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Genetic variability study for yield and quality traits in pumpkin (*Cucurbita moschata* Duch. Ex Poir)

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Abstract
Nine genotypes were studied for genetic variability studies on Pumpkin (*Cucurbita moschata* Duch. Ex Poir) at orchard of Department of Vegetable Crops, College of Horticulture, TNAU, Coimbaotre, Tamil Nadu, India during kharif 2016-17 in Randomized Block Design. The data was recorded for seventeen different characters to study genetic variability, heritability, genetic advance and genetic gain. Analysis of variance among 9 pumpkin genotypes showed highly significant differences for all the characters indicated the presence of substantial amount of genetic variability. Highest genotypic coefficient of variance (GCV) and phenotypic coefficient variance (PCV) was observed for fruit yield per vine followed by beta carotene content, number of fruits per plant indicating that these characters could be used as selection for crop improvement. High heritability coupled with high genetic advance as percent of mean was observed for traits like vine length (86.65, 32.35), days to first female flower appearance (81.90, 35.63), node number for first female flower appearance (88.25, 71.54), sex ratio (75.61, 43.09), fruit number per vine (81.30, 79.27), fruit weight (66.96, 50.97), flesh thickness (80.12, 44.40) and fruit yield per vine (95.05, 174.75), ascorbic acid content (77.78, 76.33), crude fibre content (94.15, 78.71) and beta carotene content (93.41, 101.20) indicating predominance of additive gene effects and the possibilities of effective selection for the improvement of these characters.

Keywords: Pumpkin, heritability, genetic gain

Introduction
Pumpkin (*Cucurbita moschata* Duch. Ex Poir) is the most important seed propagated monoecious climbing vegetable crop that belongs to the family Cucurbitaceae, with the chromosome number 2n=40 (Katyal and Chadha, 2000) [8]. Pumpkin has received little attention in crop improvement compared to other cucurbitaceous vegetables even it is a rich source of beta carotene next to carrot. The yellow and orange fleshed fruits are very rich in carotene (3,332 IU), which is precursor of Vitamin-A with fair quantities of vitamins B and C. It may contribute to improve the nutritional status of the people, particularly the vulnerable groups with respect to vitamin A requirement (Satkar *et al.*, 2013) [17]. The pumpkin produced in India is mainly used for domestic consumption as fresh vegetable. The mature fruits, apart from the main use as vegetables, are also utilized as industrial raw material for carotene production (Vucetic *et al.*, 1989) [21]. Being a most common nutritional rich crop scientific attempt is needed for its genetic improvement. Genetic variability is a prerequisite for a successful breeding program for any crop species. In plant breeding program, direct selection on the basis of phenotypical characters for yield as such could be misleading. Yield and yield contributing traits like fruit weight, fruit per plant, fruit length, fruit diameter and 100-seed weight, etc. must be taken into consideration for variety development (Masud *et al.*, 1995) [12]. Therefore, the study was undertaken to find out and establish suitable selection criteria for higher yield through study of variability, heritability and genetic gain.

Material and Method
The present investigation was laid out in Randomized Block Design with three replications during *kharf* 2016-17 at an orchard of Department of Vegetable Crops, College of Horticulture, TNAU, Coimbatore, Tamil Nadu. The experiment materials comprised of nine genotypes assigned at random to the pits 50 cm x 50 cm x 50 cm dimension in each block. Standard production package was followed for raising a healthy crop. To evaluate the genetic parameters, seventeen characters were taken into consideration *viz.* vine length, days to first female flower appearance, node number for first female flower appearance, sex ratio,

days to first harvest, fruit number per vine, fruit weight (kg), flesh thickness (cm), fruit yield per vine (kg/vine), ascorbic acid content (mg/100 g), crude fibre content (%) and beta carotene content (μg/g). The data were analyzed by the methods of Cochran and Cox (1957) [5] using mean values of random plants in each replication from all genotypes to determine significance of genotypic effects. Genotypic and phenotypic coefficients of variation were calculated using the formulae of Burton (1952). Broad sense heritability was calculated as per Lush (1940) and genetic advance estimated by the method of Johnson *et al.* (1955) [7]. Categorization of genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV) and genetic advance (GA) were done as per Sivasubramanian and Menon (1973) [19] and heritability was categorized as by Johnson *et al.* (1955) [7].

Results and Discussion

Range

A wide range of variation was observed among nine genotypes of pumpkin, evaluated for seventeen characters (Table 1). The mean performance of the genotypes revealed a wide range of variation for traits such as days to first female flower appearance (26.97 to 56.38 days), node number of first female flower appearance (5.07 to 15.40), sex ratio (13.57 to 28.60), days to first harvest (73.22 to 106.47 days), number of fruits per vine (1.6 to 5.4), fruit weight (2.1 to 5.0 kg), number of seeds per fruit (97.40 to 408.95), 100 seed weight (5.9 to 13.6 g), ascorbic acid content (2.4 to 9.8 mg/100g), beta carotene content (4.6 to 24.85 mg/g) and fruit yield per vine (2.57 to 26.13 kg).

Table 1: Estimates of phenotypic and genotypic coefficients of variability, heritability and genetic gain for yield and quality traits in pumpkin

Characters	Min	Max	Mean	PCV	GCV	h^2 (Broad Sense)	Genetic Advance	Gen. Adv as % of Mean
Vine length (m)	3.01	4.72	3.89	15.91	13.79	86.65	1.26	32.35
Days to first female flower appearance	26.97	56.38	46.25	17.47	14.31	81.90	16.48	35.63
Node number for first female flower appearance	5.07	15.40	8.47	34.95	30.85	88.25	6.06	71.55
Sex ratio	13.57	28.86	22.30	21.10	15.95	75.61	9.61	43.09
Days to first harvest	73.22	106.47	88.55	12.10	6.18	51.08	21.35	24.12
No. of fruit per vine	1.68	5.47	3.25	38.60	31.38	81.30	2.58	79.28
Fruit weight (kg)	2.15	5.01	3.57	24.86	16.65	66.96	1.82	50.97
Fruit equ. Diameter (cm)	14.99	29.34	20.39	20.81	18.75	90.12	8.63	42.31
Fruit polar diameter (cm)	9.38	23.92	16.66	29.01	25.78	88.87	9.92	59.54
Flesh thickness (cm)	2.36	4.67	3.21	21.60	17.30	80.12	1.43	44.41
No. of seed/ fruit	97.40	408.95	218.83	49.04	43.78	89.26	220.80	100.90
Seed wt./ fruit (g)	7.76	28.72	19.18	32.85	26.62	81.01	12.94	67.49
100 seed wt. (g)	5.97	13.69	9.89	27.25	20.01	73.44	5.53	55.94
Ascorbic acid content (mg/100 g)	2.45	9.87	6.68	37.13	28.88	77.78	5.10	76.33
Crude fiber content (%)	0.51	2.07	1.23	38.30	36.06	94.15	0.97	78.72
β carotene content (mg/g)	4.68	24.85	13.07	49.22	45.98	93.41	13.23	101.21
Fruit yield/vine (kg)	2.57	26.13	9.24	84.96	80.76	95.05	16.15	174.76

Phenotypic and genotypic coefficient of variability

The data presented in Table 1 revealed that phenotypic coefficient of variability for all the traits had higher values corresponding to their genotypic counterpart. This indicates that the influence of environment is high on observed phenotypic variation of these traits. High phenotypic and genotypic coefficient of variability were recorded for node number of first female flower appearance (34.95% and 30.84%), fruit number per vine (38.59, 31.37), fruit polar diameter (29.00% and 25.77%), number of seeds per fruit (49.04% and 43.77%), seed weight per fruit (32.85% and 26.61%), fruit yield per vine (84.96% and 80.75%), ascorbic acid content (37.13% and 28.88%), crude fibre content (38.30% and 36.03%) and beta carotene content (49.21% and 45.97%) which indicate that the observed variation in the nine genotypes for these traits is high and can be exploited to facilitate selection. Moderate phenotypic and genotypic coefficient of variability observed for vine length (15.90% and 13.78%), days to first female flower appearance (17.46% and 14.30%) indicate moderate variability in genotypes for these traits along with less influence of environment. These were in accordance with the findings of Chowdhury and Sharma (2002) [4], Mohanty (2000) [13], Pandey *et al.* (2008) [16], Kumar *et al.* (2011) [9], Akter *et al.* (2013) [1], Dhatt and Singh (2008) [6], Sultana *et al.* (2015) [20], Singh *et al.* (2019) [18].

Heritability and genetic gain

Heritability measures the contribution of genetic variability to the phenotypic variability and is a good index of the transmission of characters from parents to their offspring. The estimates of heritability can be utilized for prediction of genetic gain, which indicates the genetic improvement that would result from selection of best individuals. Genetic advance (GA) is the measure of genetic gain under selection. High heritability accompanied with high genetic advance indicates that most likely the heritability is due to additive gene effects and selection may be effective. The heritability and genetic advance as percentage of mean estimate varied from 51.08, 24.11 percent in days to first harvest to 95.05, 114.75 per cent in fruit yield per vine respectively. Moderate heritability coupled with high genetic advance as percentage of mean was observed for days to first harvest (51.08%, 24.11%).

High heritability coupled with high genetic advance as percent of mean was observed for traits like vine length (86.65, 32.35), days to first female flower appearance (81.90, 35.63), node number for first female flower appearance (88.25, 71.54), sex ratio (75.61, 43.09), fruit number per vine (81.30, 79.27), fruit weight (66.96, 50.97), flesh thickness (80.12, 44.40) and fruit yield per vine (95.05, 174.75), ascorbic acid content (77.78, 76.33), crude fibre content (94.15, 78.71) and beta carotene content (93.41, 101.20) which indicated that these traits are less affected by environment and controlled by additive gene action. Hence, these traits are highly amenable for selection. Since pumpkin is a cross pollinated crop and these traits are controlled by additive gene action, breeding procedures like synthetic breeding, composite breeding and population improvement by recurrent selection for *gca* can be followed for their improvement. The results are in line with the findings of Mohanty and Mishra (1999) [14], Bindu *et al.* (2000) [2], Dhatt and Singh (2008) [6], Akter *et al*. (2013) [1], Muralidhara *et al*. (2014) [15], Kumar *et al*. (2018) [10], Singh *et al*. (2019) [18].

Conclusion

The highest heritability coupled with highest genetic advance as per cent of mean was observed in traits like vine length, days to first female flower appearance, node number for first female flower appearance, sex ratio, fruit number per vine, fruit weight, flesh thickness, fruit yield per vine, ascorbic acid content, crude fibre content and beta carotene content. Therefore, indicating the importance of these characters in selecting a genotype for yield and quality in pumpkin.

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