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Per se performance of pumkin (*Cucurbita moschata* Duch ex Poir) hybrids for yield and quality

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ABSTRACT : An investigation was conducted at Department of Horticulture, Agricultural College and Research Institute, Madurai during 2016-2017 to study the per se performance of pumpkin hybrids evolved with diallel analysis with thirty hybrids were obtained through diallel mating design with six parents *viz*., P_1: Acc.No.MDU CM23 - Thirumangalam local, Madurai district, P_2: Acc.No.MDU CM28 - Oddanchatram local, Dindugul district, P_3: (Acc.No.MDU CM29- Harur local, Dharmapuri distict, P_4: Acc.No.MDU CM12, Department of Horticulture, AC and RI, Madurai, P_5: Acc. No.MDU CM1 – Attur local, Salem district, P_6: Acc.No.MDU CM31 - Rajapalayam local, Virudhunagar district for yield and quality traits in pumpkin (*Cucurbita moschata* Duch. ex. Poir). The *per se* performance of parents and hybrids showed that the parents P_1 (8.46), P_4 (9.36) and P_6 (4.55) were high yielding and bigger sized fruits. Among the thirty crosses, six cross combinations *viz*., $P_1 \times P_3$ (12.38), $P_1 \times P_2$ (11.79), $P_1 \times P_5$ (8.18), $P_1 \times P_5$ (11.66), $P_1 \times P_6$ (8.55) and $P_4 \times P_1$ (12.08) recorded higher values for yield per vine, fruit weight (6.13 to 10.15 kg), vine length (6.54 to 8.22) , higher sex ratio (17.05 to 24.06). The smaller sized fruits were obtained in five cross combinations *viz*., $P_2 \times P1$(1.54), $P_2 \times P_3$(1.78), $P_2 \times P_4$(1.79), $P_2 \times P_5$ (2.02) and $P_2 \times P_6$(1.68) with the fruit size ranged from 1.54 to 1.79 kg.

KEY WORDS : *Per se*, Pumkin, *Cucurbita moschata*, Hybrids, Carotene

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Pumpkin (*Cucurbita moschata* Duch. ex. Poir) is an economically important cucurbitaceous vegetable having diploid chromosome number of 2n=40. It is grown throughout the tropics of India and its occupies a prominent position due its high productivity, nutritive values, good storability, better transport quality and extensive cultivation in sub tropical and tropical regions of the globe. It is used both immature and mature stages as vegetable and consumed as processed products.

In India, pumpkin occupies an area of 11,060 hectares with an annual production of 2.77 lakh tonnes accounting to an average productivity of 25.10 tonnes per hectare during 2014. In Tamil Nadu, pumpkin occupies an area of 1,530 hectares with an annual production of about 37,340 tonnes and an average productivity of 24.41 tonnes per hectare during 2014 (Saxena and Chander, 2015). Pumpkin has received little attention in crop improvement, as compared to other cucurbitaceous vegetables. Being a cross-pollinated crop, development of hybrids is possible through heterosis breeding. Further, the development of hybrids will have the advantage of higher productivity with uniformity in size and shape. Pumpkin is nutritionally rich and its medicinal properties, comparatively little attention had been made for the improvement of this crop.

Among the several biometrical methods available to study the complex nature of yield and the influence of environment on its expression, diallel analysis was preferred as it has proved to be a successful tool in plant breeding (Sirohi, 1994). Complete exploitation of genetic variation enables to produce not only heterotic F_1 hybrids but also recombinants with desirable attributes.

Information on genetic association among components of yield and its attributes is invariably useful in improving selection efficiency. The direct and indirect effects of these different components on yield are measured by path co-efficient analysis.

Further, the development of hybrids will have the advantage of higher productivity with uniformity in size and shape. Pumpkin, being a monoecious and cross-pollinated crop, provides an ample scope for exploitation of hybrid vigour. The commercial exploitation of hybrids is easy in pumpkin due to its high seed content and easy seed extraction procedures.

Pumpkin, being a cross pollinated crop exhibits considerable variation for different traits. So far only a very few attempts have been made to improve the local types and number of released varieties available for commercial cultivation is also limited. Hence, the present investigation is undertaken To study the *per se* performance of the parents and hybrids for to a hybrid of early, small sized fruits with more carotene content and high yield.

RESEARCH METHODS

A field experiment was conducted at the College Orchard, Department of Horticulture, Agricultural College and Research Institute, Madurai, during 2016-17 the research area located at 09°58' 30.5" N latitude, 078°12' 27.4 E longitude and at an altitude of 158 m above the mean sea level.

The climate at the experimental location is generally warm. The hottest period of the year is between the months of March to August 2016, reaching the maximum temperature recorded upto 41.9°C in April (2017). The temperature drops in December and the low temperature continues upto January, reaching the minimum of 21°C. The district receives an average annual rainfall of 620.5 mm.

Parental materials :

Six genotypes of pumpkin *viz.*, P_1 (Acc.No. MDU CM23, Thirumangalam local, Madurai district), P_2 (Acc.No.MDU CM28, Oddanchatram local, Dinddugul district), P_3 (Acc.No. MDU CM29, Harur local, Dharmapuri distict), P_4 (Acc.No. MDU CM12, Department of Horticulture, AC and RI Madurai), P_5 (Acc.No. MDU CM1, Attur local, Salem district), P_6 (Acc.No. MDU CM31, Rajapalayam local, Virudhunagar district) were used as parents for crossing programme in all possible combinations adopting full diallel mating design (Doijode and Sullamath, 1983).

Selfing and crossing techniques:

All the six parents were selected based on the performance in the germplasm screening. The seeds of these six parents were sown in pits at a spacing of 2 x 2 m either way during August 2016. The recommended horticultural practices were adopted uniformly in all the parents under study.

The crossing of parents attended in full diallele mating design. Pumpkin is monoecious in nature producing staminate and pistillate flowers separately on the same plant. For hybridization, the solitary staminate and pistillate flowers of all parents were covered separately with butter paper covers on the previous day evening prior to opening. On the next day morning as soon as the flowers opened the pollen from the staminate flowers were collected 5.45 - 7.15 A.M) and the same was dusted on the stigma of the pistillate flower of the bagged female parent. The pistillate flowers were rebagged and tagged for identifying the cross-combination.

For selfing, the pollen grains from the bagged male flowers were dusted on the pistillate bagged flowers of the same plant. The pollinated parental lines were rebagged and tagged.

The seeds were extracted from the fully ripened fruits and thoroughly washed to remove mucilaginous coating. The seeds were dried at eight per cent moisture level. All the 30 F_0 seeds along with their parents and standard check hybrid CO 1 were raised in Randomized Block Design (RBD) with three replications during December 2016 to evaluate the hybrids. A spacing of 2 x 2 m was adopted. Recommended cultural practices and plant protection measures were followed to all the plants. Five plants were tagged in each hybrid and parents in each replications and biometrical observations were recorded from the tagged plants. The b-carotene content estimated in the fruits by following the procedure given by Ranganna (1979) and the dry matter content of

the fruits measured by following the methods described by AOAC (1975). The data recorded were statistically analysed by using the methodology of Panse and Sukhatme (1967).

RESEARCH FINDINGS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Analysis of variance :

Analysis of variance of parents and hybrids for quantitative traits showed highly significant difference for the traits *viz*., days to first male flower, days to first female flower, nodes to first male flower, sex ratio, days to first harvest, number of fruits per vine, average fruit weight, fruit length, fruit diameter, flesh thickness, number of seeds per fruit, fruit yield per plant and the traits vine length, number of primary branches and nodes to first female flower showed significant variability among them, hence, the essential pre- requisite for studying the genotypes can be satisfied. Analysis of variance of parents and hybrids for quality traits *viz.*, total soluble solids, b-carotene and dry matter content showed highly significant variability.

***Per se* performance of parents and hybrids:**

The success of any breeding programme depends upon the choice of elite genotypes based on the mean performance. While evaluating the genotypes, high mean value is considered as the acceptable procedure for a long time among the breeders. Parents with high order of performance would be useful in choosing better genotypes. Parents with good *per se* performance would results in good hybrids. Good hybrids are generally identified based on their high *per se* performance (Gilbert, 1958).

Vine length :

Vine length is a yield contributing trait in pumpkin which is considered as important for growth and vigour of the plants. Among the six parents, P_1 (8.14m) produced longest vine length followed by P_4 (8.01m). The hybrid P_4 x P_2 (8.71m) significantly recorded the highest value for this trait followed by P_1 x P_6 (8.22m) and P_1 x P_2 (8.13m). The present results are in agreement with the report of Kumar *et al*. (2005) in pumpkin, Aravindakumar *et al.* (2005) in musk melon and Josephin (2008) and Manikandan (2012) in ash gourd.

Days to first female flower:

Earliness is considered as one of the most important characters in any crop improvement programme and most of the genotypes or accessions are preferred when high yield is coupled with earliness. The parent P_1 (51.85) and the hybrids P_1 x P_2 (47.61), P_1 x P_3 (48.82) were early with respect to days to first female flower opening. It might be due to the expression of dominance allels present in the female parent. The results are in accordance with the reports of Aravindakumar *et al.* (2005) in muskmelon and Tamilselvi (2010) in pumpkin.

Nodes to first female flower :

The first female flower in the parents P_3(21.16), P_4 (21.33) and P_2 (22.16) appeared in lower nodes, while higher nodes in hybrids P_1 x P_5 (22.00), P_4 x P_2 (20.00) and P_4 x P_3 (20.00). It may be due to the non additive gene action of the male parents. This was supported by Josephin (2008) in ash gourd and Kumar *et al*. (2005) in pumpkin.

Sex ratio :

In general, narrow sex ratio is preferable in cucurbits crop improvement programmes, which could be favorable for the production of more number of fruits and higher yields. The parents P_6 (13.50), P_5 (16.50) and P_1 (17.05) recorded lowest values for sex ratio and the hybrids P_6 x P_5 (14.36), P_6 x P_1 (14.87), P_6 x P_2 (14.87) also recorded the lowest values. It may be due to the presence of dominant genes expression. Similar observations in ash gourd were made by Tamilselvi (2010) and Manikandan (2012).

Days to first harvest :

The days to first harvest was less in the parents P_4 and P_6 and also in hybrids P_1 x P_5 and P_2 x P_1. Similar results were also reported by Rana *et al*. (2016) in pumpkin and Kumar *et al*. (2017) in cucumber.

Number of fruits per vine :

The parents P_5 (2.17), P_3 (1.98), P_2 (1.82) and P_6 (1.80) and hybrids P_5 x P_2 (2.66), P_5 x P_4 (2.15) and P_4 x P_5 (2.12) recorded more number of fruits per vine. The dominant non additive genes might be involved. Similar pattern of results was reported by Bahari *et al*. (2012) in water melon and Manikandan (2012) in ash gourd.

Table 1 : *Per se* performance of parents and hybrids for quantitative traits of pumpkin

Hybrids/ parents	Vine length (m)	Days to first female flowering	Nodes to first female flower	Sex ratio	Days to first harvest	Number of fruits per vine	Average fruit weight (kg)	Fruit length (cm)	Fruit diameter (cm)	Flesh thickness (cm)	Number of seeds/ fruit	Fruit yield/ plant (kg)	Total soluble solids (TSS)	beta carotene (mg/ 100g)	Dry matter content (%)
P_1	8.14	51.85	24.33	17.05	89.04	1.56	8.93	29.56	65.35	2.54	341.89	8.46	6.27	0.74	1.00
P_2	4.38	53.67	22.16	18.17	85.30	1.82	1.55	17.87	53.67	2.35	260.30	2.54	7.64	0.90	0.87
P_3	3.75	54.33	21.16	19.38	88.84	1.98	1.55	16.63	44.33	2.14	335.39	3.56	8.44	0.79	0.79
P_4	8.01	55.67	21.33	22.31	92.04	1.41	5.03	22.72	60.54	2.62	349.63	9.36	8.97	0.74	0.80
P_5	3.95	55.00	22.50	16.50	88.00	2.17	3.10	26.33	63.22	2.55	328.10	3.12	9.70	0.73	0.76
P_6	4.81	52.17	25.17	13.50	93.87	1.80	3.77	20.83	58.72	3.20	376.56	4.55	7.01	0.86	0.66
$P_1 \times P_2$	8.13	47.61	20.33	17.05	89.04	1.50	7.86	29.76	65.73	2.86	348.45	11.79	6.65	0.73	1.00
$P_1 \times P_3$	7.83	48.82	22.67	17.75	89.93	1.22	10.15	29.70	66.49	2.56	351.53	12.38	6.32	0.73	0.93
$P_1 \times P_4$	7.84	52.10	22.67	17.85	89.66	0.81	7.58	30.82	66.57	2.59	336.25	8.18	7.32	0.73	0.94
$P_1 \times P_5$	6.56	51.39	22.00	17.90	88.93	1.59	7.58	31.54	65.69	2.37	324.93	10.49	6.49	0.82	1.00
$P_1 \times P_6$	8.22	54.33	22.50	18.00	89.47	1.40	6.13	30.88	67.37	2.58	355.85	8.55	6.11	0.80	0.89
$P_2 \times P_1$	4.45	53.50	22.88	18.38	85.46	1.81	1.54	17.97	54.48	2.38	268.43	1.62	7.38	0.85	1.03
$P_2 \times P_3$	4.67	52.83	24.45	18.37	87.50	1.98	1.78	17.94	54.37	2.36	289.21	3.51	7.31	0.93	0.91
$P_2 \times P_4$	4.21	53.32	23.16	18.04	86.99	1.44	1.79	18.05	53.77	2.53	280.96	3.32	7.55	0.86	0.96
$P_2 \times P_5$	4.49	55.33	21.56	18.47	85.12	2.04	2.02	18.07	54.88	2.41	282.84	4.14	7.39	0.76	0.92
$P_2 \times P_6$	4.60	53.67	23.67	18.28	85.86	1.41	1.68	18.23	53.44	2.90	262.44	2.32	7.67	0.87	1.01
$P_3 \times P_1$	3.67	54.33	25.17	19.98	88.68	1.99	3.32	17.97	44.79	2.75	335.80	7.15	8.04	0.93	0.77
$P_3 \times P_2$	3.20	54.00	20.16	18.85	88.56	1.95	2.19	17.74	45.03	2.17	338.73	4.57	9.23	0.93	0.75
$P_3 \times P_4$	4.02	55.33	20.67	19.32	88.94	1.48	2.33	17.08	44.23	2.52	340.94	3.6	9.13	0.91	0.95
$P_3 \times P_5$	3.97	52.33	20.83	19.06	89.12	1.99	2.82	17.03	45.39	2.23	342.19	5.25	8.29	0.90	0.76
$P_3 \times P_6$	3.40	52.94	22.67	18.71	89.52	1.89	2.44	17.43	44.61	2.29	342.45	5.37	8.31	0.84	0.85
$P_4 \times P_1$	8.12	52.10	21.33	24.06	88.59	1.45	8.33	24.00	61.26	2.96	351.91	12.08	9.35	0.79	0.92
$P_4 \times P_2$	8.71	51.67	20.00	23.49	92.26	1.41	3.33	23.76	62.48	2.68	398.12	7.92	9.44	0.74	0.82
$P_4 \times P_3$	6.54	51.83	20.00	22.20	89.53	1.60	3.19	22.51	60.86	2.64	352.60	1.69	9.13	0.76	0.81
$P_4 \times P_5$	6.80	51.89	22.33	22.68	90.43	2.12	5.45	23.78	63.58	2.69	355.38	11.66	8.98	0.79	0.86
$P_4 \times P_6$	6.88	54.78	23.50	23.58	89.84	1.61	5.37	24.14	61.78	2.68	350.07	8.67	8.99	0.80	0.86
$P_5 \times P_1$	3.94	53.22	20.83	19.84	91.05	2.02	3.24	27.24	68.62	2.79	350.60	3.56	8.35	0.73	0.81
$P_5 \times P2$	3.83	54.33	24.00	19.65	89.36	2.66	3.08	26.45	65.94	2.70	328.11	3.33	9.45	0.72	0.75
$P_5 \times P_3$	3.55	55.16	22.66	17.72	88.28	2.02	3.21	27.21	63.43	2.28	361.98	3.40	9.25	0.75	0.78
$P_5 \times P_4$	3.51	52.33	22.50	17.66	88.19	2.15	3.56	27.04	64.80	2.94	337.11	3.46	8.92	0.72	0.77
$P_5 \times P_6$	3.54	51.84	20.83	16.22	88.21	1.61	3.55	27.33	63.82	2.60	340.55	2.99	9.68	0.71	0.78
$P_6 \times P_1$	5.78	52.88	26.33	14.87	91.23	1.80	3.70	27.45	59.03	3.10	378.20	4.35	6.65	0.90	0.64
$P_6 \times P_2$	5.74	54.33	23.50	14.87	92.55	1.82	4.28	22.97	61.98	3.30	380.84	4.13	7.61	0.85	0.64
$P_6 \times P_3$	4.59	52.16	25.33	16.83	93.73	1.81	2.90	21.13	57.33	3.54	374.17	4.18	7.12	0.91	0.67
$P_6 \times P_4$	5.67	55.11	21.00	15.79	93.34	1.70	3.48	21.18	58.92	3.27	378.32	4.92	7.18	0.85	0.65
$P_6 \times P_5$	4.60	53.50	24.00	14.36	93.87	1.99	4.09	21.88	61.78	3.23	380.35	4.35	7.12	0.89	0.69
Check (CO1)	7.75	55.06	25.60	23.72	93.89	1.37	7.73	35.94	68.95	3.33	397.12	8.66	7.30	0.67	0.84
Mean of parents	5.51	53.78	22.77	17.82	89.51	1.79	3.99	22.32	57.64	2.56	331.98	6.56	8.00	0.79	0.81
Mean of hybrid	5.37	52.96	22.45	18.66	89.44	1.76	3.98	23.27	58.75	2.69	340.64	6.63	8.01	0.81	0.84
S.E.±	0.251	0.858	1.642	0.816	1.53	0.152	1.353	0.718	1.411	0.166	7.3	0.181	0.22	0.03	0.03
C.D.(P=0.05)	0.509	1.741	3.331	1.655	3.10	0.307	2.744	1.456	2.863	0.337	14.807	0.367	0.45	0.07	0.05

Average fruit weight:

Fruit weight is a major yield attributing character in many vegetable crops. The lowest average fruit weight was observed in the parents P_2 (1.55 kg) and P_3 (1.55 kg) and in hybrids P_2 x P_1, P_3 x P_1. This was in a consonce with the finds of Josephin (2008) in ash gourd, Kothainayagi (2013) and Rana *et al*. (2016) in pumpkin. The parents P_1 (8.93 kg) and P_4 (5.03 kg) recorded the highest fruit weight whereas, the hybrids P_6 x P_2 (4.28 kg), P_6 x P_5 (4.09 kg) recorded medium sized fruits. It might be under the control of non additive gene action and partial dominance nature. Similar results were obtained by Manikandan (2012) in ash gourd.

Fruit length:

The less fruit length among the parents were recorded in P_2 (17.87 cm) and P_3 (16.63 cm) and the maximum fruit length in P_1 (29.56 cm) and P_5 (26.33 cm). In hybrids the maximum fruit length was recorded by P_1 x P_5 (31.54 cm) followed by P_1 x P_6 (30.88 cm) and the minimum length of the fruit in P_3 x P_5 (17.03 cm). This was in accordance with the results of Umamaheshwari and Haribabu (2005) in pumpkin.

Fruit diameter :

The shape and compactness of the fruit is determined by the diameter of fruit. This traits indirectly increases the yield and is considered important in selecting pumpkin genotypes for higher yield. The parents P_3 (44.33 cm) and P_2 (53.67 cm)and hybrids P_3 x P_4 (44.23 cm), P_3 x P_6 (44.61 cm) recorded lower diameter of the fruit. The parents P_1 (65.35 cm) and P_5 (63.22 cm) recorded the maximum fruit diameter while in hybrids P_5 x P_1 (68.62 cm) was recorded highest diameter of the fruit. This present result is in accordance with Nisha (1999); Singh *et al*. (2002) and Umamaheshwari and Hari babu (2005) in pumpkin.

Flesh thickness:

Fruit flesh thickness is essential to decide the quality of edible portion of pumpkin. Further, more flesh thickness favours better keeping quality and transportability than the less thick fruits. The highest flesh thickness was observed in the parent P_6 (3.20 cm) and in hybrids P_6 x P_3 (3.54 cm), P_6 x P_2 (3.30 cm), P_6 x P_4 (3.27 cm). This might be due to the presence of both additive and dominance nature. This result is in corroboration with the findings of Singh *et al*. (2002); Tamilselvi (2010); Manikandan (2012) in ash gourd, Kothainayagi (2013) in pumpkin and Muthaiah *et al*. (2017) in ridge gourd.

Number of seeds per fruit:

The hybrid seed production requires more number of seeds per fruit as it would reduce the cost of seeds. Moreover, seeds of pumpkin are also used after roasting for medication and hence more number of seeds would be preferred. The highest mean value for number of seeds per fruit was recorded in the parents P_6 (376.56) and P_4 (349.63) and in the hybrids P_4 x P_2 (398.12), P_6 x P_2 (380.84), P_6 x P_5 (380.35). It may be due to the expression of non additive dominant gene action. It might due to dominant non-additive gene expression of the parents. The present results are in conformity with findings of Nagaraju (2014) in ash gourd, Rana *et al*. (2016) in pumpkin, Kumar *et al*. (2017) in cucumber and Muthaiah *et al*. (2017) in ridge gourd.

Yield per plant :

The fruit yield per plant in the six parents ranged from 3.31 to 11.76 kg. The parent P_1 recorded the highest yield (11.76 kg) per plant followed by P_5 (8.10 kg). The parent P_3 (2.90 kg) recorded lower fruit yield per plant. Three parents in the present study recorded significantly higher values than the grand mean (6.56 kg). The fruit yield per plant in the thirty hybrids ranged from 3.32 to 12.38 kg. The hybrid P_1 x P_3 recorded the highest yield (12.38 kg) per plant followed by P_4 x P_1 (12.08 kg). The hybrid P_2 x P_4 (3.32 kg) recorded low fruit yield per plant. Fourteen hybrids in the present study recorded significant higher values than the grand mean (6.63 kg/plant). This was in accordance with result of Pandey *et al.* (2005) in ash gourd and Veerendra *et al.* (2010) in ash gourd.

Total soluble solids :

The mean value of six parents ranged from 9.70 to 6.27 ºBrix. The parent P_5 recorded the highest value (9.70ºBrix), followed by P_4 (8.97ºBrix) and P_3 (8.44º Brix). The parent P_1 (6.27ºBrix) recorded low total soluble solids. Two parents in the present study recorded significant higher values than the grand mean (8.00 ºbrix). The total soluble solid content in the hybrids ranged from 6.32 to 9.68 ºBrix. The hybrid P_5 x P_6 recorded the highest value (9.68ºBrix) followed by P_5 x P_2 (9.45ºBrix). P_1 x P_6 recorded the lowest value (6.11ºBrix). Totally eleven hybrids in the present study recorded significantly higher values than the grand mean (8.01ºBrix). This present

results are in accordance with the Bahari *et al*. (2012) in water melon.

- carotene content :

The β-carotene content among the parents ranged from 0.73 to 0.90 mg/100g. Maximum β- carotene content was recorded in the parent P_2 (0.90 mg/100g) followed by P_6 (0.86 mg/100g) and the minimum β-carotene content was recorded in P_4 (0.74 mg/100g). Two parents recorded significantly higher values than the grand mean (0.79 mg/100g) for this character. The mean performance of β-carotene content varied from 0.93 to 0.71 mg/100g.The hybrid P_2 x P_3 and P_3 x P_2 recorded the highest β- carotene content of 0.93mg/100g. The hybrid P_5 x P_6 (0.71 mg/100g) recorded the lowest β- carotene content. The grand mean of 0.81 mg/100g was observed for this trait. Eight hybrids recorded significantly higher values than the grand mean (0.81 mg/100g). This was in accordance with result of Tamilselvi (2010) in pumpkin.

Dry matter content :

Analysis of dry mater content in fruit would be useful in the selection of vegetable as a source of dietary fibre. Crude fibre content in diet plays a major role in preventing constipation and smoother bowel movement. Among six parents P_1(1.0) and P_2(0.87) recorded favourable high *per se* values of dry mater content and in hybrids P_2 x P_6 (1.0), P_1 x P_2 (1.0) and P_1 x P_5 (1.0) recorded the higher values. The results are in accordance with the Tamilselvi (2010) in pumpkin and Rana *et al*. (2016) in pumpkin, Kumar *et al*. (2017) in cucumber, Muthaiah *et al*. (2017) in ridge gourd.

Based on the *per se* performance of 30 hybrids, six cross combinations *viz.*, P_1 x P_3, P_1 x P_2, P_1 x P_4, P_1 x P_5, P_1 x P_6 and P_4 x P_1 recorded higher fruit yield per vine. These hybrids recorded larger size fruits ranging from 6.13 to 10.15 kg. The vine length was found to be more (6.54 to 8.22 m), higher sex ratio (17.05 to 24.06) and lesser number of fruits per plant (0.81 to 11.59).The large sized fruits are not preferred in the market by nuclear families. The bigger sized pumpkin fruits are preffered only by the hotels and social events, whereas the smaller ones are much suitable for the nuclear families. Such smaller fruits were identified in five cross combinations *viz.*, P_2 x P_1, P_2 x P_3, P_2 x P_4, P_2 x P_5 and P_2 x P_6, with the fruit size varying from 1.54 to 1.79 kg and yield per plant varying from 1.6 to 3.5 kg. These hybrids had narrow male to female ratio, more number of fruits per plant and shorter vine length. The vine length of the smaller fruited plants were found to be fifty per cent lesser than that of the bigger fruited crosses. Hence, the yield per unit area can be increased by increasing plant population.

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