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Per se performance of pumpkin genotypes during *Kharif* season under southern zone of Tamil Nadu

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ABSTRACT : The present investigation was carried out at Department of Horticulture, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai during *Kharif* 2015 with 32 pumpkin (*Cucurbita moschata* Duch. ex. Poir) collected from different parts of Tamil Nadu to identify small fruited high quality genotypes. The genotypes CM-9, CM 3, CM 14 (3.40) recorded more number of primary branches, the highest vine length was recorded in CM18, CM10, CM15 (10.66, 10.50, 9.67m) genotypes. The higher petioles were recorded in CM21, CM18, CM4 (26.63, 24.77, 24.50cm). The higher leaf length was recorded in CM5, CM11, CM1, CM9, CM8, CM23, CM2, CM31 (14.03 to 14.93cm) genotypes. The leaf breadth was highest in CM15, (22.00), the higher inter nodal length in CM17, (13.53cm) were recorded. The first male flower in seventh node was observed in CM23, CM1, CM32, CM30, CM4, the first female flower appeared early in CM12, CM26, (20 and 21st node), the days taken for male flowering was ranged from 47.20 to 54.20 days and for flowering ranged from 51.73 to 63.27 days. The early female flowering was recorded in CM29, CM20 and CM17. The lowest sex ratio was recorded in CM30 (13.58). The days taken for fruit maturity less in CM29, CM28 and CM5 (83.47, 87.27 and 87.53 days). The genotypes CM29, CM28 recorded higher number of fruits per plant (4.40 and 3.13) and less fruit diameter (17.80 and 18.33cm), fruit length (44.40 and 49.73 cm), fruit weight (0.97 and 1.11kg), 100 seed weight (10 and 15g). The highest yield per plant was recorded in CM12, CM23, CM3 (9.48, 8.54 and 7.60kg). The highest TSS content (10 ^{0}Brix) in CM13, acidity (0.78) in CM27, ascorbic acid (10mg) in CM23, moisture content (99%) in CM30, CM31, beta carotene content in CM29, and CM28 (0.99 and 0.89 mg). The CM29 and CM28 genotypes were identified as small fruited type among the genotypes studied.

KEY WORDS : Pumpkin, *Cucurbita moschata*, Genotypes, Per se performance, 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, it occupies an area of 11,060 hectares with an annual production of 2,77,560 tonnes accounting to an average productivity of 25.10 tonnes per hectare. 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 in 2011-2012 (Anonymous, 2014).

Pumpkin provides a valuable source of carotenoids that have a major role in nutrition in the form of

provitamin A. Predominant carotenoids found in pumpkin include α -carotene, β-carotene and lutein, which gives colour to the fruits.The total carotenoids content in flesh of pumpkin was 12.12 mg/100g of fresh weight. The concentrations of three major carotenoids were α-carotene (5.15 mg/100g), β-carotene (3.10 mg/100g) and lutein (1.50 mg/100g). The fruits also contains 92.6 per cent moisture, 4.6 per cent carbohydrates, 25 kcal, 1.4 g protein, 0.1g fat, 0.06 mg thiamine, 0.04 mg riboflavin, 2 mg vitamin C, 10 mg calcium and 0.7 mg iron in one hundred gram of edible portion (Anonymous, 2007). The higher dietary intake of carotenoids offers protection against vitamin A deficiency related health problems (Roy, 1973). The World Health Organization (WHO) has indicated that nearly 112 million population in 108 countries including South Africa and South East Asia are suffering due to Vitamin A deficiency. Much emphasis on alleviating Vitamin A deficiency through vegetables like pumpkin, a cheaper source of carotene rich vegetable is also laid by WHO.

India is the centre of origin for many cucurbitaceous vegetables, where the cucurbits are capable of thriving and performing well even under the hot summer. The cultivated cucurbits are not merely as significant in man's economy as the other crops like legumes and cereals; they are crops of more than ordinary in the tropics, subtropics and milder portions of temperate zones. The vegetables of the family Cucurbitaceae constitute the largest group of cultivated vegetables.

Pumpkin is monoecious having both male and female flowers on the same plant. The female flower is distinguished by the small ovary at the base of the petals. These bright and colourful flowers have extremely short life span and may open only for short time as one day.

Most of the varieties and hybrids available in India are with large sized fruits of 4-5 kg which is not much preferred by a small family or nuclear family of three to four members. Further, with increased number of nuclear families of recent scenario in India, people prefer to buy only medium sized whole fruits of pumpkin instead of cut pieces. Further, the small fruits can be easily packed and transported without damage. Hence, the crop improvement work has been taken up with the objective of identifying genotypes with high yield, quality and small fruit.

RESEARCH METHODS

The present investigation was carried out at Department of Horticulture, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai during *Kharif* 2015. Totally thirty two genotypes were collected from different parts of Tamil Nadu were used for this study. The details of the genotypes used for the study were CM2, CM3, CM5, CM6, CM7, CM8, CM9, CM10, CM11, CM12, CM13, CM14, CM15, CM17, CM18, CM20, CM21 were maintained in the department of horticulture, the genotypes collected from where CM1 is Attur, Salem district, CM4 is Melur, Madurai district, CM16 is Olakkur, Villupuram district, CM19 is Gudalur, Theni district, CM22 is Gudiyatham, Vellore district, CM23 is Thirumangalam, Madurai district, CM24 id Natham, Dindugal district, CM25 is Vikravandi, Villupuram district,CM26 is Arani, Thiruvanamalai district, CM27 Sempatti, Dindugal district, CM28 is Ottamchatram, Dindugal district, CM29 is Rajapalayam, Virdhunagar district, CM30 is Tholudur, Perambalur District, CM31 is Harur, Dharmapuri district and CM 32 is Co1 variety. The experiment was laid out in Randomized Block Design with three replications. The crop was raised by taking pits at a spacing of 2m between rows and plants. The vines were allow to grow and spread on the ground. The growth, yield and quality parameters like number of primary branches, vine length petiole length, leaf length, leaf breadth, inter node length, first male flower node, First female flower node, days of first male flowering, days to first female flowering, sex ratio, yield per plant, days to fruit maturity, Number of fruits per plant, fruit length (cm), fruit diameter, flesh thickness, fruit weight, 100 seed weight, yield per plant, total soluble solids (^{o}Brix), acidity (%), ascorbic acid, moisture content and beta carotene content. The data recorded were subjected to statistical analysis adopting standard procedures of analysis (Panse and Sukhatme, 1967).

RESEARCH FINDINGS AND DISCUSSION

The results revealed that number of primary branches per plant is one of the yield increasing trait in pumpkin. In the present study, the genotypes CM-9 (3.47), CM-14 (3.40), CM-3 (3.40) recorded more number of primary branches. The results are in accordance with Rakhi and Rajamony (2005) in culinary melon.

Vine length is considered as one of the important traits for growth and vigour of the plants. In the present investigation, the genotypes exhibited significant differences for vine length. Among the 32 genotypes,

CM-18 (10.66cm) and CM-10 (10.50cm) recorded maximum vine length. The results are in line with the findings of Shanthipriya *et al* (2004) in cucumber, Dhillon *et al*. (2007) in snap melon and Rad *et al.* (2010) in melon.

Petiole length is considered as one of the traits for growth of the plants. In the present investigation, the genotypes exhibited significant differences for petiole length. Among the 32 genotypes, CM-21 (26.63 cm) and CM-18 (24.77 cm) recorded maximum petiole length. The results are in line with the findings of Pandey *et al.* (2010) in muskmelon.

Leaf length and breadth is considered as one of the important traits for growth and vigour of the plants. In the present investigation, the genotypes exhibited significant differences for leaf length. Among the 32 genotypes, CM-5 (14.93 cm) and CM-1 (14.63 cm) recorded maximum leaf length. The 32 genotypes, CM-

Table 1 : Mean performance of pumpkin genotypes for vegetative traits

Genotypes	No. of primary branches per plant	Vine length (cm)	Petiole length (cm)	Leaf length (cm)	Leaf breadth (cm)	Internode length (cm)	First male flower node	First female flower node	Days to first male flowering	Days to first female flowering	Sex ratio
CM-1	2.53	394.67	20.17	14.63	18.62	8.83	7.40	24.53	49.13	57.27	19.44
CM-2	2.80	618.33	21.97	14.13	16.73	6.53	10.67	24.73	51.33	58.07	18.33
CM-3	3.40*	534.67	17.73	13.53	15.30	7.13	8.33	24.67	48.60	60.67	18.65
CM-4	3.07*	708.00	24.50	13.77	18.43	8.00	7.93	24.80	49.60	57.20	27.65
CM -5	3.33*	749.00	20.53	14.93	16.07	7.13	9.20	23.67	49.00	56.67	19.68
CM -6	3.00*	844.67	19.73	11.53	16.83	5.73	11.20	24.13	50.20	59.73	24.62
CM -7	3.27	639.00	19.97	12.57	16.30	10.20	11.87	24.33	50.27	58.87	25.62
CM -8	3.07	374.33	19.80	14.27	15.77	9.30	13.80	24.40	48.60	55.80	24.87
CM -9	3.47	933.00	20.87	14.40	16.93	8.07	10.93	22.53	49.87	63.27	26.25
CM -10	2.80	1050.33	21.90	12.79	16.67	8.53	10.67	22.80	47.20	58.20	25.87
CM -11	3.00	800.33	21.47	14.63	16.07	8.60	8.80	23.07	50.00	57.87	17.62
CM -12	2.53	793.67	18.87	12.40	14.13	8.47	9.73	20.73	49.47	60.93	25.12
CM -13	2.33	588.00	18.97	13.17	15.57	8.33	10.20	23.33	49.27	58.00	16.51
CM -14	3.40	481.33	19.70	12.97	16.80	8.20	11.67	24.00	51.00	56.33	16.87
CM -15	2.60	967.67	23.90	13.60	22.00	8.47	11.67	27.80	52.93	60.47	21.12
CM -16	2.33	740.33	22.47	12.07	15.77	8.27	9.20	25.73	48.33	55.87	18.35
CM -17	3.13	368.00	21.17	12.83	18.50	13.53	11.13	28.93	49.33	55.40	28.67
CM -18	2.67	1066.00	24.77	13.80	19.67	10.63	8.73	23.20	51.40	58.07	19.45
CM -19	2.67	770.67	19.70	12.67	17.10	8.87	10.20	25.47	49.33	56.60	19.11
CM -20	3.27	609.67	22.80	13.67	17.83	10.63	8.67	23.47	48.93	55.33	19.61
CM -21	2.40	548.33	26.63	11.93	16.27	9.77	8.07	26.13	51.33	57.87	14.98
CM -22	2.20	525.00	22.87	13.03	17.53	9.87	10.53	24.93	51.07	58.00	22.63
CM -23	2.53	817.33	18.33	14.27	17.07	9.37	7.00	24.47	49.73	56.87	16.21
CM -24	2.67	618.33	19.17	12.00	18.03	10.53	9.53	26.13	49.27	57.27	17.35
CM -25	2.53	629.00	23.53	9.88	15.27	11.40	10.67	25.27	52.67	56.07	19.81
CM -26	2.60	877.00	18.37	11.23	16.03	9.07	9.67	21.53	52.20	57.07	24.36
CM -27	1.67	837.00	20.17	10.93	16.70	8.80	11.47	24.20	52.87	56.33	23.36
CM -28	1.87	443.67	18.00	11.13	14.20	8.33	9.13	24.60	51.27	55.67	26.89
CM -29	2.53	375.33	17.07	12.87	15.77	10.13	9.67	24.53	47.80	51.73	15.34
CM -30	2.73	666.67	20.87	13.47	16.97	9.83	7.53	28.93	54.27	58.33	13.58
CM -31	3.00	493.67	17.57	14.03	19.03	8.53	10.40	28.27	53.87	57.40	16.96
CM -32	2.53	779.33	17.73	13.50	18.70	8.33	7.47	24.80	54.20	57.47	21.34
Mean	2.75	676.32	20.67	13.02	16.96	8.98	9.79	24.69	50.45	57.52	20.82
S.E.±	0.17	83.28	0.80	0.61	1.04	0.59	0.72	0.94	2.08	1.31	0.45
C.D. (P=0.05)	0.34	166.48	1.60	1.23	2.08	1.18	1.44	1.89	4.16	2.62	0.90

15 (22.00 cm) and CM-18 (19.67 cm) recorded maximum leaf breadth. The results are in line with the findings of Hossain *et al.* (2010) in cucumber.

Inter node length is considered as one of the important traits for growth and vigour of the plants. In the present investigation, the genotypes exhibited significant differences for inter node length. Among the 32 genotypes, CM-6 (5.73) and CM-2 (6.53 cm) recorded shortest inter node length.

One of the main attributes for earliness is first male flower node. The genotype CM-1 (7.40) produced male flower at lowest node. Female flowering is one of the main attribute for earliness. The genotype CM-12 (20.73) produced female flower at lowest node. Similar trend of earliness was reported by Hanchinamani *et al.* (2011) in culinary melon.

Earliness is considered as one of the most important character in any crop improvement programme, and most

Table 2 : Mean performance of pumpkin genotypes for yield and quality traits

Genotypes	Days to fruit maturity	No. of fruits per plant	Fruit length (cm)	Fruit diameter (cm)	Flesh thickness (cm)	Fruit weight (kg)	100 seed weight (g)	Yield per plant (kg)	Total soluble solids (ºBrix)	Acidity (%)	Ascorbic acid (mg $100g^{-1}$)	Moisture content (%)	Beta-carotene (mg $100g^{-1}$)
CM-1	90.87	1.80	27.53	65.67	3.83	2.41	16.42	3.49	9.64	0.33	8.48	96.46	0.35
CM-2	93.53	2.27	26.87	62.80	3.47	2.29	27.21	4.17	8.90	0.23	6.30	91.30	0.48
CM-3	90.80	2.00	35.13	78.27	2.97	4.76	16.35	7.60	7.05	0.29	5.66	96.24	0.52
CM-4	88.00	2.00	26.13	60.53	3.13	2.86	15.15	4.58	8.02	0.39	6.51	87.68	0.60
CM -5	87.53	1.67	26.62	70.87	3.13	4.15	17.55	5.64	7.02	0.38	7.82	93.18	0.42
CM -6	89.33	1.60	20.20	63.00	3.23	2.35	14.53	3.01	6.76	0.22	6.08	95.90	0.56
CM -7	92.27	2.40	28.80	66.13	3.33	3.41	14.05	6.52	7.08	0.20	5.27	96.48	0.76
CM -8	89.33	2.07	28.20	63.00	3.07	3.08	10.17	5.08	9.03	0.31	4.94	89.52	0.58
CM -9	91.20	1.60	25.47	63.73	3.27	4.09	13.47	5.23	5.80	0.24	7.46	95.40	0.45
CM -10	89.47	2.20	26.00	60.27	2.57	4.22	15.09	7.42	5.06	0.41	7.18	87.26	0.73
CM -11	88.80	2.07	29.97	57.37	2.70	3.39	18.83	5.60	7.14	0.18	6.75	90.20	0.34
CM -12	90.87	2.67	24.10	59.73	3.17	4.45	12.10	9.48	9.25	0.32	7.56	95.94	0.79
CM -13	90.47	1.80	25.67	62.00	3.07	2.57	15.85	3.73	10.00	0.17	8.99	87.24	0.33
CM -14	89.53	2.13	27.87	59.33	3.13	2.71	15.15	4.42	8.08	0.22	8.95	97.88	0.69
CM -15	91.13	1.67	27.47	62.33	3.17	3.36	14.54	4.46	5.99	0.43	5.01	93.72	0.71
CM -16	89.20	1.93	21.47	58.67	2.83	2.66	14.46	4.16	6.01	0.52	7.71	82.66	0.66
CM -17	88.00	1.53	26.00	60.20	3.07	2.72	13.64	3.36	9.14	0.24	5.95	86.52	0.71
CM -18	90.00	1.87	24.40	59.13	2.87	2.12	14.06	3.17	9.95	0.23	8.19	97.02	0.78
CM -19	89.40	1.93	29.27	59.87	2.87	3.25	13.28	5.022	9.96	0.32	7.77	92.67	0.76
CM -20	88.20	1.73	29.80	71.51	2.77	4.08	18.24	5.64	9.13	0.12	7.84	93.20	0.89
CM -21	91.40	1.73	26.10	60.33	3.80	2.80	14.53	3.91	7.04	0.42	5.68	95.26	0.55
CM -22	92.40	1.93	26.63	74.63	2.57	3.15	20.20	5.36	7.86	0.20	5.38	92.10	0.81
CM -23	88.93	1.47	30.67	68.47	2.70	7.29	24.87	8.54	6.78	0.32	10.08	94.14	0.74
CM -24	89.00	2.20	30.27	62.60	2.60	3.29	10.57	5.81	7.05	0.43	5.54	91.24	0.59
CM -25	89.87	1.33	23.40	60.87	2.93	1.96	17.43	2.09	5.96	0.34	6.51	97.42	0.64
CM -26	88.47	1.20	32.43	60.33	2.83	2.68	13.37	2.57	5.06	0.65	4.54	89.56	0.34
CM -27	91.20	1.53	32.27	61.07	2.80	4.29	20.00	5.25	8.56	0.78	7.30	85.54	0.62
CM -28	87.27	3.13	18.33	49.73	2.27	1.11	10.01	2.79	7.63	0.34	5.39	97.03	0.89
CM -29	83.47	4.40	17.80	44.40	2.00	0.97	15.48	3.41	8.18	0.41	4.75	97.88	0.99
CM -30	91.47	1.67	18.40	57.13	2.80	2.22	16.88	2.95	6.06	0.32	6.53	99.68	0.45
CM -31	92.13	2.60	19.87	61.27	2.90	2.15	15.04	4.39	6.93	0.44	6.45	99.08	0.87
CM -32	90.67	1.07	36.27	76.80	3.23	7.89	17.91	6.65	7.20	0.23	9.58	95.98	0.67
Mean	89.82	1.98	26.54	62.56	2.97	3.273	15.82	4.859	7.60	0.33	6.82	93.17	0.63
S.E.±	1.99	0.38	1.16	1.27	0.16	1.75	0.37	8.58	0.25	0.02	0.26	0.77	0.03
C.D. (P=0.05)	3.98	0.62	2.31	2.55	0.31	0.21	0.74	5.77	1.44	0.14	1.46	4.37	0.18

of the genotypes or accessions are preferred when higher yield is coupled with earliness. The present study also identified out certain genotypes for earliness with respect to days to first male and female flower opening. The genotype CM-10 (47.20 days) had the earliest male flower opening. The genotype CM-29 (51.73days) had the earliest female flower opening. The results are in accordance with the reports of Samadia (2002) in bottle gourd, Bairagi *et al*. (2005) and Hossain *et al.* (2010) in cucumber.

Early harvest is also one of the important desirable traits for crop improvement programme. The present study had identified CM-29 (83.47) and CM-28 (87.27) certain genotypes with significantly early harvest. This is in accordance with the findings of Maurya *et al.* (2003) in bottle gourd and Ahmed *et al.* (2005) in culinary melon.

Fruit length indirectly increases yield and is therefore considered to be an important trait for selecting a pumpkin genotypes. Longer fruits were observed in the genotypes CM-32 (36.27cm) and CM-3 (35.13cm) and small size fruits were observed in the CM-29 (17.80cm) and CM-28 (18.3cm). Studies conducted by Rakhi and Rajamony (2005) in culinary melon and Rai *et al*. (2006) in chow chow observed similar trend of results for fruit polar length.

Greater fruit diameter was recorded in the genotype CM-3 (78.27cm) and CM-32 (76.80) and lesser fruit diameter was recorded in the genotype CM-29 (44.40cm) and CM-28 (49.73cm). Similar trend of results were reported by Pandey *et al.* (2010) in muskmelon.

Flesh thickness and fruit cavity is an important character, contributing better yield in pumpkin. Maximum flesh thickness was observed in the genotype CM-32 (3.83), followed by CM-21 (3.80cm) and CM-2 (3.47cm). This is in corroboration with the findings of Singh and Ram (2003) in musk melon.

The highest average fruit weight was observed in the genotypes CM-32 (7.89 kg) followed by CM-23 (7.29 kg) and CM-3 (4.76 kg) and lowest was shown by CM-29 (0.97 kg) and CM-28 (1.11 kg). Similar pattern of results were reported by Singh and Ram (2003) in musk melon and Yadav *et al*. (2008) in bitter gourd.

With respect of number of fruits per plant, the genotypes CM-29 (4.40) and CM-28 (3.13) were the best performing genotypes among 32 genotypes during *Kharif*. Similar pattern of results was reported by Shanmugasundaram (2006) in water melon.

In respect of fruit yield per plant, the genotypes CM-12 (9.48 kg) and CM-23 (8.54 kg) excelled in comparison with all other genotypes. High marketable fruit yield per plant recorded by these genotypes might have been due to the presence of maximum number of fruits per plant and maximum average fruit weight. These two characters were directly influenced the marketable fruit yield per plant. The similar trend of result of high marketable fruit yield was obtained by Pandey *et al.* (2010) in musk melon.

From the nutrient point of view, quality is considered as in important factor in any vegetable crop. Generally, the higher total soluble solids content would increase the nutritive value and sweetness of the fruits, respectively (Lisa and Li Tian, 2011).

In the present study, the genotypes CM-13 (10.00 ^{o}Brix) and CM-19 (9.96 ^{o}Brix) recorded higher total soluble solids, followed by CM-19 (9.95 ^{o}Brix) and CM-18 (9.95 ^{o}Brix). Similar findings have also been reported by Singh and Ram (2003), in muskmelon.

In the present study, the genotypes CM-27 (0.78 %) and CM-26 (0.65 %) recorded high acidity content. The genotypes CM-23 (10.08) and cm-31 (9.58) recorded high ascorbic acid content, the genotypes CM-30 (99.68 %) and CM-32 (99.08 %) recorded high moisture content. The genotypes CM-29 (0.99 mg/100g) and CM-28 (0.89 mg/100g) and CM-10 (13.73 mg/100g) recorded high beta carotene content. Zinash *et al.* (2013) in pumpkin reported similar results.

In the present investigation, based on *per se* performance, accession CM-29 was adjudged as the best one as evidenced by superior performance for nine characters out of the 24 characters studied *viz.*, days to first male flowering, days to first female flowering, days to fruit maturity, number of fruits per plant, fruit length (cm), fruit diameter (cm), flesh thickness (cm), fruit weight (kg) and beta- carotene content. Another genotype *viz.*, CM-18 was superior for three characters out of 24 characters.

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