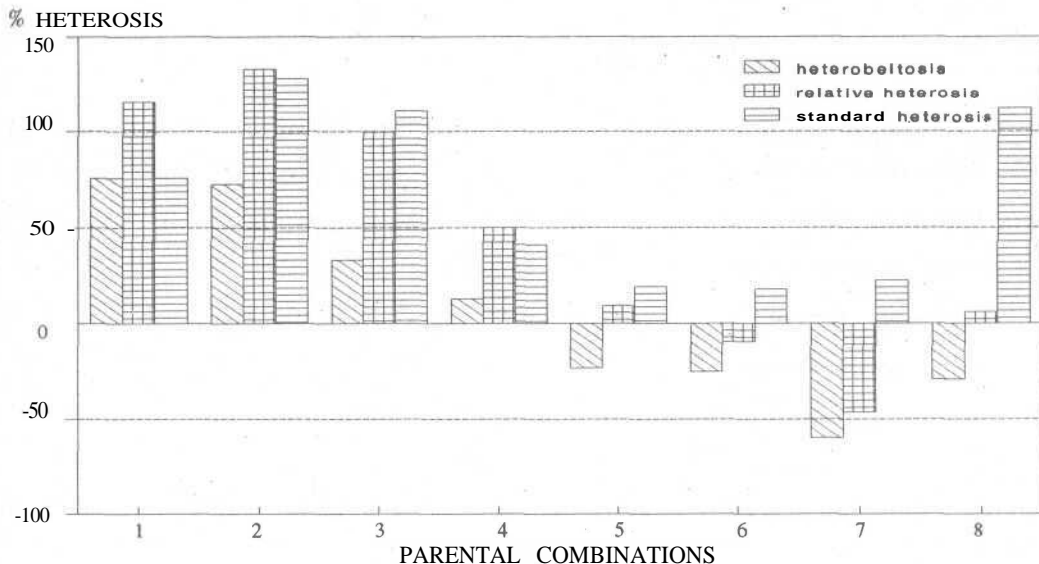


Fig 3. Heterosis for number of developed berries per spike in different hybrids

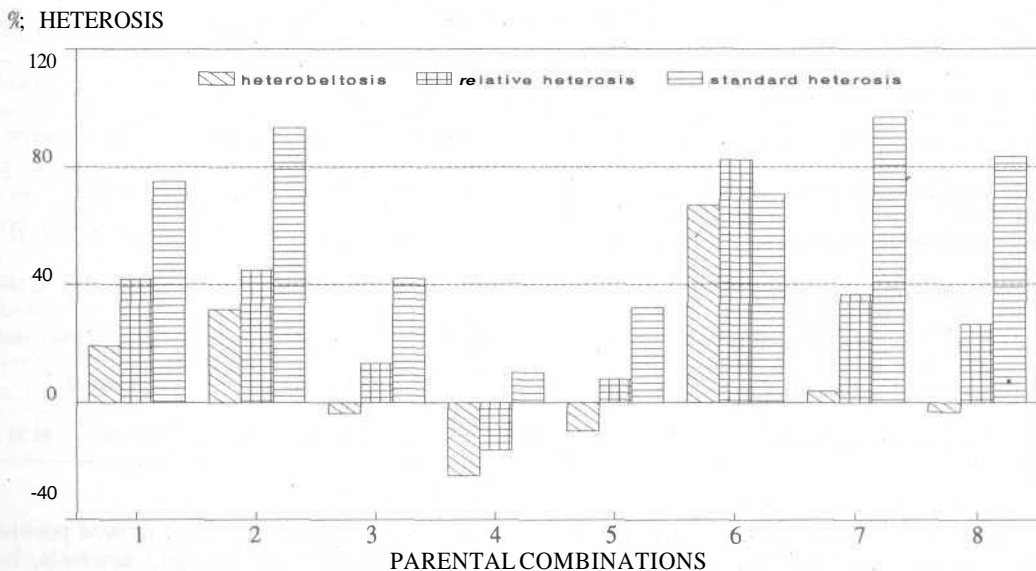


Fig 4. Heterosis for length of spike in different hybrids

all the hybrids of this cross were found poor. Fig 3 shows the performance of the best hybrid with respect to this character in each parental combinations.

Length of spike

The hybrid of Karivilanchy x Cheriayakania-kkadan (C 406) showed maximum heterosis

Table 5. Per cent heterosis for number of developed berries per spike

Sl. No.	Parental combination	No. of hybrids	Heterobeltiosis		Relative heterosis		Standard heterosis	
			Mini.	Maxi.	Mini.	Maxi.	Mini.	Maxi.
1	Uthirenkotta x Karimunda	21	-56.77	75.94	-88.29	115.67	-56.77	75.94
2	Uthirenkotta x Balankotta	3	-47.01	72.93	-28.32	133.91	-30.08	128.20
3	Uthirenkotta x Cheryakaniakkadan	1	33.57		90.82		110.90	
4	Uthirenkotta x Kottanadan	4	-41.05	13.00	-21.69	50.22	-26.32	41.35
5	Uthirenkotta x Kuthiravaly	2	-54.29	-23.10	-35.01	9.35	-28.95	19.55
6	Karivilanchy x Cheryakaniakkadan	1	-25.24		-9.51		18.05	
7	Panniyur-1 x Kuthiravaly	1	-59.47		-46.07		22.95	
8	Panniyur-1 x Karimunda	12	-90.80	-29.29	-86.20	6.10	-72.37	112.41

Table 6. Per cent heterosis for length of spike

Sl. No.	Parental combinations	No. of hybrids	Heterobeltiosis		Relative heterosis		Standard heterosis	
			Mini.	Maxi.	Mini.	Maxi.	Mini.	Maxi.
1	Uthirenkotta x Karimunda	21	-44.29	19.21	-33.75	41.79	-18.28	74.88
2	Uthirenkotta x Balankotta	3	-8.44	31.59	0.80	44.87	34.32	93.04
3	Uthirenkotta x Cheryakaniakkadan	1	-3.86		13.26		41.95	
4	Uthirenkotta x Kottanadan	4	-26.37	-24.92	-17.99	-16.38	8.02	10.14
5	Uthirenkotta x Kuthiravaly	2	-32.64	-9.81	-19.35	7.99	-1.18	32.31
6	Karivilanchy x Cheryakaniakkadan	1	66.59		82.35		70.52	
7	Panniyur-1 x Kuthiravaly	1	3.73		36.52		96.58	
8	Panniyur-1 x Karimunda	12	-58.49	-3.24	-45.68	26.63	-21.34	83.37

over better parent, mid parental value and standard variety (Table 6). The performance of the hybrid C 4968 was also found to be good.

In general all the combinations produced at least one hybrid with positive standard heterosis. This is because, standard heterosis was estimated over cultivar Karimunda in which spikes are comparatively shorter.

The hybrid of cross 3 (C 331) showed positive relative heterosis and standard heterosis, but the per cent heterosis was small. With respect to this character also, the two crosses, Uthirenkotta x Kottanadan and Uthirenkotta x Kuthiravaly showed poor performance. For C 1297 (cross 7), all the values were positive but the heterobeltiosis was very low. The performances of hybrids of Panniyur 1 x Karimunda

were poor. Fig 4 shows the performance of best hybrid with respect to this character in each combination.

From these results, it is clear that with respect to yield and the three component characters studied, high heterosis was exhibited by one of the hybrids viz. Culture 4968, belonging to the cross Uthirenkotta x Balankotta. Another promising parental combination found was Uthirenkotta x Cheriakaniakkadan (C 331). In this cross, even though number of spikes per vine showed negative heterosis, the high heterosis exhibited in yield was mainly due to the high heterosis in number of developed berries per spike and moderate heterosis in length of spike. The potential to produce high yielding hybrids in the cross Karivilanchy x Cheriakaniakkadan (C 406) is also comparable.

Out of the combinations of Uthirenkotta with five other cultivars, the best combination was Uthirenkotta x Balankotta, followed by Uthirenkotta x Cheriakaniakkadan and Uthirenkotta x Karimunda. With Kottanadan and Kuthiravaly, it produced hybrids with negative heterosis for most of the characters studied. The combinations of Panniyur 1 with Karimunda also produced hybrids with negative heterosis even though Panniyur 1 is a promising hybrid and Karimunda is a generally good yielding cultivar.

Out of the two crosses in which Kuthiravaly was used as the male parent, the combination Panniyur 1 x Kudiiravaly was better than

Uthirenkotta x Kuthiravaly. Karimunda, when used as male parent in the cross Uthirenkotta x Karimunda, produced better results than in the combination Panniyur 1 x Karimunda. Even then, this is not conclusive as number of hybrids studied were variable. Hence further experiments are required to prove their combining ability.

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