Current Journal of Applied Science and Technology

39(24): 45-52, 2020; Article no.CJAST.59912
ISSN: 2457-1024
(Past name: British Journal of Applied Science & Technology, Past ISSN: 2231-0843, NLM ID: 101664541)

Influence of Different Times of Planting on Seed Attributes of *Gaillardia pulchella* Foug. Local Cultivars

A. Nikhila Vaagdevi[1*], T. Suresh Kumar[2], P. Prasanth[3], A. Kiran Kumar[4] and N. Sunil[5]

[1]Department of Floriculture and Landscape Architecture, Sri Konda Laxman Telangana State Horticultural University, Hyderabad, India.
[2]Department of Fruit Science, Horticultural Research Station, Sri Konda Laxman Telangana State, Horticultural University, Konda Mallepally, Nalgonda, India.
[3]Department of Floriculture and Landscape Architecture, Floricultural Research Station, ICAR-AICRP, Sri Konda Laxman Telangana State Horticultural University, Hyderabad, India.
[4]Department of Fruit Science, Sri Konda Laxman Telangana State Horticultural University, Hyderabad, India.
[5]Department of Genetics and Plant Breeding, Winter Nursery Centre, ICAR-IIMR, Hyderabad, India.

Authors' contributions

This work was carried out in collaboration among all authors. Author ANV conducted the investigation as a part of M.Sc. Research under the chairmanship of author TSK. Author PP member of advisory committee guided in the experimental planning and checked the manuscript. Authors AKK and NS, as members of Advisory committee helped in drafting the paper. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CJAST/2020/v39i2430872
Editor(s):
(1) Dr. Chen Chin Chang, Hunan Women's University, China.
Reviewers:
(1) Joaquim Júlio de Almeida Júnior, Centro Universitário de Mineiros, Brasil.
(2) Renata de Melo Ferreira Lopes, Universidade Federal de Viçosa, Brazil.
Complete Peer review History: http://www.sdiarticle4.com/review-history/59912

Original Research Article

Received 06 June 2020
Accepted 13 August 2020
Published 20 August 2020

ABSTRACT

The present research was conducted during September 2018 to June 2019 at Floricultural Research Station, Hyderabad, India to examine the influence of different times of planting on seed attributes in *Gaillardia pulchella* local cultivars. The experimental design is Factorial Randomized Block Design comprising of two cultivars namely Local yellow (C_1) and Local red (with yellow tip) (C_2) and five

**Corresponding author: E-mail: nikhilavaagdevi.anumala@gmail.com;*

times of planting namely, 1st week of October (T_1), 1st week of November (T_2), 1st week of December (T_3), 1st week of January(T_4) and 1st week of February (T_5) with three replications. The plot size is 2×2m with spacing followed is 30 × 45 cm. The results revealed that, maximum number of seeds/inflorescence was recorded with T_1 (1st week of October) and minimum with T_2 (1st week of November). T_4 (1st week of January) recorded maximum seed yield /hectare, seed yield/plot and seed yield/plant and minimum in T_2 (1st week of November). Germination percentage was recorded maximum with T_1 (1st week of October) and minimum with T_5 (1st week of February). Among cultivars, significant variation was observed in germination percentage. C_1 (local yellow) showed higher germination % than C_2 (local red with yellow tip). Interaction effect between cultivars and different planting times was non-significant in all the characters. Hence, it can be concluded that the cultivars namely Local yellow and Local red (with yellow tip) performed well with respect to seed yield. T_4 (1st week of January) gave higher seed yield among different planting times and could be the best time of planting for seed production in *Gaillardia pulchella*.

Keywords: Gaillardia; planting time; seed yields; cultivars; annuals.

1. INTRODUCTION

Gaillardia (*Gaillardia pulchella* Foug.) (2n= 36) commonly known as blanket flower belongs to Asteraceae family, is one of the hardiest summer annuals grown on wide range of soils in varied climatic conditions. It is native to central and western United States. The genus name Gaillardia was named in honour of Gaillardia de Marentoneau, a French patron of botany.

Gaillardia inflorescence is attractive with wide range of vibrant colours like yellow, red, red tipped yellow, orange, scarlet. The flowers are available in single, semi-double or double forms with long flowering duration. It is widely marketed as a loose flower for garland preparation and decoration. It is also used in landscaping as mixed herbaceous borders and edging purposes. Gaillardia flowers show better vase life in water and floral preservatives and can also be used as a cut flower.

Due to its year-round cultivation, hardy nature, wider adaptability, it is gaining importance as a commercial loose flower crop and is often used as a substitute to chrysanthemum or marigold whenever these flowers are off season. The annual gaillardia is propagated through seeds, which are sown either in pots or in raised beds from January to October to obtain flowers almost throughout the year. Seed production is a lucrative business due to high prices of flower seed. The importance of good seed has been very well recognized for successful production of any crop. Though gaillardia can be grown throughout the year, the climate has its own effect on growth and seed yield. Kaul and dadlani [1] reported that the yield potential of various flowering annuals varies critically and dependent mainly upon the planting time that affects the growth, seed yield and quality. In view of its ease of cultivation, it is essential to generate scientific information for the benefits of the farming community. However, meagre studies have been done so far in *Gaillardia pulchella* with respect to planting time and cultivars.

Hence, the present study has been performed with an objective to find out the optimum time of planting in which *Gaillardia pulchella* cultivars performs well to get higher seed yields.

2. MATERIALS AND METHODS

The present study was held during September 2018 to June 2019 at Floricultural Research Station, Sri Konda Laxman Telangana State Horticultural University, Hyderabad. The experimental site comes under semi-arid, sub-tropical climate zone with an average rainfall of 616.6 mm per annum. The monthly mean meteorological data recorded during the experimentation is given in Table 1. The experimental soil was of sandy clay loam with good drainage. The pH and EC of the soil are 8.08 and 0.35 dSm^{-1} respectively.

The experiment was conducted by adopting Factorial Randomized Block Design (FRBD) comprising of two cultivars i.e. Local Yellow (C_1) (Fig. 1) and Local Red (Yellow tip) (C_2) (Fig. 2) and 1st Week of October (T_1), 1st Week of November (T_2), 1st Week of December (T_3), 1st Week of January (T_4) and 1st Week of February (T_5) are five different times of planting with three replications. In each replication, treatments were allotted randomly.

The entire experimental block was divided into three strips with ten plots in each strip and each

plot size was 2×2 m. The spacing followed between plant to plant is 30 cm and between row to row is 45 cm. Well decomposed FYM (15 t ha^{-1}) was applied uniformly and Nitrogen, Phosphorus and Potassium (150:80:60 kg NPK/ha) were applied in the form of Urea, Single Super Phosphate and Muriate of Potash respectively. Half dose of Urea and full doses of single super phosphate and Muriate of potash were applied at the time of transplanting. The crop was top dressed with the remaining half dose of urea at 30 days after transplanting. Gaillardia seedlings were raised in the nursery by sowing the seeds, forty-five days before the date of transplanting to the main plot during each time of planting. The forty-five days old seedlings were then transplanted on 1st week of every month from October to February followed by light irrigation. Irrigations were given at an interval of 6-7 days depending on the climatic conditions and soil moisture status. The seeds were obtained by harvesting the completely dried inflorescence on randomly selected plants from each treatment. Paper towel germination method (Between papers) under recommended temperature regime of 20-30°C was conducted to test the germination percentage after seven days. The observations on seed parameters like seed weight/inflorescence (g), no of seeds/inflorescence, Test weight (g), Seed yield/hectare (q/ha), Seed yield/plot (kg/plot) Seed yield/plant (g/plant) and Germination percentage (%) were recorded, tabulated and analyzed statistically using OPSTAT programme. The results and discussions are briefly explained below.

Fig. 1. Local yellow
Place: Hyderabad, Telangana, India. time: 2018-19

Fig. 1. Local red (with Yellow tip)
Place: Hyderabad, Telangana, India. time: 2018-19

Table 1. Meteorological data for the period of experimentation (September 2018 to June 2019) recorded at the meteorological observatory of the agricultural research station, Rajendranagar, Telangana, India

Month	Temperature (°C)		R.H. (%)		Rainfall	Sunshine
	MAX.	MIN	I	II	(mm)	(Hours)
September 2018	31.42	19.93	90.20	58.07	43.40	5.88
October 2018	32.40	16.45	86.06	39.00	43.20	7.44
November 2018	31.30	13.70	87.17	38.10	0.00	8.19
December 2018	27.89	12.73	90.13	47.35	13.60	5.37
January 2019	28.69	08.34	89.77	41.16	25.20	7.95
February19	32.21	14.36	85.61	47.07	02.00	9.32
March 2019	36.66	16.76	77.10	42.32	00.00	8.66
April 2019	39.00	18.30	72.00	34.00	43.20	8.80
May 2019	41.20	21.30	59.00	29.00	09.00	9.30
June 2019	36.80	30.00	81.00	48.00	85.00	7.40

3. RESULTS AND DISCUSSION

3.1 Number of Seeds/Inflorescence

The results obtained pertaining to number of seeds/ inflorescence as influenced with different planting times in cultivars i.e. Local yellow and Local Red (yellow tip) are illustrated in Table 2. The number of seeds per inflorescence showed significant variation due to the influence of different planting times in Gaillardia. T_1 (1st week of October) (206.66) was recorded with maximum number of seeds per inflorescence and was on par with T_4 (1st week of January) (199.30) and T_3 (1st week of December) (175.50). T_2 (1st week of November) (154.23) recorded minimum number of seeds/ inflorescence which was found to be on par with T_5 (1st week of February) (158.33). These findings are in close agreement of earlier work done by Shahrbabaki et al. [2] in calendula who stated that planting time has a significant effect on number of seeds/inflorescence with highest number of seeds recorded in September sowing. Somanagouda et al. [3] reported maximum number of seeds and 1000 seed weight on 1st October sowing as compared to later sowings. There was no significant variation in number of seeds per inflorescence between the cultivars (C_1) Local yellow and (C_2) Local Red (yellow tip). Interaction effect of the two cultivars with different times of planting for number of seeds/inflorescence was non- significant.

3.2 Seed Weight per Inflorescence (g)

There was no significant variation in seed weight per inflorescence between the cultivars as well as among the different planting times. Interaction effect of different planting times and cultivars for seed weight per inflorescence was found non-significant.

3.3 Test Weight (g)

There was no significant variation in test weight between the cultivars as well as among the different planting times. Interaction effect of different planting times and cultivars for test weight was found non- significant.

3.4 Seed Yield/Plant (g/plant)

The results obtained with respect to seed yield/plant (g/plant) as influenced by different planting times in cultivars i.e. Local yellow and Local Red (yellow tip) are illustrated in Table 3. The seed yield/ plant varied significantly due to the influence of different times of planting in gaillardia. T_4 (1st week of January) was recorded with maximum seed yield/plant (37.05 g/plant) which was on par with T_2 (1st week of November) (30.25 g/plant). Dhatt [4] reported that before the actual flowering, the plants put on to enough vegetative growth to support the exhaustive flowering, seed development and its maturity. Minimum seed yield/ plant was recorded in T_5 (1st week of February) (19.18 g/plant) which was found to be on par with T_1 (1st week of October) (23.05 g/plant). These results are supported by the findings of Ahmed et al. [5] who reported maximum seed yield in November 20 planting in sunflower. On the contrary, Nagaraju et al. [6] in aster reported maximum flower yield in October which ultimately resulted in higher seed yield. There was no significant variation in seed yield per plant between the cultivars (C_1) Local yellow and (C_2) Local Red (yellow tip). Interaction effect of different planting times and cultivars for seed yield/plant was non- significant.

3.5 Seed Yield/Plot (kg/plot)

Data pertaining to Seed yield/plot (kg/plot) as effected by different planting times in cultivars i.e. Local yellow and Local Red (yellow tip) are illustrated in table 4. The seed yield/plot varied significantly due to the influence of different planting times in gaillardia. T_4 (1st week of January) (0.81 kg/plot) was recorded with maximum seed yield/plot which was on par with T_3 (1st week of December) (0.80 kg/plot) and T_2 (1st week of November) (0.74 kg/plot). The maximum seed yield per plot could be attributed to prevalence of favorable environmental conditions along with better plant growth. These results are in conformity with the findings of Dhatt [4] who stated that the highest seed yield was obtained from 20th November planting in *Gaillardia aristata*. Priyanka et al. [7] stated that maximum number of siliquae per plant, seed yield per plot and 1000 seed weight in candytuft was observed in early planting of September compared to later planting times on account of early favourable warm temperature. Minimum seed yield/plot was recorded in T_5 (1st week of February) (0.47 kg/plot) which was found to be on par with T_1 (1st week of October) (0.55 kg/plot). There was no significant variation in seed yield per plot between the cultivars (C_1) Local yellow and (C_2) Local Red (yellow tip). Interaction effect of cultivars and different planting times for seed yield/ plot was non-significant.

3.6 Seed Yield/Hectare (q/ha)

The data pertaining to seed yield/hectare (q/ha) as effected by different planting times in cultivars i.e. Local yellow and Local Red (yellow tip) are presented in Table 5. There was no significant variation in seed yield/hectare between the cultivars (C_1) Local yellow and (C_2) Local Red (yellow tip). The seed yield/hectare showed significant variation due to the influence of different planting times in Gaillardia. T_4 (1st week of January) (20.25 q/ha) was recorded with maximum seed yield per hectare which was on par with T_3 (1st week of December) (20.00 q/ha) and T_2 (1st week of November) (18.66 q/ha). Seed yield which is a factor of inflorescence yield was maximum which could be due to increase in number of inflorescence//plant and inflorescence yield/plant. T_5 (1st week of February) (11.79 q/Ha) recorded minimum seed yield/hectare which on par with T_1 (1st week of October) (13.83 q/Ha). The Maximum and minimum seed yield per hectare could be related to seed yield per plant and seed yield per plot which followed similar trend. Interaction effect of different planting times and cultivars for seed yield/hectare was non- significant.

3.7 Germination Percentage (%)

The data pertaining to Germination percentage (%) as influenced by different planting times in cultivars i.e. Local yellow and Local Red (yellow tip) are presented in Table 6. Significant variation was recorded in germination percentage between the cultivars Local yellow and Local Red (yellow tip). Maximum germination percentage was observed with cultivar C_1 (local yellow) (45.20 %) and the minimum germination percentage was observed with C_2 local red (with yellow tip) (41.20 %). The variation between the cultivars could be attributed to genetic makeup of the cultivar, environmental influence and other management factors. The Germination percentage varied significantly due to the influence of different planting times in Gaillardia. T_1 (1st week of October) (63.50 %) was recorded with maximum germination percentage. Minimum germination percentage was recorded in T_5 (1st week of February) (22.00 %). It is evident from the Table 5 that the germination percentage gradually decreased from T_1 (October planting) to T_5 (February planting). These results are similar to the findings of Rakesh et al. [8] in China aster that recorded maximum germination in October planting compared to September, November and December planting. However, it might also be due to the presence of resting period in the seeds of Gaillardia. Srivastava and Kandpal [9] documented that gaillardia seeds need a 4 month after ripening period before germination, but the seeds have no dormancy. On contrary, Ying et al. [10] reported that the seeds of gaillardia have endogenous, non-deep physiological dormancy which need to be further investigated for exact reason of lowest germination percentage. Interaction effect of different planting times and cultivars for germination percentage was non- significant.

Table 2. Influence of different times of planting on number of seeds per inflorescence of gaillardia cultivars

Time of Planting	Cultivars		Mean
	C_1: Local Yellow	C_2: Local Red (Yellow tip)	
T_1: 1st Week of October	187.20	226.13	206.66^{a}
T_2: 1st Week of November	156.00	152.46	154.23^{b}
T_3: 1st Week of December	193.46	156.73	175.10^{ab}
T_4: 1st Week of January	190.20	208.40	199.30^{a}
T_5: 1st Week of February	170.46	146.20	158.33^{b}
Mean	179.46	177.98	
Factors	**SE (m) ±**	**CD (5%)**	
Cultivars (A)	6.96	NS	
Time of Planting (B)	11.01	32.73	
Factor A X B	15.57	NS	

Place and time of Research: Hyderabad, India; 2018-2019

Table 3. Influence of different times of planting on seed yield/plant (g/plant) of gaillardia cultivars

Time of Planting	Cultivars		Mean
	C_1: Local Yellow	C_2: Local Red (Yellow tip)	
T_1: 1st Week of October	22.94	23.17	23.05^{cd}
T_2: 1st Week of November	31.50	29.01	30.25^{ab}
T_3: 1st Week of December	32.64	24.48	28.56^{bc}
T_4: 1st Week of January	40.00	34.10	37.05^{a}
T_5: 1st Week of February	21.84	16.53	19.18^{d}
Mean	29.80	25.46	
Factors	**SE (m) ±**	**CD (5%)**	
Cultivars (A)	1.50	NS	
Time of Planting (B)	2.34	6.96	
Factor A X B	3.31	NS	

Place and time of research: Hyderabad, India; 2018-2019

Table 4. Influence of different planting times on seed yield per plot (Kg/plot) of gaillardia cultivars

Time of Planting	Cultivars		Mean
	C_1: Local yellow	C_2: Local red (yellow tip)	
T_1: 1st Week of October	0.55	0.55	0.55^{bc}
T_2: 1st Week of November	0.75	0.73	0.74^{ab}
T_3: 1st Week of December	0.78	0.82	0.80^{a}
T_4: 1st Week of January	0.80	0.81	0.81^{a}
T_5: 1st Week of February	0.54	0.40	0.47^{c}
Mean	0.68	0.66	
Factors	**SE (m) ±**	**CD (5%)**	
Cultivars (A)	0.04	NS	
Time of Planting (B)	0.06	0.19	
Factor A X B	0.09	NS	

Place and time of research: Hyderabad, India; 2018-2019

Table 5. Influence of different planting times on seed yield per hectare (q/ha) of gaillardia cultivars

Time of Planting	Cultivars		Mean
	C_1: Local Yellow	C_2: Local Red (Yellow tip)	
T_1: 1st Week of October	13.83	13.83	13.83^{b}
T_2: 1st Week of November	18.91	18.41	18.66^{a}
T_3: 1st Week of December	19.50	20.50	20.00^{a}
T_4: 1st Week of January	20.08	20.41	20.25^{a}
T_5: 1st Week of February	13.58	10.00	11.79^{b}
Mean	17.18	16.63	
Factors	**SE (m) ±**	**CD (5%)**	
Cultivars (A)	0.99	NS	
Time of Planting (B)	1.60	4.70	
Factor A X B	2.22	NS	

Place and time of research: Hyderabad, India; 2018-2019

Table 6. Influence of different planting times on germination percentage (%) of gaillardia cultivars

Time of Planting	Cultivars		Mean
	C_1: Local Yellow	C_2: Local Red (Yellow tip)	
T_1: 1st Week of October	65.00	62.00	63.50[a]
T_2: 1st Week of November	55.33	52.00	53.66[b]
T_3: 1st Week of December	45.66	40.66	43.16[c]
T_4: 1st Week of January	35.33	32.00	33.66[d]
T_5: 1st Week of February	24.66	19.22	22.00[e]
Mean	45.20	41.20	
Factors	**SE (m) ±**	**CD (5%)**	
Cultivars (A)	0.60	1.79	
Time of Planting (B)	0.95	2.83	
Factor A X B	1.35	NS	

Place and time of research: Hyderabad, India; 2018-2019

4. CONCLUSION

Based upon the results discussed above, a conclusion can be drawn that both the gaillardia cultivars namely Local yellow and Local red (with yellow tip) performed good with respect to seed attributes. In terms of different times of planting, 1st week of January gave higher seed yield and could be best time for better seed yields.

5. SUGGESTIONS

Further, Studies are suggested on the effects of the time of seed harvest on the percentage of germination, effects of the age of the parent plant on the percentage of germination of its seeds, effects of seed storage on the percentage of germination, studies on dormancy and its break in speed and percentages of seed germination in gaillardia crop.

ACKNOWLEDGEMENTS

The financial support in the form of stipend rendered by College of Horticulture, Sri Konda Laxman Telangana State Horticultural University (SKLTSHU), Rajendranagar, Hyderabad is duly acknowledged. We also extend our sincere thanks to Floricultural Research Station, SKLTSHU, Rajendranagar for providing the facilities to conduct the research.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kaul GL, Dadlani NK. Prospects of Floriculture in India. Ministry of Agriculture, Govt. of India; 1995.
2. Shahrbabaki SMAK, Zoalhasani S, Kodory M. Effect of sowing date and nitrogen fertilizer on seed and flower yield of pot marigold (*Calendula officinalis* L.) in Kerman. Advances in Environmental Biology. 2013;7(13):3925-3929.
3. Somanagouda G, Bhandiwaddar TT, Manjula M. Effect of planting time on seed yield, quality parameters and economics on safflower. International Journal of Current Microbiology and Applied Sciences. 2020;9(4):812-816.
4. Dhatt KK. Effect of planting time on plant growth and Seed yield of flowering annuals. Agricultural Research Journal. 2015;52(4):52-55.
5. Ahmed B, Sultana M, Jesmin Z, Santos KP, Mokhlesur R, Rezaul I, Falguni M. Effect of sowing dates on the yield of Sunflower. Bangladesh Agronomy Journal. 2015;18(1):1-5.
6. Nagaraju D, Reddy BS, Patil RT, Gangadharappa PM, Kulkarni BS. Effects of dates of planting on flowering and flower quality of China aster. Journal of Ornamental Horticulture. 2004; 7:132-134.
7. Priyanka S, Gupta YC, Dhiman SR, Sharma P, Bhargava B. Effect of different planting dates and climatic conditions on growth, flowering and seed yield of candytuft (*Iberis amara)*. Indian Journal of Agricultural Sciences. 2017;87(6):792-795.
8. Rakesh CM, Vyakaranahal and Deshpande VK. Influence of planting time and picking stages on seed yield and quality in Asters (*Callistephus chinensis* (L.) Nees) genotypes. Indian Journal of Agricultural Sciences. 2008;42(3):224-227.
9. Srivastava R, Kandpal K. *Gaillardia* in Bhattacharjee SK (Ed). Advances in

ornamental horticulture. Pointer Publisher, Jaipur. 2006;1(23): 294-304.

10. Ying ZF, Chen CY, Hu ZH. Effects of PEG-6000 stress on seed germination and seedling physiological characteristics of *Gaillardia aristata* Pursh. Journal of Northwest A & F University - Natural Science. 2014; 42:132–136.

© 2020 Vaagdevi et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/59912