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Assessment of *per se* Performance of Gomphrena (*Gomphrena globosa* L.) Genotypes for Productivity and Quality traits

G N Nagajyothi[1], Balaji S Kulkarni[2], D Satish[3] and Sateesh R Patil[4]
College of Horticulture, University of Horticultural Sciences, Bagalkot-587104, Karnataka (India)

ABSTRACT

An experiment was conducted to evaluate 13 Gomphrena genotypes for qualitative and quantitative traits at College of Horticulture, Bagalkot in a randomized block design with three replications during 2022. Observations were recorded from each genotype for both qualitative and quantitative traits. The results revealed that maximum plant height, plant spread in N-S and E-W direction, stem girth, days from bud to bloom, duration of flowering, , individual flower weight, number of flowers per plant and yield per plant was observed in genotype AGS-4. More number of primary branches were noticed in AGS-7, secondary branches in AGS-10, maximum leaves count in AGS-5. The genotype AGS-9 took minimum number of days to bud initiation, while AGS-8 took least number of days to 50 percent flowering. The quality traits like stalk length and inflorescence length were best in genotype AGS-1. The highest shelf life and display life was observed in genotype AGS-3 and AGS-6. Based on the qualitative results, genotype AGS-8, 9 and 10 exhibited upright growth habit and remaining other genotypes belonged to spreading type. RHS colour chart grouped all genotypes into four major flower colour groups *i.e,* pink, white, purple and red flower colour, leaf blade as reddish purple group, genotype AGS-1, 2, 4, 5 8 and 9 belonged to short acuminate blade shape, whereas other genotypes showed acute leaf blade shape.

Keywords: AGS-genotype, Flower, Gomphrena, Growth, Parameters,Yield,

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INTRODUCTION

Bachelor's button *(Gomphrena globosa* L.) is a popular everlasting flower crop commercially cultivated in India. It signifies special importance due to its vibrant bright inflorescence, hardiness and ease in cultivation, marketability, short duration and easy transportation (Esmat and Mittapally, 2020). The Globe Amaranth (*Gomphrena globosa* L.) is native to North America, South America, Myanmar and India (Ashwini *et al.,* 2019), known by different names; makhmali' in Nepal, Raktamallika in Sanskrit, Adikehuvvu/rudrakshihuvvu in Kannada and 'Gul-e-makhmal in Hindi and Gundi in Kashmir. Genus belongs to the family Amaranthaceae with chromosome number 2n=38 consists of about 100 species of half-hardy annual, biennial and herbaceous perennial plants, but only one species *Gomphrena globosa* is in general cultivation. In India, around 18 genera and 50 species have been recorded (Jiang *et al*, 2011). The flower has amazing ability to last for years when dried. In India, it is majorly grown in Karnataka, Tamil Nadu, Kerala and in Andhra Pradesh. In Karnataka, commercially grown in Dharwad, Belagavi, Raichur and Bellary Districts (Anonymous, 2020).

Commercially it is used for making garlands, pomanders, bouquets, flower balls, wreath, greeting cards, pot pourris, flower arrangements, stage decorations during marriages, indoor decoration and widely used during Onam, the famous Kerala festival to decorate Pookolam and Bathukamma festival in Telangana (Rathava *et al*, 2021). The flowers are rich in antioxidants, which possess many health benefits like antibacterial, antifungal, detoxifying and purifying properties and for treating high blood pressure and diabetes. The flowers are rich in betacyanin used as additives and supplements in the food industry, cosmetics and livestock feed. Because of its hardy nature, used in landscaping as flower bed, hedge and edge plant (Ehsanullah *et al*, 2021). Even though crop is gaining economic significance, but improved varieties not available to farmers for cultivation. There is an urgent need to develop high-yielding *Gomphrena* genotypes with improved quality traits. With this, the present study was conducted to evaluate *Gomphrena* genotypes for their productivity and quality characteristics.

MATERIALS AND METHODS

The present study was carried out during 2022–23 at the experimental block of the College of

Corresponding Author's Email - nagajyothichary9891@gmail.com

Table 1: *Per se* performance of Gomphrena (*Gomphrena globosa* L.) genotypes for growth and flowering parameters.

Genotype	Plant height (cm)	Number of leaves per plant	Stem girth (mm)	Plant spread N-S direction	Plant spread E-W direction	Primary branches	Secondary branches	Days to bud initiation	Days to 50 per cent flowering	Duration of flowering (days)
AGS-1	61.40	398.00	9.97	52.07	43.27	6.60	23.47	10.00	37.00	65.33
AGS-2	59.07	412.53	9.14	52.93	45.27	8.00	25.00	11.00	35.00	66.33
AGS-3	55.00	397.87	8.69	45.67	44.80	8.50	24.40	9.33	31.67	66.00
AGS-4	65.80	454.53	11.31	56.13	53.53	9.17	28.20	11.00	36.00	67.00
AGS-5	60.33	564.47	9.36	54.93	48.60	8.53	25.67	10.33	35.00	66.17
AGS-6	60.33	519.40	9.31	43.93	42.67	8.13	26.07	10.00	37.33	62.00
AGS-7	62.33	520.53	8.97	47.40	45.67	8.67	24.07	11.00	36.67	65.00
AGS-8	54.40	414.53	8.66	44.87	37.00	8.87	25.53	10.00	31.67	62.33
AGS-9	62.87	436.40	8.47	48.20	44.60	9.27	27.87	9.00	33.67	61.00
AGS-10	56.47	381.60	8.62	46.20	40.87	8.33	28.40	10.00	32.00	61.00
AGS-14	23.73	214.67	4.52	42.27	43.33	6.63	15.20	15.00	41.00	62.67
AGS-16	59.93	366.40	8.67	50.87	47.67	7.67	25.67	10.00	35.00	64.67
AGS-17	60.13	336.40	8.49	51.93	46.80	8.17	25.07	9.67	34.67	64.33
S. Em ±	0.53	0.58	0.29	0.58	0.51	0.33	0.66	0.59	0.59	0.51
C.D at 5%	1.54	1.70	0.84	1.70	1.50	0.95	1.92	1.73	1.72	1.50

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Horticulture, Bagalkot. Located in Karnataka's Northern Dry Zone, Bagalkot falls under Zone 3, Region 2 of the state's agro-climatic classification. It is situated at an altitude of 542 m above mean sea level, with coordinates of 16.18° N latitude and 75.70° E longitude. Thirteen Gomphrena genotypes collected from previous experiment at College of Horticulture, Bagalkot were used in the present study to evaluate *per se* performance of Gomphrena genotypes for productivity and quality traits in a randomized block design with three replications and the thirteen genotypes were presented in plate-1

The experimental field was prepared to a fine tilth by thoroughly plowing the soil to a depth of 30 cm. Well-decomposed farmyard manure @ 25 t/ha was evenly incorporated into the soil. The field was measured and divided into three replications of homogenous blocks of equal area and then the blocks were subdivided into plots of RCBD design. Ridges and furrows were prepared and 30 days old seedlings were planted at 30x30cm spacing. After 20 days of transplanting pinching operation was done to encourage the lateral branches. The recommended fertilizer dosage of NPK was applied at a rate of 180:60:60 kg/ha using urea, single super phosphate, and muriate of potash, respectively (Anonymous, 2020). Five plants were randomly selected from each genotype to record the observations on various growth, flowering, yield and quality parameters. Genotypes were characterized for various qualitative traits like leaf blade shape, leaf blade colour, leaf blade undulations at margin as per the Celosia UPOVA DUS guidelines (Celosia, 2002). Observations were also recorded on different growth, earliness, yield and quality traits, then the mean data was subjected to statistical analysis (INDOSTAT software).

RESULTS AND DISCUSSION

Evaluating Gomphrena genotypes is crucial to identify high-yielding genotypes, understand genetic traits for breeding programs and conserve genetic diversity of best genotypes for further research purposes. Selecting superior genotypes through evaluation helps to improve traits like flower color, size and shelf life through breeding strategies. The analysis of variance indicated highly significant differences among the genotypes for all the traits studied, primarily attributed to the genetic composition of each genotype.

Growth parameters

The *per se* performance of *Gomphrena* genotypes across various growth parameters is presented in Table 1. Among the genotypes plant height varied from 23.73 to 65.80cm.

The genotype AGS-4 had maximum plant height (65.80cm) followed by genotype AGS-9 (62.87cm) and the minimum plant height (23.73cm) was observed in AGS-14. The number of leaves per plant varies from 214.67 to 564.47. Highest leaf count was observed in genotype AGS-5 (564.47) followed by AGS-7 (520.53), while, AGS- 14 has recorded lowest number of leaves (214.67). Mean range of plant spread

Table 2. *Per se* performance of Gomphrena (*Gomphrena globosa* L.) genotypes for yield and flower quality parameters.

Genotype	Number of flowers/plant	Yield per plant (g)	Inflorescence length (cm)	Diameter of flower (cm)	Individual flower weight (g)	Shelf life (days)	Display life (days)
AGS-1	275.73	597.60	4.74	1.86	2.68	5.50	36.00
AGS-2	244.80	674.70	4.01	1.93	3.18	5.00	34.33
AGS-3	244.63	724.54	3.78	1.82	3.05	7.00	30.00
AGS-4	279.53	763.57	3.85	1.97	3.19	5.00	32.00
AGS-5	255.47	617.58	4.03	1.77	2.37	6.00	36.33
AGS-6	244.23	564.60	3.79	1.82	2.47	7.00	37.00
AGS-7	253.93	534.37	2.99	1.91	2.13	5.00	30.00
AGS-8	231.47	588.27	2.53	1.98	2.73	7.00	32.33
AGS-9	255.40	397.77	2.79	1.75	1.79	6.00	32.67
AGS-10	244.67	633.57	3.40	1.75	2.84	6.00	27.00
AGS-14	167.00	357.70	3.68	1.45	2.31	5.00	27.00
AGS-16	264.53	597.93	3.57	2.01	3.17	6.00	32.33
AGS-17	238.73	554.67	2.71	2.16	2.36	6.00	32.67
S. Em ±	0.53	0.52	0.16	0.04	0.08	0.39	0.56
C.D at 5%	1.55	1.52	0.46	0.13	0.25	1.12	1.65

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was 42.27 to 56.13cm in N-S and 37.00 to 53.53cm in E-W direction. The genotype AGS-4 had maximum plant spread (56.13cm) in North-South direction followed by AGS-5 (54.93cm), whereas AGS-14 showed minimum plant spread (42.27cm). The genotype AGS-4 had maximum spread (53.50cm) in East-West direction and it was minimum in AGS-8 (37.00cm). Number of primary branches ranged from 6.60 to 9.27. The highest number of branches (9.27) was recorded in genotype AGS- 9, which was followed by AGS-4 (9.17), lowest in AGS-1(6.60). The number of secondary branches ranged from 15.20 to 28.40. Highest branches (28.40) was recorded in AGS-10, on par with AGS-9 (27.87) and AGS-4(28.20), whereas lowest in AGS-14(15.20). The variation in vegetative parameters among genotypes may be attributed to genetic differences as well as the influence of climatic conditions during the crop period. Similar findings have been reported by Ashwini *et al*. (2019), Tarannum and Naik (2014), and Kumar *et al*. (2021) in *Gomphrena*.

The performance of *Gomphrena* genotypes for flowering parameters is presented in Table 1. The number of days required for flower bud initiation varied among the genotypes, ranging from 9 to 15 d. Genotype AGS-9 took minimum number of days (9d) and was on par with AGS-3 (9.33d) for flower bud initiation, whereas genotype AGS-14 took maximum number of days (15d). Days to 50 per cent flowering ranged from 31.67 to 41d, genotype AGS-3 and AGS-8 took minimum number of days (31.67d) and was on par with AGS-10 (32d). The genotype AGS-14 took maximum number of days (41 days). Duration of flowering ranged from 61 to 67 d on crop. Maximum duration of flowering (67 d) was noticed in genotype AGS-4 followed by AGS-2 (66.33 d) and AGS-3 (66d), genotype AGS-9 and AGS-10 had minimum of 61d each. Variation of these characters due to inherent character and by the impact of physiological factors by environment condition, as takes earlier time for transition from vegetative to reproductive stage. Similar reports were observed in marigold by Mahantesh *et al* (2018), Lohar *et al* (2018) in African marigold, Singh *et al* (2022) and Sharma *et al* (2019) in Chrysanthemum and Rathava *et al* (2021) in Gomphrena.

The average number of flowers per plant ranged from 167 to 279.53. The highest flower count per plant (279.53) was recorded in the genotype AGS-4, followed closely by AGS-1 (275.73), whereas minimum number of flowers (167.00) were recorded in AGS-14. The mean yield per plant ranged between 357.70 to 763.57g. The highest flower yield (763.57g) was reported in AGS-4 followed by AGS-3(724.54g), while lowest (357.70g) in genotype AGS-14 (Table 2). The mean flower length ranged from 2.53cm to



Plate 1. Individual flower of different Gomphrena genotypes

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4.74cm, highest inflorescence length (4.74cm) was observed in genotype AGS-1 followed by AGS-5 (4.03cm) and AGS-2 (4.01cm), whereas lowest in case of genotype AGS- 8 (2.53cm). The flower diameter had a mean value ranging from 1.45 to 2.16cm. Genotype AGS-17 had recorded maximum flower diameter of 2.16cm followed by AGS-16 (2.01cm) and AGS-4 (1.97cm), minimum in case of AGS-14 (1.45cm). The mean of individual flower weight varied from 1.79 to 3.19g among the genotypes. The genotype AGS-4 had recorded maximum flower weight (3.19g) which was on par with AGS-2 (3.18g) and AGS-16 (3.17g), whereas the genotype AGS-9 had recorded the minimum individual flower weight (1.79g). The mean ranges from 5 to 7days for shelf life of flower. The flowers of genotype AGS- 3, 6 and 8 remained fresh for longer days (7 days), whereas less shelf life (5 days) was recorded in AGS- 2, 4, 7 and 14. The mean number of days flower remained fresh in the field on the plant ranged from 27 to 37days. The genotype AGS-6 had maximum display life of 37days followed by AGS-5 (36.33days), whereas AGS-10 and AGS-14 had less display life of 27 days each (Table 2). Similar reports were reported by Mehta (2022) in African marigold, Srinivas and Rajasekharan (2019) in marigold.

Variation observed for various qualitative parameters among the Gomphrena genotype presented in table 3. Based on plant growth habit, Gomphrena genotypes were grouped into 2 groups. The genotypes AGS-1,2,3,4,5,6,8,9,10,17,14 had shown spreading habit and AGS-8, 9 and 10 exhibited upright nature. The seed colour of all the genotypes shown bluish white colour group with colour code N 155 A. RHS colour chart was used to differentiate the flower colour of 13 genotypes of Gomphrena, based on the visual observations, genotype AGS-1, AGS-5, AGS-9 and AGS-17 had shown Strong reddish purple group with N 78 A colour code. The genotype AGS-2 belongs to strong purplish pink group with code 63 C. The genotype AGS-4 and AGS-6 belongs to light purplish pink code 63 D. The genotype AGS-3, AGS-7, AGS-10 and AGS-16 had shown pale yellow green colour with code 155 A. The genotype AGS- 8 exhibited colour code NN 74 D as strong reddish purple group. The genotype AGS- 14 had moderate red with N 45A colour code. The leaf characters like leaf blade shape and colour and leaf blade undulations at margin were examined based on Celosia DUS characterization. The genotypes AGS-1, 2, 4, 5, 8, 9 had shown short acuminate leaf blade shape, while AGS-3, 6, 7, 10, 14, 16 and 17 had shown acute blade shape. For leaf blade colour, all the genotypes shown reddish purple colour with undulations at margins of leaf (Plate 2). The variation w.r.t to flower colour was observed among the Gomphrena genotypes and were majorly grouped into purple, red, white and pink colours. Growth habit has showed that all the Gomphrena genotypes were majorly grouped into upright and spreading types. Similar findings were reported by Kumar *et al*. (2021) in Gomphrena.

CONCLUSION

It can be concluded that analysis of variance revealed presence of significant variation for all traits studied among the Gomphrena genotypes. Genotype

Table 3. Variability for qualitative parameters in Gomphrena (*Gomphrena globosa* L.) genotypes.

Genotype	Growth habit	Flower colour group	Flower colour code	Seed colour group	Seed colour code	Leaf blade shape	Leaf blade colour	Leaf blade undulation at margins
AGS-1	Spreading	Strong reddish purple	N 78 A	Bluish white	N 155 A	Short acuminate	Reddish purple	Present
AGS-2	Spreading	Strong purplish pink	63 C	Bluish white	N 155 A	Short acuminate	Reddish purple	Present
AGS-3	Spreading	Pale yellow green	155 A	Bluish white	N 155 A	Acute	Reddish purple	Present
AGS-4	Spreading	Light purplish pink	63 D	Bluish white	N 155 A	Short acuminate	Reddish purple	Present
AGS-5	Spreading	Strong reddish purple	N 78 A	Bluish white	N 155 A	Short acuminate	Reddish purple	Present
AGS-6	Spreading	Light purplish pink	63 D	Bluish white	N 155 A	Acute	Reddish purple	Present
AGS-7	Spreading	Pale yellow green	155 A	Bluish white	N 155 A	Acute	Reddish purple	Present
AGS-8	Upright	Strong reddish purple	NN 74 D	Bluish white	N 155 A	Short acuminate	Reddish purple	Present
AGS-9	Upright	Strong reddish purple	N 78 A	Bluish white	N 155 A	Short acuminate	Reddish purple	Present
AGS-10	Upright	Pale yellow green	155 A	Bluish white	N 155 A	Acute	Reddish purple	Present
AGS-14	Spreading	Moderate red	N 45 A	Bluish white	N 155 A	Acute	Reddish purple	Present
AGS-16	Spreading	Pale yellow green	155 A	Bluish white	N 155 A	Acute	Reddish purple	Present
AGS-17	Spreading	Strong reddish purple	N 78 A	Bluish white	N 155 A	Acute	Reddish purple	Present

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AGS-4 identified as top performing genotype for yield (763.57g) and yield contributing traits, that shows its superiority followed by AGS-3 (724. 54g) and AGS-5 (617.58g), which can be further exploited for crop improvement programme. The genotypes AGS-8, AGS -9 and AGS -10 can be used in landscaping as hedge plant as they exhibited upright growth habit, which is very much useful in creating mobility in garden by attracting pollinators.

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Plate 2. Morphological variation of leaf

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