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Variability studies and value addition in Gomphrena (*Gomphrena globosa L.*)

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Abstract

The present experiment was carried out in COH, Bengaluru. Twelve genotypes of Gomphrena were evaluated for growth, flowering and yield attributes to study their genetic parameters such as variability, heritability, genotypic coefficient of variation(GCV) and phenotypic coefficient of variation (PCV). All traits showed significant difference among the genotypes. The maximum value of GCV and PCV were recordedfor individual flower weight, flower petiole length, secondary branches. The highestbroad sense heritability was recorded for individual flower weight, secondary branches, primary branches, duration of flowering, plant spread in N-S direction, plant height, and flower petiole length. High heritability and genetic advance as percent mean are due to additive type of gene action. In value addition Two genotypes of Gomphrena namely *Gomphrena globosa L.*'white' and *Gomphrena globosa L.*'magenta' were exposed to air drying and hot air oven drying. The data recorded on fresh weight, dry weight, moisture loss and duration of drying were analyzed by following factorial CRD. With respect to drying methods hot air oven drying retains colour and took minimum time for drying Gomphrena flowers. Hence this method is advantageous over air drying. The interaction effect showed that *Gomphrena globosa L.*'magenta' with oven drying achieved maximum score with respect to colour (20.53), texture (16.78), shape (20.98) and overall acceptability (20.33).

Keywords: Gomphrena; Phenotype; Genotype; Genetic advance; Heritability; GCV; PCV; Drying; Air Drying, Hot air oven drying

1. Introduction

*Gomphrena globosa L.*is commonly known as Bachelors button, globeamaranth, vadamalli and makhmali. It belongs to Amaranthaceae family and native to India. Plants are suitable to grown in wide range of climatic conditions from tropical to subtropical condition. Flowering starts after two months of transplanting, profuse flowering occurs in the month of September to October. The flower has wide variation of colors from white, purple, magenta, pink and rose color. Flowers are used in the preparation of garlands, strings and, single flower is used in the worshiping of God, besides its use in landscape gardening. Success of crop improvement program depends on themagnitude of the genetic variability and the efficiency of selection.

In view of the importance, popularity and potentiality of this crop, there is a lot of scope for breeding new varieties with higher yield and superior quality flowers. Before takingup crop improvement program in any crop species, a thorough knowledge on the amount of genetic variability for various characters existing in the crop is essential. Information on nature and magnitude of variability in the existing plant material and association among the various characters is a prerequisite for improvement in the yield.

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Value addition: Any step taken to increase the value of a product anytime between harvesting and sale of the final product. It increases the value and appeal of the product through changes in processing. Value added product means any consumer is ready to pay more than they would for a raw product. It increases consumer's acceptability and also adds more to the profit. Flower preservation through different methods is one among the value-added product and flower preservation is a recent phenomenon. Flower balls, greeting cards, covers, festive decorations, bouquets, wreaths and sweet-smelling pot pourri are some of the important value added products from dry flower.

2. Material and methods

The present experiment on Variability studies andvalue addition in Gomphrena (*Gomphrena globosa L.*) was carried out in the experimental field of Department of Floriculture and Landscape Architecture, College of Horticulture, Bengaluru from December 2019 to July 2020. The seeds of all genotypes were sown in earthen pots to raise seedlings and transplanting was done after one month of sowing with spacing of 45 x 45 cm. The observations were recorded on five randomly selected plants from each replication. The genotypes were assessed and observations were recorded for various growth and flowering related traits *viz.* plant height, plant spread in N-S and E-W direction, primary and secondary branches, flower head diameter, flower petiole length flower yield per plant and flower yield per hectare. Phenotypic and genotypic co-efficient of variation were calculated by using the formulae suggested by Burton (1953). The broadsense heritability (h2BS) was estimated by following the procedure suggested by Robinson *et al.* (1966). The expected genetic advance as per cent of mean for each character was predicted by the formula given by Johnson *et al* (1955). In value addition the flowers were harvested at maturity stages and harvested flowers were subjected to air drying and hot air oven drying. For air drying, bunches were made by adding twenty flowers having equal stalk length, four bunches per replication were made separately for magenta and white color. Flowers were hanged upside down in a well-ventilated room for proper drying for a period of 3 to 4 days. After 3 to 4 days bunches were removed carefully from the rope and observations were recorded. On the other hand, hot air oven drying was chosen as a second method of drying at 50^{o}C with silica gel as an embedding media for uniform drying. Among two drying methods best drying method was standardized for Gomphrena based on the experimental results. Statistical analysis was carried out by following CRD given by Sundarraj *et al.* (1972).

3. Results and discussion

In any breeding program, the mean performance and variability are the important factors for selection. With a view to understand the extent to which the observed variations are due to genetic factors, the range, mean, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV),broad sense heritability (h2) and genetic advance as per cent mean (GAM) were worked out and are presented in Table 1. In the present study, the estimates of phenotypic coefficient of variation (PCV) were higher than their corresponding genotypic coefficient of variation (GCV) for all the characters. The maximum value of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were recorded for individual flower weight (g) (33.33 % and 34.67 %, respectively), flower petiole length (cm) (21.38 % and 23.89 %, respectively), secondary branches (22.63% and 23.62%, respectively) compare to other characters, indicating the presence of high amount of variability and effective for selection because the response to selection is directly proportional to the variability present in the experimental material. The lower value of GCV and PCV was observed for plant height (cm) (18.98 % and 21.17 %, respectively), plant spread in N-S (19.74 % and 21.55 %, respectively) and E-W direction(18.57 % and 20.07% respectively), primary branches (15.08 % and 15.97 %, respectively), days to first flowering (12.22 % and 13.45 %, respectively), days to 50 % flowering (11.65 % and 13.10 %, respectively), duration of flowering (12.44 % and 13.53 %, respectively), flower yield per plant (9.79 % and 14.13 %, respectively). Significant difference was achieved between GCV and PCV for majority of the traits. The difference indicates little environmental influence on these characters. This helps in achieving maximum variability.The similar findings were registered in dahlia by earlier workers (Basavaraj, 2006).

All the characters exhibited broad sense heritability expect for shelf life in the present work. The genotypes showed high heritability for most of the traits, and it was ranged from 0.938 to 92.45 per cent. The highest broad sense heritability was recorded for individual flower weight (g) (92.45 %), secondary branches (91.87 %), primary branches (89.23 %), duration of flowering (84.56 %), plant spread in N-S direction (83.90 %), plant height(80.43 %), flower petiole length (80.12 %), . The lowest heritability was recorded for shelflife (0.938 %) (Panse, 1957). Hence selection of best genotype was computed by using coupled heritability with genetic advance. The present work is in conformity with the findings of Munikrishnappa (2011) in China aster.

Table 1 Mean, range, variance, genotypic and phenotypic coefficient of variation, heritability, genetic advance and genetic advance asper cent mean for vegetative, flowering, quality and yield traits in Gomphrena

Parameters	**Mean**	**Range**	**GCV (%)**	**PCV (%)**	**Heritability (%)**	**GA**	**GAM (%)**
Plant height (cm)	40.05	21.84-48.33	18.98	21.17	80.43	14.04	35.07
Plant spread N-S (cm^2)	43.85	24.40-53.06	19.74	21.55	83.90	16.33	37.25
Plant spread E-W (cm^2)	45.01	24.20-53.66	18.57	20.77	79.94	15.40	34.21
Primary branches	9.59	7.88-13.15	15.08	15.97	89.23	2.81	29.36
Secondary branches	57.63	28.88-68.48	22.63	23.62	91.87	25.76	44.70
Days to first flowering	10.50	8.82-12.77	12.22	13.45	82.62	2.40	22.89
Days to 50 % flowering	23.53	18.50-29.58	11.65	13.10	79.01	5.02	21.33
Duration of flowering	144.34	119.76-184.00	12.44	13.53	84.56	34.02	23.57
Flower head diameter (cm)	1.66	1.56-1.83	4.50	7.08	40.49	0.098	5.90
Flower petiole length (cm)	7.45	3.62-10.29	21.38	23.89	80.12	2.94	39.43
Shelf life (days)	12.20	11.19-13.03	1.88	6.14	0.938	0.14	1.18
Individual flower weight (g)	0.53	0.23-0.77	33.33	34.67	92.45	0.351	66.02
Flower yield per plant (g)	375.70	329.33-487.26	9.79	14.13	48.09	52.94	13.99

GV -Genetic variation
GCV - Genotypic coefficient of variation
GA - Genetic advance

PV -Phenotypic variation
PCV-Phenotypic coefficient of variation
GAM - Genetic advance as % mean

Heritability	GAM, GCV and PCV
Low-0-30%	Low - 0-10%
Moderate -30-60%	Moderate - 10-20%
High ->60%	High->20%

Heritability alone does not provide reliable information on expression of characterand also it does not provide the information of the amount of genetic progress that would result from the selection of best individuals. Highest genetic advance over mean was recordedfor individual flower weight (66.02 %), secondary branches (44.07 %). The genotypic variations for such characters are probably due to high additive gene effects and least influenced by the environment. However, low genetic advance was reported for shelf life and flower head diameter selection for these characters would not be much effective. The studies revealed that genetically diverse genotypes are further utilized for crop improvement program with broad genetic base.

In value addition, parameters like dry weight, moisture loss, time taken for drying, colour, shape, appearance and texture of dry flowers are influenced by different drying methods are presented in Table 1 and 2. The significant difference was seen in all the treatments with respect to dry weight and moisture loss. Among the varieties *Gomphrena globosa L .*'magenta' recorded highest fresh weight (24.90 g) and dry weight (5.86 g) with minimum moisture loss percentage (76.77 %) and maximum duration of drying (36.56 hours). Whereas *Gomphrena globosa L.*'white' showed best results by recording minimum fresh weight (18.43 g) and dry weight (5.18 g) with maximum moisture loss percent (72.48 %) and minimum time for drying (32.34 hours). This variation was due to genetic makeup ofa trait (Meeteren, 1988). Among drying methods air drying recorded maximum fresh weight (23.90 g) and dry weight (7.11 g) with minimum moisture loss (69.45 %) and maximum drying duration (64.28 hours). Whereas, oven drying recorded minimum dry weight (3.93 g) with maximum moisture loss per cent (79.81 %) and minimum durationof drying (4.62 hours). This was due to the influence of surrounding atmosphere. Among interaction effect *Gomphrena globosa L.*'white' recorded minimum dry weight with maximum moisture loss per cent and minimum time for drying (Singh *et al*., 2004).

In the interaction effect flowers dried in hot air oven with *Gomphrena globosa L.*'magenta' embedded in silica gel maintained good colour by recording maximum score (20.53). This may be due to the rapid drying which generated little amount of heat (White, 2002). *Gomphrena globosa L.*'magenta' with oven drying recorded maximum score with respect shape (20.98), texture (16.78) and overall acceptability (20.33). However and it is on par with the treatment combination of *Gomphrena globosa L.*'white' with air drying (Singh, 2018).

Table 2 Influence of drying method on colour, shape texture and overall acceptabilityof dried Gomphrena flowers as assessed through sensory evolution

Interaction effect (V x D)	**Colour**	**Shape**	**Texture**	**Overall acceptability**
V1 D1 – GGM x Air drying	16.39	16.93	11.50	16.39
V1 D2 – GGM x Hot air ovendrying	20.53	20.98	16.78	20.33
V2 D1 – GGW x Air drying	10.32	11.07	11.50	10.58
V2 D2- GGW x Hot air oven drying	16.93	11.57	10.29	11.47

25-point scale with the weightage of 21-25: Very good, 16-20: Good, 11-15: Average, 6-10:Poor, 0-5: Very poor

Table 3 Fresh weight, dry weight, moisture loss and time taken for drying Gomphrenaflowers as influenced by drying methods

Treatment	**Fresh weight (g)**	**Dry weight (g)**	**Moisture loss (%)**	**Drying duration**
Variety (V)				
V1-*Gomphrena globosa* magenta (GGM)	24.90	5.86	76.77	36.56
V2- *Gomphrena globosa L.* white (GGW)	18.43	5.18	72.48	32.34
S. Em ±	0.15	0.13	0.73	0.25
C.D @ 5%	0.47	0.42	2.27	0.79
Drying method (D)				

D1- Air drying	23.90	7.11	69.45	64.28
D2- Hot air oven drying	19.43	3.93	79.81	4.621
S. Em ±	0.15	0.13	0.73	0.25
C.D @ 5%	0.47	0.42	2.27	0.79
Interaction effect (V x D)				
V1 D1 – GGM x Air drying	27.92	7.21	74.14	68.05
V1 D2 – GGM x Hot air ovendrying	21.89	4.50	79.41	5.07
V2 D1 – GGW x Air drying	19.89	7.00	64.76	60.51
V2 D2- GGW x Hot air ovendrying	16.98	3.36	80.20	4.16
S. Em ±	0.21	0.19	1.032	0.36
C.D @ 5%	0.67	0.59	3.21	1.12

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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