Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2020; 9(1): 312-314
Received: 19-11-2019
Accepted: 21-12-2019

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Variability studies in Crossandra (*Crossandra infundibuliformis*)

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Abstract
The present investigation was under taken to study the genetic parameters such as, heritability, genotypic and phenotypic coefficient of variation (GCV, PCV) for ten characters of different crossandra genotypes. The highest phenotypic and genotypic coefficient of variation, heritability and genetic advance as percent of mean was noticed for number of spikes per plant, yield per plant, rachis length, number of leaves, number of flowers per spike, plant height, primary branches and 100 flower weight.

Keywords: Crossandra, GCV, PCV

Introduction
Crossandra (*Crossandra infundibuliformis* (L.) Nees) is an important loose flower crop, commercially grown in southern parts of India. Though it is not having any fragrance it became very popular due to its excellent color and demand in the market. Selection of superior variety depends upon the variation. Variability in a population with respect to character is an essential requirement for a successful breeding programme. Use of open pollinated crops for exploiting increased variations especially in heterozygous crop like marigold is gaining considerable importance (Singh and Misra, 2008) [12]. Estimation of heritability reveals transmission of characters from one generation to another generation. Heritability alone is not useful for breeding programmes, heritability along with genetic advance is pre-requisite for selection process. The adequate information on extent of variability parameters may be helpful to improve the yield by selecting the yield component traits because yield is a complex trait, whose manifestation depends on the component traits (Angadi and Archana, 2014) [1]. Based on the requirement, this research work has been undertaken to assess and estimate the magnitude of variation among the different genotypes with respect to various traits which can be further utilized in crop improvement programme.

Materials and Methods
The present experiment was carried out at the Department of Floriculture and Landscape Architecture, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. The ten different genotypes were selected based on the superior yield and yield contributing characters. The crop was raised during rainy season. One month old seedlings were transplanted to main field with spacing of 60 cm x 45 cm. Observations were recorded on single plant basis for plant height (cm), plant spread (cm), number of primary branches per plant, number of leaves per plant, 100 flower weight (g), number of flowers per spike, number of spike per plant, rachis length (cm) and total flower yield per plant (g). The genotypic and phenotypic coefficient of variation was estimated according to the methods of Burton (1952) [2]. Heritability in broad sense was calculated as per method given by Lush (1949) and Robinson *et al*. (1949) [5, 9]. The expected genetic advance as per cent of mean was worked out as suggested by Johnson *et al.* (1955) [3].

Results
In any breeding programme, the mean performance and variability are the important factors for selection. Based on mean performance undesirable plant may be eliminated and also variability may be used for selection procedure.

Plant height
Plant height at 120 days after transplanting registered genotypic coefficient of variation and phenotypic coefficient of variation of 20.05 and 20.90%, respectively. Heritability was recorded as 92.00% and GA as per cent of mean was noted as 39.62 per cent.

Plant spread at 120 DAT in N-S direction
Plant spread at 120 DAT in N-S direction registered 7.74% genotypic coefficient of variation and 9.70% phenotypic coefficient of variation. Heritability observed as 63.74% and GA as percent of mean was recorded as 12.74 per cent.

Plant spread at 120 DAT in E-W direction
Plant spread at 120 DAT in E-W direction registered 9.79 and 11.38% of genotypic coefficient of variation and phenotypic coefficient of variation, respectively. Heritability and GA as percent of mean recorded was 74.00 and 17.34%, respectively.

Number of primary branches on 120 DAT
Primary branches on 120 DAT showed 13.91% genotypic coefficient of variation and 15.10% phenotypic coefficient of variation. Heritability observed was 85.05% and GA as percent of mean as 26.44 per cent.

Number of leaves per plant at 120 DAT
Number of leaves per plant at 120 days after transplanting revealed that genotypic coefficient of variation and phenotypic coefficient of variation as 28.10 and 28.70% respectively. Heritability was recorded as 95.88% and GA as percent of mean was noted as 56.67 per cent.

100 flower weight
100 flower weight showed 13.32 and 14.66% of genotypic coefficient of variation and phenotypic coefficient of variation, respectively. Heritability and GA as percent of mean recorded as 82.70 and 24.96%, respectively

Number of flowers per spike
Number of flowers per spike registered genotypic coefficient of variation and phenotypic coefficient of variation of 26.76 and 27.31% respectively. Heritability was recorded as 95.97% and GA as percent of mean was noted as 54.00 per cent.

Number of spikes per plant
Number of spikes per plant showed 50.05% genotypic coefficient of variation and 50.38% phenotypic coefficient of variation. Heritability observed, 98.66% and GA as percent of mean was recorded as 102.40 per cent.

Rachis length
Rachis length revealed 28.05 and 28.57% of genotypic coefficient of variation and phenotypic coefficient of variation, respectively. Heritability and GA as percent of mean recorded as 96.44 and 56.76% respectively.

Yield per plant
Yield per plant registered 41.32% genotypic coefficient of variation and 40.92% phenotypic coefficient of variation. Heritability observed as 98.00% and GA as percent of mean was recorded as 83.42 per cent.

Discussion
The presence and magnitude of genetic variability is prerequisite for any breeding program. It will be useful for quantifying the genetic variability, heritability and genetic advance of genotypes to identify for high yielding characters. Phenotypic coefficient of variation recorded was higher than the genotypic coefficient of variation for all the parameters which shows that greater influence over environment in plants. High GCV and PCV were recorded for plant height, number of leaves, rachis length, number of spikes per plant and yield per plant. It indicates that maximum variability is observed in these characters. Moderate GCV and PCV was noticed in number of primary branches and 100 flower weight. Low GCV and PCV was found in plant spread. This results in agreement with the results of Sharma and Raghuvansi (2011) [11] who recorded moderate variation for flower bud appearance in French marigold. The results of the present study were supported by Mishra *et al*. (2001) [6] who also observed high heritability for total crop duration in carnation, Singh and Misra (2008) [12] recorded high heritability for number of secondary branches and single flower weight, Singh and Kumar (2008) for number of flowers per plant and days taken for flower bud appearance.
Variability of characters are a good index of the transmission of characters from parents to their offspring. Heritability plays an important role in the selection process in plant breeding because, it is an estimate from additive genetic variance and it plays an important role in the selection of elite genotypes from segregating population Panwar *et al*. (2013) [7].
High heritability was found in all the characters recorded. High heritability value of a particular character had less influence of environment which is highly useful in selecting genetically good individual. High heritability with high genetic advance was noted in plant height, number of leaves, primary branches, number of spikes per plant, number of flowers per spike, 100 flower weight, rachis length and yield per plant. High heritability with high genetic advance is an important character for selection and these are traits controlled by additive gene action. Higher heritability with moderate genetic advance was recorded in plant spread. It is due to additive and non-additive gene effect. This character can be improved through hybridization or by selection. Similar reports were reported by Kadam *et al.* (2014) [4] in gladiolus, Poornima *et al.* (2006) and Sankari *et al.* (2019) [8, 10] in China aster.

Mean, genotypic and phenotypic co- efficient variation, heritability and genetic advance as percent of mean for different parameters of crossandra genotypes

S. No	Characters	Mean	GCV	PCV	Heritability	GA (%) of mean
1	Plant height 120 DAT	41.20	20.05	20.90	92.00	39.62
2	Plant spread 120 DAT in N-S direction	28.83	7.74	9.70	63.74	12.74
3	Plant spread 120 DAT in E-W direction	34.85	9.79	11.38	74.00	17.34
4	No. of primary branches on 120 DAT	3.90	13.91	15.10	85.05	26.44
5	Number of leaves at 120 days	149.17	28.10	28.70	95.88	56.67
6	100 flower weight	6.79	13.32	14.66	82.70	24.96
7	Number of flowers per spike	32.29	26.76	27.31	95.97	54.00
8	Number of spikes per plant	36.10	50.05	50.38	98.66	102.40
9	Rachis length	7.74	28.05	28.57	96.44	56.76
10	Yield per plant	81.90	41.32	40.92	98.00	83.42

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