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Characterization and petal color analysis of Gerbera cultivars

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ABSTRACT

Breeders and Researchers need information for selecting and improving gerbera flower as promising cut flowers through flower color analysis. This experiment was accomplished to accurately define the different flower color cultivar and analysis of flower color of gerbera in the Horticulture farm of Sher-e-Bangla Agricultural University during the period of January, 2017 to June, 2017. Fourteen gerbera cultivars were used in this experiment arranged in Randomized Complete Block Design with three replications. The gerbera cultivars have been classified based on peduncle length and diameter, receptacle diameter, ray floret diameter, trans floret diameter, disc diameter, flower head type, disc color, flower shape, flower per plant and floret color following UPOV authorized guidelines. The color of the gerbera cultivars were definitely measured and expressed through L (lightness), a* and b* (two Cartesian coordinates) including C* and hab (Chroma & Hue angle) based on CIELab scale. Classification and variation in petal color attributes presented in tables and plates that may be used for further research to improve the flower sector.*

***Key Words**: Gerbera, CIELab, UPOV and Colorimeter*

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I. Introduction

Flowers have been regarded as the icon of beauty and food for our sight. Flower boosts the visual sense of human beings and meets the requirement of heart feelings. Flowers have not only aesthetic purposes also have public, financial significance. Floriculture is an important profitable enterprise and a multibillion dollar industry that plays a role to contribute GDP in the agriculture sector. Flower demand is increasing day by day and simultaneously the land under flower cultivation and the total yield of flower is also increasing to reach about Taka 1200 core and day by day the flower market is boosted up return (Rakibuzzaman et al., 2018). Currently, the annual sale of flower sector in Bangladesh is more than Tk. 1000 million. Approximately about 100,000 to 120,000 individuals are either directly or ultimately associated with floriculture industry (Hussain and Anwar, 2011). Among different flowers, contribution of market share of gerbera flower is only 0.64 percent and the retail revenue was 0.6 million USD (USAID, 2014). There are a lot of options why this kind of popular flower

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market share and production place is still far away from national demand. Our farmers have to collect seedling from foreign country, our breeders and breeders are still in conducting research, having no implementation to farmer's field.

Now a days, our public demand is increasing towards gerbera flowers because gerbera flowers have lots of colors like violet, pink, white, and various bicolor and presented dual and semi-double blooming with shelf life. Flower color is an important breeding objective in gerbera and many varieties have been bred to obtain desirable color types (Singh et al., 2011).

However, very few research works related to development and place production of Gerbera have been carried out in our country and there is still lack of hybrid varieties. Local varieties had lower yields than hybrids, some hybrids are poor in quality, some were best in both quality and quantity and some hybrids presented similar yields (Yama et al., 2006). According this consideration, researchers and breeders should conduct study to observe the varietal activities of gerbera in Bangladesh. Therefore, this study was conducted to classify fourteen gerbera cultivars under the study into different grouped following UPOV standard and measurement of petal color with colorimeter.

II. Materials and Methods

Description of the experiment site

The experiment was conducted at the Horticulture research field of Sher-e-Bangla Agricultural University, Dhaka, from January, 2017 to June, 2017. The location of the site is $23^0$74' N latitude and $90^0$35' E longitudes with an elevation of 8.2 meter from sea level in Agro-Ecological Zone of Madhupur Tract (AEZ No. 28).

Experiment design and treatment

The field experiment was conducted in Randomized Complete Block Design following three replications. Fourteen gerbera cultivars: V_1 (Sweet pink), V_2 (Yellow with black centre), V_3 (Reddish orange), V_4 (Red), V_5 (White), V_6 (Purplish pink), V_7 (Yellow), V_8 (Creamy yellow), V_9 (Magenta), V_{10} (Red with black centre), V_{11} (Bright orange), V_{12} (Magenta pink), V_{13} (Orange) and V_{14} (Yellow with greenish centre) were used in this experiment collected from Pune, India.

Classification of gerbera cultivars and petal color measurement

The purpose of this research work was to study the flower characteristics and petal coloration of different Gerbera cultivars grown in Bangladesh's condition. Variation in the studied parameters was observed among the cultivars due to their different genetic makeup. Accurate measurement of the variation in petal color attributes was conducted using CIELab colorimeter. The gerbera cultivars have been classified based on peduncle length and diameter, receptacle diameter, ray floret diameter, trans floret diameter, disc diameter, flower head type, disc color, flower shape, flower per plant and floret color. Accurate measurement of the variation in petal color attributes was measured using CIELab colorimeter. The colors of the gerbera cultivars were definitely measured and expressed through L* (lightness), a* and b* (two Cartesian coordinates) including C* and hab (Chroma & Hue angle) based on CIELab scale with standard observer 100 and standard illumination D65 using precision colorimeter IWAVE WF32.

III. Results and Discussion

Classification of Gerbera cultivars

Classification of Gerbera according to the peduncle length

Gerbera cultivars were divided into three classes according to the length of peduncle following the UPOV standard.

Short: Six cultivars of gerbera among fourteen cultivars under study showed short length of peduncle (40-45 cm). V_2, V_5, V_7, V_9, V_{12} and V_{14} belong to this category.

Medium: Among the studied gerbera cultivars five showed medium peduncle length (45-50 cm). V_3, V_4, V_6, V_8 and V_{13}belong to this class.

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Long: Three cultivars among the fourteen gerbera cultivars under study showed higher peduncle length. Above 50 cm of petiole length was found in case of V_1, V_{10}& V_{11}.

Table 01. Classification of Gerbera according to the peduncle length

Category	Length ranges (cm)	Cultivars
Short	Less than 45	V_2, V_5, V_7, V_9, V_{12}, V_{14}
Medium	45-50 cm	V_3, V_4, V_6, V_8, V_{13}
Long	Above 50 cm	V_1, V_{10}, V_{11}

Table 02. Classification of Gerbera according to the peduncle diameter

Category	Breadth ranges (mm)	Cultivars
Weak	Less than 4.5	V_5, V_{13}
Medium	4.5-5.0	V_2
Strong	5.0-5.5	V_6, V_7, V_8, V_9, V_{10}, V_{11}
Very strong	Above 5.5	V_1, V_3, V_4, V_{12}, V_{14}

Classification of Gerbera according to the peduncle diameter
The total gerbera cultivars under study were divided into four classes according to the peduncle diameter.

Weak: Two cultivars (V_5 & V_{13}) of gerbera among fourteen cultivars under study showed weak performance (less than 4.5 mm).

Medium: V_2 cultivars of gerbera showed medium peduncle diameter (4.5 - 5.0 mm).

Strong: V_6, V_7, V_8, V_9, V_{10}, V_{11}showed strong peduncle diameter (5.0 - 5.5 mm).

Very Strong: V_1, V_3, V_4, V_{12} & V_{14} showed very strong peduncle diameter (above 5.5 mm).

Classification of Gerbera according to the receptacle diameter
Receptacle of gerbera cultivars was divided into three classes according to the receptacle diameter following the UPOV standard (Table 03).

Small: V_5 &V_{12} study showed small receptacle diameter.

Medium: V_1, V_2, V_3, V_4, V_7, V_9, V_{11}, V_{13} & V_{14} understudy showed medium receptacle diameter.

Large: Three cultivars of gerbera among fourteen cultivars under study showed large receptacle diameter. V_6, V_8 & V_{10} belong to this category.

Classification of Gerbera according to the ray floret diameter
Head of gerbera cultivars was divided into three classes according to the ray floret diameter following the UPOV standard (Table 03).

Small: Three cultivars showed small ray floret diameter (Less than 90 mm) where V_5, V_7 & V_8 belong to this category.

Medium: V_1, V_2, V_4, V_9, V_{10}, V_{11}, V_{12}, V_{13} & V_{14} belong to medium ray floret diameter (90-95 mm).

Large: Two cultivars among the fourteen gerbera cultivars under the study showed large ray floret diameter (Above 95 mm) where, V_3 & V_6 belong to this category.

Classification of Gerbera according to the trans floret diameter
Head of gerbera cultivars was divided into three classes according to the trans floret diameter following the UPOV standard (Table 03).

Small: V_1, V_2, V_5, V_9, V_{10}, V_{11}, V_{12}, V_{13} & V_{14} expressed small trans floret diameter (less than 40 mm).

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Medium: medium trans floret diameter (40-50 mm) found in V_3 & V_4 cultivar.

Large: Three cultivars viz. V_6, V_7 & V_8 belong to this category (above 50 mm).

Classification of Gerbera according to the disc diameter
Head of gerbera cultivars was divided into three classes according to the disc diameter following the UPOV standard (Table 03).

Small: Four cultivars among the fourteen gerbera cultivars under the study showed small disc diameter (Less than 15 mm) where V_2, V_3, V_5 & V_8 belong to this category.

Medium: Eight cultivars among the fourteen gerbera cultivars under the study showed medium disc diameter (15-20 mm) where V_4, V_7, V_9, V_{10}, V_{11}, V_{12}, V_{13} & V_{14} belong to this category.

Large: V_1 & V_6 showed large disc diameter (above 20 mm).

Table 03. Classification of Gerbera according to the receptacle diameter, ray floret diameter, trans floret diameter and disc diameter

Category	Receptacle diameter	Ray floret diameter	Trans floret diameter	Disc diameter
Small	V_5, V_{12}	V_5, V_7, V_8	V_1, V_2, V_5, V_9, V_{10}, V_{11}, V_{12}, V_{13}, V_{14}	V_2, V_3, V_5, V_8
Medium	V_1, V_2, V_3, V_4, V_7, V_9,V_{11}, V_{13}, V_{14}	V_1, V_2, V_4, V_9, V_{10}, V_{11}, V_{12}, V_{13}, V_{14}	V_3, V_4	V_4, V_7, V_9, V_{10}, V_{11}, V_{12}, V_{13}, V_{14}
Large	V_6, V_8, V_{10}	V_3, V_6	V_6, V_7, V_8	V_1, V_6

Here, V_1 (Sweet pink), V_2 (Yellow with black centre), V_3 (Reddish orange), V_4 (Red), V_5 (White), V_6 (Purplish pink), V_7 (Yellow), V_8 (Creamy yellow), V_9 (Magenta), V_{10} (Red with black centre), V_{11} (Bright orange), V_{12} (Magenta pink), V_{13} (Orange) and V_{14} (Yellow with greenish centre)

Classification of Gerbera according to the flower head type
Head of gerbera cultivars was divided into three classes according to the flower head type following the UPOV standard (Table 04).

Single: Varieties having single whorl of petals are considered as single type flower heads in accordance with UPOV. Two cultivars among the fourteen cultivars of gerbera under this study were found single type. V_9 & V_{14} belong to this category.

Semi-double: Varieties having one whorl of ray florets with one small and irregular whorl of trans florets are considered as semi-double type flower heads. V_1, V_2, V_3 & V_{12} were this category.

Double: Varieties having one whorl of ray florets with one large and regular whorl of trans florets are considered as double type flower head in accordance with UPOV. Eight cultivars among the fourteen cultivars of gerbera under this study were found double type. V_4, V_5, V_6, V_7, V_8, V_{10}, V_{11} & V_{13} belong to this category.

Table 04. Classification of Gerbera according to the flower head type

Category	Cultivars
Single	V_9, V_{14}
Semi-Double	V_1, V_2, V_3, V_{12}
Double	V_4, V_5, V_6, V_7, V_8, V_{10}, V_{11}, V_{13}

Classification of Gerbera according to the disc color
According to the disc color gerbera cultivars was divided into three classes (Table 05 and Plate 01).

Dark: Six cultivars among the studied fourteen gerbera cultivars were found dark color disk. V_1, V_2, V_3, V_9, V_{10} & V_{12} belong to this category.

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Greenish Yellow: Four cultivars among the studied fourteen gerbera cultivars were found greenish yellow color disk. V_4, V_5, V_8 & V_{11} belong to this category.

Same as Floret Color: Four cultivars among the studied fourteen gerbera cultivars were found same as floret color disk. V_6, V_7, V_{13} & V_{14} belong to this category.

Table 05. Classification of Gerbera according to the disc color

Category	Cultivars
Dark	V_1, V_2, V_3, V_9, V_{10}, V_{12}
Greenish yellow	V_4, V_5,V_8, V_{11}
Same as floret color	V_6, V_7, V_{13}, V_{14}

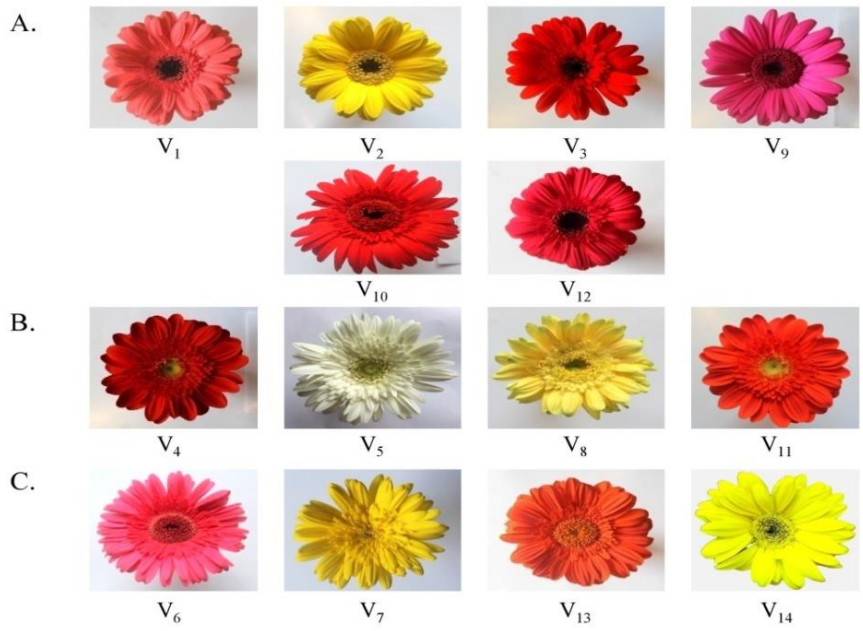
Table 06. Classification of Gerbera according to the floret shape

Category	Cultivars
Pointed	V_5, V_6,V_7,V_{10}
Oval	V_1, V_2, V_3, V_4, V_8, V_9, V_{11}, V_{12}, V_{13}, V_{14}

Classification of Gerbera according to the floret shape
Head of gerbera cultivars was divided into two classes based on the shape of the floret following the UPOV standard (Table 06).

Pointed: Four cultivars (V_5, V_6, V_7 and V_{10}) were pointed floret type belong to this category.

Oval: Among the studied fourteen gerbera cultivars V_1, V_2, V_3, V_4, V_8, V_9, V_{11}, V_{12}, V_{13} & V_{14}were found oval type of floret, belong to this category.



Here,
V_1: Sweet pink
V_2: Bright yellow
V_3: Reddish orange
V_4: Bright red
V_5: white
V_6: Purplish pink
V_7: Bright yellow
V_8: Creamy yellow
V_9: Purple magenta
V_{10}: Deep red
V_{11}: Bright orange
V_{12}: Magenta
V_{13}: Bright orange
V_{14}: Bright yellow

Plate 01. Classification of Gerbera according to the disc color.

Table 07. Classification of Gerbera according to the no. of flower per plant

Category	Cultivars
Poor	V_5, V_9, V_{12}
Medium	V_2, V_3, V_7, V_{13}, V_{14},V_{11}
Good	V_1, V_6, V_{10}, V_4, V_8

Classification of Gerbera according to the no. of flower per plant
Gerbera cultivars divided into three classes according to the no of flower per plant (Table 07).

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Poor: Three cultivars among the studied fourteen gerbera cultivars were showed poor performance in case of no of flower production. V_5, V_9 & V_{12} belong to this category.
Medium: Six cultivars among the studied fourteen gerbera cultivars were showed medium performance in case of no of flower production. V_2, V_3, V_7, V_{11}, V_{13} & V_{14} belong to this category.

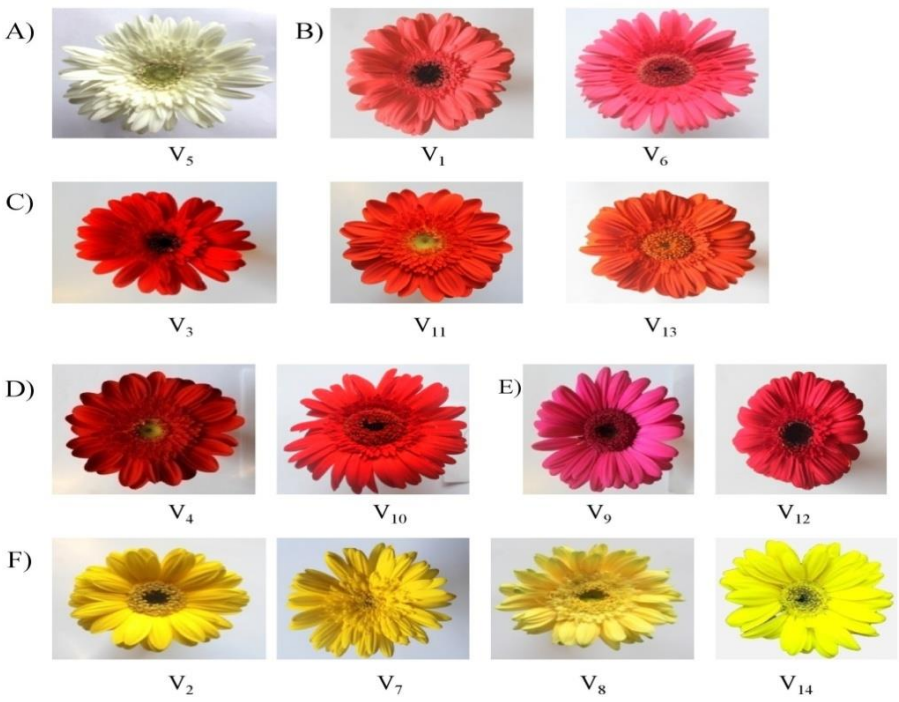
Good: Five cultivars among the studied fourteen gerbera cultivars were showed good performance in case of no of flower production. V_1, V_4, V_6, V_8 & V_{10} belong to this category.

Classification of Gerbera according to the floret color
On the basis of number of colors present in petals, the studied gerbera cultivars can be classified into two groups following UPOV standard.

a. **Single color:** All cultivars under study were single color flower (V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_8, V_9, V_{10}, V_{11}, V_{12}, V_{13}, and V_{14}).
b. **Bicolor:** There was no bicolor variety observed under this study.

The studied gerbera cultivars were further classified into six groups according to their visual color. For visual distinction color was measured by observation (Table 08 and Plate 02).

i. **White:** V_5 was found to have white color.
ii. **Pink:** Two cultivars found pink color where V_1 was sweet pink and V_6 was purplish pink color.
iii. **Red:** Two cultivars found red color. V_4 was bright red and V_{10} was deep red.
iv. **Orange:** Three cultivars such as V_3 reddish orange, V_{11}bright orange and V_{13} orange in color.
v. **Yellow:** V_2, V_7, V_{14} were bright yellow in color and V_8 was creamy yellow color.
vi. **Magenta:** Two cultivars like V_9 was purplish magenta and V_{12} was magenta.



Here,
V_1: Sweet pink
V_2: Bright yellow
V_3: Reddish orange
V_4: Bright red
V_5: white
V_6: Purplish pink
V_7: Bright yellow
V_8: Creamy yellow
V_9: Purple magenta
V_{10}: Deep red
V_{11}: Bright orange
V_{12}: Magenta
V_{13}: Bright orange
V_{14}: Bright yellow

Plate 02. Classification of Gerbera according to visual observation (A: White, B: pink, C: Orange, D: Red, E: Magenta and F: Yellow).

Colorimetric measurement of gerbera cultivars under study using CIELab
The colorimetric measurement of the fourteen gerbera cultivars under study was conducted using a precision colorimeter IWAVE WF32 (Shenzhen Wave) and L* (lightness), a* and b* (two Cartesian coordinates) including C* and *hab* (Chroma & Hue angle) based on CIELab scale with standard observer 100 and standard illumination D65 (McGuire, 1992). The respective data for each of the lines were presented in Table 08.

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Table 08. Variations in petal color attribute in different Gerbera cultivars

Cultivars	L*	a*	b*	C	h_{ab}	petal color	Illustration
V_1	51.45	57.91	22.45	62.1	21.19	Sweet pink	
V_2	82.27	8.92	89.9	90.35	84.33	Bright yellow	
V_3	29.58	48.04	39.79	62.38	39.63	Reddish orange	
V_4	37.98	53.73	39.72	66.82	36.47	Bright red	
V_5	94.04	-2.34	16.55	16.71	98.05	white	
V_6	49.28	54.23	-4.18	54.39	355.59	Purplish pink	
V_7	83.73	10.39	87.21	87.83	83.21	Bright yellow	
V_8	85.22	4.3	48.5	48.69	84.94	Creamy yellow	
V_9	39.42	54.08	18.1	57.03	18.5	Purple magenta	
V_{10}	37.33	54.9	41.81	69.01	37.29	Deep red	
V_{11}	40.47	50.8	47.98	69.88	43.36	Bright orange	
V_{12}	39.97	57.69	18.17	60.48	17.49	Magenta	
V_{13}	43.32	54.96	56.52	78.83	45.8	Bright orange	
V_{14}	80.48	10.38	88.61	89.21	83.32	Bright yellow	

Here, V_1 (Sweet pink), V_2 (Yellow with black centre), V_3 (Reddish orange), V_4 (Red), V_5 (White), V_6 (Purplish pink), V_7 (Yellow), V_8 (Creamy yellow), V_9 (Magenta), V_{10} (Red with black centre), V_{11} (Bright orange), V_{12} (Magenta pink), V_{13} (Orange) and V_{14} (Yellow with greenish centre).

IV. Conclusion

From the result and discussion, it can be concluded that the gerbera cultivars under study showed significant variation in the studied characteristics. Through the present study, the studied gerbera cultivars were categorized based on the different morphological parameters and varietal performance for the researchers and farmers to recommend better cultivars and improve production technology.

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