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# HETEROSIS FOR YIELD AND YIELD COMPONENTS IN PUMPKIN (*CUCURBITA MOSCHATA* DUCH. EX. POIR.)

B. K. MOHANTY* AND R. S. MISHRA

*Department of Horticulture,*
*Orissa University of Agriculture and Technology, Bhubaneswar 751 003*

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## ABSTRACT

An 8 × 8 half diallel cross of pumpkin was evaluated with parents for heterotic manifestation of yeild and yield attributing characters. Heterosis to the extent of 17.8, 18.1, 70.0, 150.0, 68.7, 48.4 and 181.5 per cent over better parent was recorded for vine length, number of primary branches, female flowers and fruits per plant, average fruit weight, flesh thickness and yield per plant respectively. The crosses between high × low performing (gca) parents exhibited greater hybrid vigour. Heterosis for yield wa generally accompanied by heterosis for yield components. Ten promising crosses were identified for developing high yielding $F_1$ hybrids/varieties of pumpkin with many desirable traits.

**Key Words** : Heterosis, pumpkin, yield components

Pumpkin (*Cucurbita moschata* Duch. ex. Poir.) is widely cultivated all over the country for it's mature and immature fruits. At present, development of high yielding $F_1$ hybrids of pumpkin with desirable fruit characters need special emphasis [1]. The scope for exploitation of hybrid vigour largely depends on the direction and magnitude of heterosis and ease with which hybrid seeds can be produced. The reproductive biology and production of appreciable quantity of seeds per fruit provide ample opportunity for manifestation of heterosis in pumpkin. The present investigation was undertaken to ascertain the nature and extent of heterosis for yield and it's component characters in this crop.

## MATERIALS AND METHODS

A set of 8 × 8 diallel crosses of pumpkin excluding reciprocals were evaluated along with their eight inbred parents (Guamal Local, Ambili, Baidyabati, Khurda Local, Cuttack Local, BBS-8, BBS-10 and Pusa Vishwas) in a randomized block design

*Senior Scientist (Horticulture), Regional Research Station, Bhawanipatna, Dist. Kalachandi, Orissa 766 001

with three replications at the Horticultural Research Station, Bhubaneswar during rabi, 1994-95. Each of the 36 genotypes in a replication consisted of four hills spaces 2.0 m apart in a plot of 4.0 m × 4.0 m size with two plants per hill. Normal recommended cultural practices were followed during experimentation. Observations were recorded on seven quantitative characters, viz., vine length, number of primary branches, female flowers and fruits per plant, average fruit weight, flesh thickness and yield per plant from four randomly selected plants in each genotype. The $F_1$ hybrid performance was computed as the estimate of heterosis over better parent and their significance was examined with 't' test.

## RESULTS AND DISCUSSION

The analysis of variance showed significant estimates of mean squares for all the seven characters indicating sufficient diversity among the genotypes. The range for mean performance and heterosis and the best hybrids identified on the basis of these two parameters are presented in Table 1. The highest range was noticed for

**Table 1. Range, heterosis, best parent and hybrids for yield and its components in pumpkin**

| Chracters | Range | | Heterosis (percent) over better parent | Best parent | Best hybrids based on | |
|---|---|---|---|---|---|---|
| | Parents | Hybrids | | | Perfor-mance | BP heterosis |
| Vine length (m) | 3.33-4.67 | 3.83-5.40 | –15.4 to 17.8 | 7 | 6 × 7 | 3 × 8 |
| Number of primary branches per plant | 3.57-4.77 | 4.00-5.43 | –0.7 to 18.1 | 7 | 7 × 8 | 1 × 5 |
| Number of female flowers per plant | 3.43-4.67 | 4.00-6.80 | 0.0 to 70.0 | 7 | 1 ×5 | 1 × 5 |
| Number of fruits per plat | 2.00-3.00 | 2.33-5.00 | 11.1 to 150.0 | 2 | 1 × 5 | 1 × 5 |
| Average fruit weight (kg) | 3.50-4.60 | 4.17-6.47 | 0.0 to 68.7 | 3 | 2 × 7 | 2 × 7 |
| Flesh thickness (mm) | 20.67-35.33 | 20.67-45.00 | 0.9 to 48.4 | 5 | 2 × 7 | 2 × 7 |
| Yield per plant (kg) | 7.77-12.53 | 9.50-23.90 | 1.1 to 181.5 | 3 | 2 × 7 | 1 × 5 |

1 = Guamal Local, 2 = Ambili, 3 = Baidyabati, 4 = Khurda Local, 5 = Cuttack Local, 6 = BBS-8, 7 = BBS-10 and 8 = Pusa Vishwas

flesh thickness in both parents and crosses, whereas the range of BP heterosis was high for yield/plant followed by number of fruits and female flowers per plant, average fruit weight and flesh thickness. A persual of the top heterotic crosses

revealed that none of the crosses was top heterotic for all the traits simultaneously. The cross Guamal Local × Cuttack Local showed higher potential for yield, number of fruits, female flowers and primary branches per plant.

Out of 28 crosses studied, fourteen most promising combinations were identified and their heterotic expression for different characters analysed (Table 2). Of the

**Table 2. Heterosis (percent) over better parent (H) and mean performance (P) of promising crosses for yield and yield components in pumpkin**

| Cross | Vine length (m) | | Number of primary branches per plant | | Number of female flowers per plant | | Number of fruits per plant | | Average fruit weight (kg) | | Flesh thickness (mm) | | Yield per plant (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | H | P | H | P | H | P | H | P | H | P | H | P | H | P |
| 1 × 2 | 14.55** | .7 | 6.2 | 4.0 | 29.0** | 4.9 | 11.1 | 3.3 | 6.7 | 4.3 | 37.3** | 30.7 | 29.7* | 13.4 |
| 1 × 5 | 1.6 | 4.2 | 18.1** | 5.0 | 70.0** | 6.8 | 150.** | 5.0 | 25.0* | 5.0 | 1.4 | 36.0 | 181.5** | 22.3 |
| 1 × 8 | 5.6* | 4.4 | 16.4** | 5.2 | 41.5** | 6.1 | 100.0** | 4.7 | 17.9 | 4.8 | 11.8* | 38.0 | 123.4** | 21.7 |
| 2 × 5 | 5.8* | 4.2 | 0.0 | 4.2 | 27.5** | 5.1 | 33.3** | 4.0 | 66.7** | 6.0 | 13.2** | 40.0 | 119.4** | 22.7 |
| 2 × 7 | 7.1** | 5.0 | 11.9** | 5.3 | 11.4* | 5.2 | 33.3** | 4.0 | 68.7** | 6.5 | 48.4** | 45.0 | 131.3** | 23.9 |
| 3 × 7 | 11.4** | 5.2 | 7.0 | 5.1 | 12.1* | 5.2 | 37.5** | 3.7 | 34.1** | 6.2 | 36.3** | 41.3 | 63.6** | 20.5 |
| 3 × 8 | 17.8** | 5.1 | 11.2** | 5.0 | 33.1** | 5.8 | 62.5** | 4.3 | 37.7** | 6.3 | 24.5** | 42.3 | 90.2** | 23.8 |
| 4 × 6 | -15.3** | 3.8 | -0.7 | 4.5 | 8.3 | 4.8 | 66.7** | 3.3 | 1.5 | 4.5 | 9.3 | 35.3 | 57.9** | 14.0 |
| 4 × 7 | 2.1 | 4.8 | 7.0 | 5.1 | 5.0 | 4.9 | 83.3** | 3.7 | 27.6* | 5.4 | 26.4** | 38.3 | 118.0** | 18.5 |
| 4 × 8 | 9.6** | 4.6 | 13.9** | 5.2 | 30.8** | 5.7 | 57.1** | 3.7 | 51.2** | 6.4 | 27.5** | 43.3 | 136.4** | 22.9 |
| 5 × 8 | 8.0** | 4.5 | 14.2** | 5.1 | 15.4** | 5.0 | 28.6* | 3.0 | 34.2** | 5.5 | 25.5** | 44.3 | 63.2** | 15.8 |
| 6 × 7 | 15.7** | 5.4 | 4.9 | 5.0 | 5.0 | 4.9 | 44.4** | 2.7 | 26.3* | 5.6 | 19.6** | 38.7 | 61.3** | 14.3 |
| 6 × 8 | 0.7 | 4.6 | 4.5 | 4.7 | 35.3** | 6.0 | 42.9** | 3.3 | 31.6** | 5.8 | 14.7** | 39.0 | 89.0** | 18.3 |
| 7 × 8 | 12.9** | 5.3 | 14.0** | 5.4 | 7.1 | 5.0 | 57.1** | 3.7 | 38.2** | 5.7 | 16.7** | 39.7 | 99.3** | 19.3 |
| C.D. (0.05) | 0.7 | 0.7 | 1.0 | 1.0 | 1.4 | 1.7 | 1.7 | 1.9 | 2.7 | 3.4 | 9.1 | 11.4 | 7.3 | 7.0 |

1 = Guamal Local, 2 = Ambili, 3 = Baidyabati, 4 = Khurda Local, 5 = Cuttack Local, 6 = BBS-8, 7 = BBS-10 and 8 = Pusa Vishwas
Significant at *p = 0.05, **p = 0.01

fourteen promising crosses, 13 exhibited positive heterosis and only one showed negative heterosis for vine length and number of primary branches/plant, whereas all the fourteen hybrids manifested positive heterosis for number of female flowers and fruits per plant, average fruit weight, flesh thickness and yield/plant. All the fourteen crosses also out yielded the best parent of the set, i.e., Baidyabati. Both addictive and non-addictive gene action were observed by Suneal Kumar [2], while non-additive gene effect alone was recorded by Sirohi *et al.* [3] governing the yield of pumpkin. The yield components like vine length, number of branches, female

flowers and fruits per plant, average fruit weight and flesh thickness were reported to be controlled by both additive and non-additive gene effects [2, 3, 4]. Pronounced epistasis was observed for yield and yield contributing characters [3].

The cross Baidyabati × Pusa Vishwas showed the highest heterobeltiosis for vine length (17.8 %) but the hybrid Ambili × BBS-10 manifested the highest BP heterosis for average fruit weight (68.7 %) and flesh thickness (48/4 %). Similarly, the highest heterosis of 18.1, 70.0, 150.0 and 181.5 per cent over better parent for number of primary branches and female flowers, fruit number and yield per plant respectively were expressed by the cross Guamal Local × Cuttack Local. The hybrids Khurda Local × Pusa Vishwas, Ambili × BBS-10, Baidyabati × Pusa Vishwas and Cuttack Local × Pusa Vishwas exhibited significant positive heterobeltiosis for yield and all the yield attributing characters studied. This indicated that heterosis for yield was through component heterosis. Hybrid vigour of even small magnitude of individual yield components may have additive or synergistic effect on the end product. Similar heterotic effect of yield components on final yield of pumpkin was observed earlier [2, 5, 6]. It would thus seem possible to achieve yield improvement in this crop by manipulating any or a number of component characters. The incidence of negative heterosis observed for the lone hybrid Khurda Local × BBS-8 may be due to the combination of unfavorable genes of the parents as reported in summer squash [7].

Out of 28 crosses investigated, 15 hybrids significantly exceeded their better parent for vine length of which 14 were in positive direction, whereas 7 $F_1$s showed significant positive heterosis over better parent for number of primary branches/plant. Similarly, significant positive BP heterosis was expressed by 18 hybrids each for number of female flowers/plant and flesh thickness but 12 crosses manifested heterobeltiosis significantly and positively for average fruit weight. Twenty two $F_1$s each for number of fruits and yield per plant exhibited significantly positive BP heterosis. The magnitude and incidence of heterosis in these crosses were indicative of dominance and epistatic interactions. However, the above results suggested that heterosis manifested in respect of certain yield components was rather less but certain cross combinations appeared to be promising for exploitation of hybrid vigour for yield and yield attributing characters in pumpkin. Similar findings were also reported earlier [2, 4-8, 9].

Parents having high *per se* expression and better performance in hybrids should be used in heterosis breeding programme. In the present investigation, Pusa Vishwas was found to be a good performing parent for yield and other component traits studied followed by Baidyabati, the best performer for yield along with other attributes except flesh thickness. Other promising parents were Ambili for yield and number

of fruits per plant; BBS-8 for yield, fruit weight, flesh thickness, number of female flowers/plant and vine length; BBS-10 for number of female flowers/plant, vine length, number of branches/plant and flesh thickness; Khurda Local for number of branches/plant and fruit weight and Cuttack Local for flesh thickness. A cross showing desirable heterosis and having at least one good performing parent, the possibility of its exploitation in practical breeding is very high. Such crosses are expected to throw up desirable transgressive segregates if the additive genetic system present in the good performer (combiner) and complementary epistasis if present in the cross act in the same direction so as to maximise the desirable plant attribute. The present study showed that Guamal Local × Cuttack Local was the top heterotic cross which manifested 181.5 % higher yield over the better parent, whereas Ambili × BBS-10 was the best performing hybrid which recorded the highest yield of 23.9 kg/plant. Although the ranking of cross combinations based on *per se* performance and value of heterosis varied, the best ten hybrids for yield were common in both the criteria. These superior crosses were Guamal Local × Cuttack Local, Khurda Local × Pusa Vishwas, Ambili × BBS-10, Guamal Local × Pusa Vishwas, Ambili × Cuttack Local, Khurda Local × BBS-10, BBS-10 × Pusa Vishwas, Baidyabati × Pusa Vishwas, BBS-8 × Pusa Vishwas and Baidyabati × BBS-10 (Table 2). Exploitation of these promising hybrids could be highly rewarding.

Majority of the high heterotic crosses involve high × low performing (gca) parents and a few high × high and low × low combinations. In case of high × high crosses as observed for Baidyabati × Pusa Vishwas and BBS-8 × Pusa Vishwas, there are possibilities of complementary epistatic effect acting in the direction of additive effects of the good performer that can be exploited for developing high yielding pure lines through progeny selection. In case of low × low crosses with high heterosis as recorded for Guamal LOcal × Cuttack Local and Khurda Local × BBS-10, non-additive type of variation can be exploited by multiple crosses followed by intermating among desirable segregates. The crosses of high × low group with the expression of positive heterotic effects as observed for the remaining six hybrids may be due to the dominant × recessive interaction showing considerable additive genetic variance, expected to produce desirable segregates [10].

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