

Vegetative Growth and Flowering Behavior of Cockscomb (*Celosia cristata* L.) in Response to Sowing Dates

Tanveer F Miano^{1*}, Atiq U R Baloch¹, Mahmooda Buriro², Asma Miano², Tahseen F Miano³ and Muhammad Farooq³

¹Department of Horticulture, Sindh Agriculture University, Tando Jam, Pakistan

²Department of Agronomy, Sindh Agriculture University, Tando Jam, Pakistan

³FST, Sindh Agriculture University, Tando Jam, Pakistan

Abstract

The study was carried out during the year 2015 to investigate vegetative growth and flowering behavior of Cockscomb (*Celosia cristata* L.) in response to sowing dates. Treatments included three sowing dates ($S_1=5^{\text{th}}$ March, $S_2=20^{\text{th}}$ March and $S_3=4^{\text{th}}$ April) and two varieties (Cockscomb Amigo Red and Cockscomb Amigo Orange). The results revealed significant difference for vegetative and flowering traits of Cockscomb varieties in response to sowing dates. However, non-significant difference was observed among all observed indices within Cockscomb varieties. On the basis of present findings the crop sown on 4th April took minimum days for seed germination (3.41 days) for both varieties of Cockscomb. Cockscomb Amigo Red took 23.22 cm plant height, 25.30 number of leaves per plant, 20.38 days to 1st flower, 3.73 cm flower diameter, 21.59 g of single flower weight and 5.89 days to flower persistence. Likewise the variety Cockscomb Amigo Orange attained 25.42 cm plant height, 21.16 leaves per plant, 35.95 days to 1st flower, 4.28 cm flower diameter, 32.45 g flower weight, 8.05 days to flower persistence. Planting date 4th April with variety Amigo Orange proved better for most of the characteristics than Amigo Red.

Keywords: Cockscomb; Sowing dates; Vegetative; Flowering behavior

Introduction

Cockscomb (*Celosia cristata* L.), belongs to Amaranthaceae that is mostly grown for use in landscape, regardless there are some hybrid land racers commercially used as cut flowers too. Its flower resemblance to rooster head for which it is termed as Cockscomb [1]. In Pakistan, Cockscomb is locally termed as *Kalgha* and is sown during March-April and September to January as a beautiful ornamental plant and cut flowers. Due to versatile flower colors *C. cristata* has a great economic value as a cut flower through-out the world. Its demand as a cut flower has been on inclined because of attractive shapes and better vase life. Variant environmental conditions of Sindh (Pakistan) have made the Cockscomb cultivation difficult [1]. Date of sowing has a great fluctuation on growth and quality of *Celosia* as well as tuberose, vegetative and flowering behavior these annuals might be upgraded through changing seeding time [2].

More numbers of spikes per plant (7.65) had been noted when sown during April to May while maximum weight of single flower (5.09 g) per plant was obtained from March and April plantings [3]. Sowing date of 15th January took maximum days to flower (110 days) in Cockscomb cv. Bombay. Cockscomb sown early during 1st September to 1st December had 94-95 day to produce flower. 1st May and 1st June sowing took 55 days to flower, which was thirteen days earlier than other dates, Most of annual flowering species like Zinnia, Sunflower, Marigold, Cockscomb and Cosmos set flowered at the end of November to April [4]. Further research on influence of date of planting on Cockscomb cultivars reported by Rahmann and Aksoy concluded better performance on March 20 than May 1 or April 10 [5]. Better performance and flower display was achieved (16 days) when seeds were sown on April 01 [6,7]. Cockscomb genotypes performed well when grown from 24-31 March or April 1-7 [8].

Date of sowing for Cockscomb has a prominent place in environmental distress countries like Pakistan, where climatic conditions vary greatly throughout the country further it has been reported that late planting decreased Cockscomb display by 58.2%

[9]. To enhance consumer's attraction and better sell income, flower size plays a significant contribution. Its production under unfavorable climate has been neglected for that no research in the past has been initiated to explore this natural gift, therefore, present research has been initiated to find out the most appropriate planting date on Cockscomb to commercialize its vegetative quality and flower production under the subtropical environment of Sindh, Pakistan. Present study has been planned to investigate the proper sowing date for Cockscomb for good growth, best flower quality and maximum production under environmental conditions of Tando Jam to promote this beautiful ornamental cut flower.

Materials and Methods

The experiment was conducted during spring 2015 at Horticulture Garden, Department of Horticulture, Sindh Agriculture University Tando Jam. The experiment was laid out in a three replicated Completely Randomized Design (CRD). In the present research work seeds of two Cockscomb varieties (Cockscomb Amigo Red and Cockscomb Amigo Orange) were sown at different dates ($S_1=5^{\text{th}}$ March, $S_2=20^{\text{th}}$ March and $S_3=4^{\text{th}}$ April) with the interval of 15 days in the earthen pots then seedlings at 2 to 4 leaf stage were transplanted in the separate earthen pots. Observations recorded on days to seed germination which were counted after seed sowing till its emergence, plant height (cm) was measured when plant came to flower formation stage, leaves per plant were counted visually at the time of plant maturity, days to 1st flower were counted from seed sowing to flower emergence, flower diameter

***Corresponding author:** Tanveer F Miano, Department of Horticulture, Sindh Agriculture University, Tando Jam, Pakistan, Tel: 09980371096; E-mail: drtanveerfmiano@yahoo.in

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(cm) was randomly recorded with this formula: $D=4/3 \pi r^2$, weight of single flower (g), days to flower persistence were observed from flower opening till it remained in fresh condition on plant.

The collected data was subjected to statistical analysis using Statistix 8.1 computer software [10].

Results and Discussion

Days to seed germination

The results regarding the days taken to seed germination of Cockscomb varieties as influenced by sowing dates has been demonstrated in Table 1. The analysis showed significant ($P<0.05$) influence of sowing dates on the seed germination of Cockscomb; it has been found from the fallouts that the Cockscomb plant took minimum days to seed germination (3.41 days) when planted on 4th April, However, statistically 4th April and 20th March results are at par (3.54 and 3.43 days) and 5th March that resulted in maximum days to seed germination of 7.91 and 7.83 days, respectively within both varieties. The treatment interaction indicated that 4th April of sowing x varieties resulted in minimum days to seed germination (3.41), this variation might be due to environmental conditions where temperature was high (33°C) in the month of April as compared to March, however, genetically the varietal response remained same. Present study is in accordance with Akinbode et al., who reported that the germination was prompt in seeds of *Amaranthus cruentus* (3.22 days) and *Corchorus olitorius* (4.44 days) under late sowing 25th March while the seeds of *D. regia* germinated more on 10th April. Whereas, germination of *Celosia argentea* and *Abelmoschus esculentus* at early sowing 15th February had no main effect [11].

Plant height (cm)

The results regarding the plant height of Cockscomb as inferences by sowing dates have been presented in Table 1. The analysis submitted significant ($P<0.05$) effect of sowing dates on the Cockscomb height; It has been cleared from the data that the Cockscomb Ambigo Orange plant produced supreme tallness (25.42 cm) when seeded on 4th April, followed by Ambigo Red (23.22 cm). While 20th March and 5th March plantation produced minimum height between two varieties that might be due to prevailing low temperature (28°C) and some cloudy weather. The treatment interaction indicated that 4th April sowing x variety Cockscomb Amigo Orange resulted in maximum plant height (25.42 cm), while 5th March sowing x variety Cockscomb Amigo Red lead to in lower most tallness (9.08 cm). Plant height of Cockscomb was mainly affected by the temperature and RH presented during April to June (33-35°C and 70-75%). These results are supported by Zeb et al., who observed plant length of 47 cm in gladiolus when planted on

Varieties	Sowing dates	Seed germination (days)	Plant height (cm)	Leave per plant
Cockscomb Amigo Red	5 th March	7.91 a	9.08 c	9.06 c
	20 th March	3.54 b	13.11 b	16.73 b
	4 th April	3.41 b	23.22 a	25.30 a
Cockscomb Amigo Orange	5 th March	7.83 a	10.19 b	10.68 c
	20 th March	3.43 b	11.87 b	17.73 b
	4 th April	3.41 b	25.42 a	21.16 a
SE ±	-	0.5558	0.9683	1.0156
LSD 0.05	-	0.7861	1.3693	1.4363

Table 1: Seed germination, plant height (cm) and leaves plant¹ of Cockscomb varieties in response to sowing dates.

15 September as mid planting time [12]. Obe et al., revealed that the sowing dates is one of the methods employed to improve the sprouting %, growth and flower traits of major ornamentals [13].

Leave per plant

The results regarding the leaves per plant of Cockscomb as demonstrated by varieties and sowing dates have been presented in Table 1. The analysis suggested significant ($P<0.05$) effect of dates on the leave of Cockscomb varieties which explicitly depicts that Cockscomb Ambigo Red plant produced many leave per plant (25.30) when sown on 4th April, tracked by crop planted on 20th March and 5th March that bring about in average leave per plant of 16.73 and 9.06, respectively. Variety Cockscomb Amigo Orange resulted in maximum number of leave (21.16), while 5th March resulted in lowest number of leave per plant (10.68). Production of maximum leave was directly correlated with plant height which was mostly favored by temperature during development. These findings are in consistence with [12,14].

Days to 1st flower

The results regarding the days to 1st flower of Cockscomb as influenced by varieties and sowing dates are shown in Table 2. The analysis concluded significant ($P<0.05$) results of sowing dates on the days to 1st flower of Cockscomb varieties It is apparent from the fallouts that the Cockscomb Amigo Red produced flowers within minimum time (20.38 days) as compared to the sowing date 5th March which took maximum days to 1st flower (60.77 days), In case of variety Cockscomb Amigo Orange the days to 1st flower was markedly minimum (35.95 days) on 4th April sowing. Present variation might be due to environmental changes and particularly the day temperature and Relative Humidity (33-35°C, RH=70-75%) that triggered florigen hormone to produce flowers at earliest as compared to March sowing dates. These findings are in consistence with scientists [12,14,15]. who found that plants sown above optimum temperature may produce reduced flowers with maximum time (60 days). Plants took 99 days to flower in early sowing dates 1st and 15th March and 1st April. Flowering time was reduced (79-80 days) in subsequent sowing dates i.e., from 15th April to 15th May. However, it increased significantly (July showing 85 days (15th June) as confirmed by Baloch et al. [16].

Flower diameter (cm²)

The results relating to the flower diameter of Cockscomb varieties in terms of sowing dates are accessible in Table 2. The analysis was significant ($P<0.05$) on the effect of sowing dates on flower diameter of Cockscomb varieties. It is assumed from the data that the Cockscomb Amigo Orange produced maximum flower diameter (4.28 cm²) when the seeds were put into soil on 4th April, monitored by seeds planted on 20 March as well as 5th March that produced in minimum flower diameter of 1.39 and 0.44 cm², respectively. In case of Cockscomb

Varieties	Sowing dates	Days to 1 st flower	Flower diameter (cm ²)
Cockscomb Amigo Red	5 th March	60.77 a	0.03 c
	20 th March	41.50 b	1.65 b
	4 th April	20.38 c	3.73 a
Cockscomb Amigo Orange	5 th March	54.97 a	0.44 c
	20 th March	41.82 b	1.39 b
	4 th April	35.95 c	4.28 a
SE ±	-	6.3398	0.1592
LSD 0.05	-	8.9658	0.2251

Table 2: Days to 1st flower and flower diameter (cm) of Cockscomb varieties in response to sowing dates.

Amigo Red having maximum flower diameter of 3.73 cm² on 4th April date, while minimum diameter 0.03 cm² was noted on 5th March sowing date. The treatment interaction indicated that 4th April sowing x varieties resulted in maximum flower diameter while 5th March sowing X varieties resulted in less flower diameter in between varieties. Increase in flower diameter is mainly due to environmental factors and genetic makeup of the variety. In addition, planting dates had a significant main effect on the seasonal average flower diameter of Cockscomb. Although pairwise comparisons revealed that the effect involved only two means, 4.28 cm² for the May planting and 3.67 cm² for the April seeding [14]. Planting from May to July might results reduced growth and immature flowers which affected on later flower formation that could be due to high temperature exposure or remaining in packs or flats too long in the spring when planted too early [17].

Weight of single flower (g)

The results for the single flower weight of Cockscomb under varieties and sowing dates have been demonstrated in Table 3. The analysis suggested significant (P<0.05) influence of sowing dates on the weight of single flower of Cockscomb varieties. It is evident from the results that the Cockscomb Amigo Orange produced markedly extreme weight of single flower (32.45 g) when the seeds was sown on 4th April, followed by crop sown on 20th March and 5th March that yielded an average flower weight of 18.59 and 11.17 g, respectively. This variation in results was highly due to increase in temperature during April (33-35°C) which was correlated with maximum flowering traits of varieties. In case of Cockscomb Amigo Red weight of single flower was maximum (21.59 g) than other sowing dates, 5th March produced less weight of flower (10.45 g). The treatment interaction indicated that 4th April sowing x varieties Cockscomb Amigo Orange resulted in maximum single flower weight (32.45 g), while 5th March sowing x variety Cockscomb Amigo Red resulted in lowest weight of flower (10.45 g). Zeb et al. reported that 44.29 g of flower weight was obtained when sown on late April [12]. Ismail et al. observed that date of planting highly influenced the vegetative and flowering parameters of *Tagetes* [18]. Baloch et al. found that when Cockscomb sown early (Sept-December) flower weight (5.67 g) reduced drastically under low temperature [16]. Blanchard and Runkle found that plants sown above optimum temperature might have produced reduced flowers [15].

Days to flower persistence

The results regarding the days to flower persistence of cockscomb as influenced by varieties and sowing dates are existing in Table 3. The analysis yielded significant (P<0.05) data on sowing dates for the days to flower persistence within Cockscomb varieties. The aforementioned is evident from the outcomes of data that the Cockscomb Amigo Orange persisted flowers for many days on the plant (8.05 days) when sown on 4th April, followed by Amigo Red, where, the days to flower persistence

Varieties	Sowing dates	Flower weight (g)	Flower persistence days)
Cockscomb Amigo Red	5 th March	10.45 c	0.59 b
	20 th March	17.10 b	4.30 a
	4 th April	21.59 a	5.89 a
Cockscomb Amigo Orange	5 th March	11.17 c	0.74 c
	20 th March	18.59 b	2.36 b
	4 th April	32.45 c	8.05 a
SE ±	-	3.7221	1.3357
LSD 0.05	-	5.2638	1.8889

Table 3: Flower weight (g) and days to flower persistence of Cockscomb varieties in response to sowing dates.

was markedly maximum (5.89) under 4th April sowing date, it is clear from the results that varietal differences is minimal due to similar genetic makeup. The treatment interaction indicated that 4th April sowing x Amigo Orange resulted in maximum days of flower persistence (8.05), while 5th March sowing X Amigo Red resulted in lowest number of days to flower persistence of (0.74 days) which might be due to lower temperature (28°C). Further Dole and Wilkins, 2005 found that *Celosia* sown in warm season thrives well in terms of vegetative and flowering response, further they reported that Cockscomb flowers picked on 06-8, 07-11 and 08-28 (58, 91, and 139 days); and Wheat *Celosia* on 05-22, 06-20, 07-17, and 08-26 (41, 70, 97, and 137 Days After Transplanting) produced maximum flowers with many days of persistence on the plant that might lead to the availability of this cut flower for longer period in the market [19]. On these dates *Celosia* produced maximum flowers of good quality. The analysis specified that 4th April could be considered as an applicable sowing date, as it decreased the days to seed germination improved plant height, leaves plant⁻¹, earliest flower emergence, maximum flower weight and flower persistence on the plant. Present study is in accordance with Akinbode et al., who found 6.32 days of flower persistence on Mid-March to late March sowing time. Additionally, regardless the sowing time, the variety Cockscomb Amigo Orange resulted in moderately maximum days to flower persistence than those sown by Cockscomb Amigo Red, mainly due to environmental influence and moderately genetic variation [11]. However much environmental effect was noticed for *Celosia* in terms of growth and flowering response.

Conclusion

It was concluded that the Cockscomb varieties sown on 4th April showed maximum performance in vegetative and flower characteristics due to high temperature and RH (33°C, 70%). The variety Cockscomb Amigo Orange may be choice of cultivar for achieving superior performance on flowering traits for Tandojam location. Other sowing dates along with varieties and geographical locations might be explored for future research activities.

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