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Effect of different levels of nitrogen and weed management practices on flower quality and yield of gaillardia (*Gaillardia pulchella* Foug.) under Hyderabad conditions

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Abstract
The present investigation was carried out during the year 2018-2019 at Floricultural Research Station, Hyderabad to study the effect of different levels of nitrogen and weed management practices on flower quality and yield of gaillardia (*Gaillardia pulchella* Foug.) under Hyderabad conditions. The experiment was laid out in FRBD comprising of 20 treatment combinations with three replication. The results revealed that 180 kg N/ha (N_1) and mulching with (T_1) black and silver polythene sheet recorded highest flower diameter (6.77 cm), flower yield per plant (193.83 g and 196.33 g), flower yield per hectare (165.13 q and 164.39 q) compared to other nitrogen levels. However, flower diameter was highest (6.77 cm and 7.08 cm) in 180 kg N/ha (N_1) and control plot (without weeding) with poor quality of flowers.

Keywords: Nitrogen, weed management practices, flower quality, yield, gaillardia, *Gaillardia pulchella* Foug

Introduction
Gaillardia, commonly known as Blanket Flower or Fire Wheel, belong to the family Asteraceae and is a native to Central and Western United States. The plants possess brilliant daisy-like flower with single, double and semi double forms. The large centers of flowers are rose-purple and the densely frilled petals are yellow, orange, crimson or copper scarlet. Flowers are small and numerous, born in solitary, usually showy heads which is stated as capitulam with 4 to 6 cm in diameter. Individual flowers in a capitulam are called florets which ranged from one to ten according with cultivars or genotypes. As a member of Asteraceae it has both ray and disc florets which are pistillate and hermaphrodite, respectively. The crop produce flowers in a wide range of colors such as yellow, orange, cream, scarlet, bronze, brick-red, red and can be grown all around the year. The flowers are attractive, brightly colored and is an important substitute to commercial flower crop like chrysanthemum and china aster (Bose *et al.*, 2003) [3], especially during summer months in South India. It is extensively used as loose flower, interior decorations, as herbaceous borders and flower beds in landscaping, apart from this it has ability to reduce soil erosion in coastal dune areas (Carig, 1977) [4].

Application of major nutrient i.e nitrogen play an important role in growth and development of many flower crops thereby increase the flower yield. Excess application of Nitrogenous fertilizers results in heavy weed growth, thereby increasing the cost of cultivation. Due to energy crisis, high cost of chemical fertilizers and poor purchasing power of marginal and small farmers, it is imperative to develop strategies for using optimum Nitrogenous fertilizers for improving the soil fertility and aiming at getting higher yield, quality and at the same time safeguards the interests of farmers and environmental concerns.

Weeds not only reduce the amount of N available to crops but the growth of many weeds is also improved by higher soil N levels (Blackshaw *et al*., 2003) [2]. Weeds are inherently different in responsiveness to higher soil N levels (Moreau *et al*., 2014) [10]. Weeds cause heavy damage to this crop by competing with main plants for water, nutrients, light and space (Kori and Patil, 2003) [8] besides acting as alternate hosts to a number of pathogens and pests. Hence, for higher yields in this crop, proper weed management is of utmost significance.

Therefore, the present investigation was formulated to standardize optimum level of nitrogen and effective weed management practices in gaillardia which can give better growth, flower quality and flower yield.

Material and Methods

The present experiment was conducted at Floricultural Research station, Agricultural Research Institute, Rajendranagar, Hyderabad. It was laid out in Factorial Randomized Block Design comprising of twenty treatments with cultivar Local Red (yellow tip) with three replications. The treatments consisted of four nitrogen levels i.e. 0 Kg N/ha (N_1), 75 Kg N/ha (N_2), 150 Kg N/ha (N_3), 180 Kg N/ha (N_4) and five weed management practices i.e, Black and silver polythene mulch (40 microns) (T_1) Paddy straw mulch (T_2), Pendimethalin 1kg *a.i.* /ha + weeding 30 DAT (T_3), Weed free control (T_4), Control (without weeding) (T_5). The size of the was 1.8 × 0.9 m with a spacing 30 × 45 cm. Forty five days old seedlings were transplanted on 2nd fortnight of September and all the recommended package of practices were adopted systematically.

Five plants were selected randomly from each treatment, tagged and recorded growth parameters viz., flower diameter, flower yield per plant, flower yield per plot and flower yield per hectare was recorded. The observations were statistically analyzed.

Results and Discussion

The data related to flower diameter, flower yield per plant, flower yield per plot and flower yield per hectare are presented in Table-1, 2, 3 and 4.

Flower diameter

Flower diameter has increased with increase in nitrogen levels, application of 180 kg N/ha was significantly maximum (6.77 cm) over other treatments and followed by (N_3) 150 kg N/ha (6.58 cm), (N_2) 75 kg N/ha (6.03 cm), whereas application of (N_1) 0 kg N/ha has shown minimum (5.59 cm) flower diameter. Higher accumulation of photosynthates might be the reason for increasing flower diameter with increasing level of nitrogen dosage. Similar results were registered by Kore *et al.* (2003) [7].

Flower diameter differed significantly due to different weed control treatments. The maximum flower diameter (7.08 cm) was recorded in (T_5) control (without weeding) which was followed by (T_3) pendimethalin at 1 kg *a.i.* /ha + weeding 30DAT (6.57 cm), (T_1) black and silver polythene mulch (6.30 cm). Minimum flower diameter (6.21 cm) was found in (T_2) paddy straw mulch. Maximum flower diameter due to more number of weeds grown in control plots, which leads to poor quality flowers consisting of less number of petals and loose petals.

Flower yield per plant

Application of 180 kg N/ha recorded maximum flower yield per plant (193.83 g) and it was followed by the treatment (N_3) 150 kg N/ha (177.49 g), (N_2) 75 kg N/ha (162.15 g) and application of 0 kg N/ha showed minimum (144.58 g) flower yield per plant. This can be attributed to higher accumulation of photosynthates. Similar results were registered by Kore *et al.* (2003) [7].

Significant difference was noticed regarding yield of flowers per plant due to weed management practices, mulching with (T_1) black and silver polythene sheet recorded significantly higher weight of flowers per plant (196.33 g) which was significantly followed by (T_2) paddy straw mulch (181.98) whereas minimum flower yield per plot was recorded in (T_5) control (without treatment) (138.05 g). It may be due to constant moisture on least evaporation has seen in black and silver polythene sheet, and kept flowers fresh. Apart from these it retained to some extent warm and humid conditions around the plant. Thus induced to yield more flowers in terms of weight (Younis *et al*., 2012) [12].

Flower yield per plot

Maximum (3.49 kg) flower yield per plot has observed at 180 kg N/ha and it was statistically superior over the treatment (N_3) 150 kg nitrogen per ha (3.17 kg) followed by (N_2) 75 kg/ha (2.95 kg) and application of 0 kg nitrogen per ha has shown minimum (2.47 kg) flower yield per plant. Increased yield may be due to the fact that the continuous supply of nutrients at critical stages of plant growth.

Significantly maximum flower yield (3.44 kg) per plot was recorded in mulching with (T_1) black polythene sheet and was statistically superior over rest of the treatments which was followed by (T_4) weed free control (3.23 kg), (T_3) pendimethalin 1kg *a.i.* /ha + weeding 30 DAT (3.10 kg) and (T_2) paddy straw mulch (2.85 kg). However, the minimum flower yield per plot was recorded in (T_5) control (without weeding) (2.50 kg).

Higher flower yield might also be attributed to the availability of nutrients, moisture and less competition from weeds for sunlight and space. The lowest flower yield was obtained in weedy check. This might be due to severe weed competition which ultimately resulted in lower yield. Similar, findings were also observed by Tripathy *et al*. (2015) [11] in chrysanthemum.

Flower yield per hectare

Maximum (165.13 q) flower yield per plot was observed at 180 kg N/ha and it was followed by the treatment (N_3) 150 kg N/ha (147.62 q), (N_2) 75 kg N/ha (137.95 q) while application of (N_1) 0 kg N/ha has shown minimum (115.18 q) flower yield per plant. Higher nitrogen dosage supplied might be the possible reason for increased production of food materials which subsequently increased the growth and thereby, increased the flower yield. The results obtained by Deshpande *et al.* (2005) [6] in gerbera are also in line with present investigation.

Significantly maximum flower yield (164.39 q) per hectare was recorded in mulching with (T_1) black polythene sheet and was statistically superior over rest of the treatments which is followed by (T_4) weed free control (149.53 q), (T_3) pendimethalin 1kg *a.i.* /ha + weeding 30 DAT (141.46 q) and (T_2) paddy straw mulch (133.02 q), Whereas, the minimum flower yield per plot was recorded in control (118.95 q).

The higher yield and improvement in quality of flowers due to mulching by black and silver polythene sheet may be attributed to the fact that application of mulch regulates the soil temperature and helps in maintaining soil moistures by reduction in evaporation losses. This mulch also might helped to maintain microbial activities at higher level. All these intern were likely to influence favourable nutrient availability and their uptake by the plants. Whereas, control recorded less flower yield per plant, per plot as well as hectare due to higher weed density which resulted in higher competition of weed with the crop plants that ultimately suppressed the growth and flowering of Gaillardia. Mulching material play a major impact on yield (AI- Rawahy *et al*., 2011), similar results were obtained by Chawla (2008) in African marigold, Kumar and Chakraborty (2010) [9] in Rose.

There was no significant difference in the interaction effect of different levels of nitrogen and weed management practices on flower diameter, flower yield per plant, flower yield per plot and flower yield per hectare.

Conclusion

On the basis of the results of the present investigation, it can be concluded that, among the different levels of nitrogen and weed management practices, gaillardia (cv. Local red with yellow tip) plants treated with 180 kg N/ha and black and silver polythene mulch recorded maximum flower yield (165.13 q/ ha and 164.39q /ha).

Table 1: Effect of nitrogen levels, weed management practices and their interaction on flower diameter of Gaillardia Cv. Local red (with yellow tip)

Treatment	Flower Diameter (cm)				
	N_1	N_2	N_3	N_4	Mean
T_1	5.62	5.94	6.79	6.84	6.30 [c]
T_2	5.57	6.12	6.55	6.59	6.21 [d]
T_3	5.80	6.19	6.79	7.14	6.57 [b]
T_4	5.47	6.20	6.45	6.83	6.26 [d]
T_5	6.44	6.78	7.34	7.75	7.08 [a]
Mean	5.59 [d]	6.03 [c]	6.58 [b]	6.77 [a]	
For comparing the means of	SEm±		CD @ 5%		
N (Factor A)	0.06		0.17		
T (Factor B)	0.06		0.19		
N X T	0.13		NS		

Table 2: Effect of nitrogen levels, weed management practices and their interaction on flower yield per plant of Gaillardia Cv. Local red (with yellow tip)

Treatment	Flower yield per plant (g)				
	N_1	N_2	N_3	N_4	Mean
T_1	165.94	181.65	207.89	229.83	196.33 [a]
T_2	157.51	171.51	197.83	201.06	181.98 [b]
T_3	146.66	162.75	177.34	194.53	170.32 [b]
T_4	141.52	155.31	170.42	176.32	160.89 [b]
T_5	111.30	139.54	133.98	167.40	138.05 [c]
Mean	144.58 [d]	162.15 [c]	177.49 [b]	193.83 [a]	
For comparing the means of	SEm±			CD @ 5%	
N (Factor A)	3.74			10.72	
T (Factor B)	4.18			11.98	
N X T	8.37S			NS	

Table 3: Effect of nitrogen levels, weed management practices and their interaction on flower yield per plot of Gaillardia Cv. Local red (with yellow tip)

Treatment	Flower yield per plot (kg)				
	N_1	N_2	N_3	N_4	Mean
T_1	2.77	3.18	3.71	4.11	3.44 [a]
T_2	2.37	2.76	3.02	3.23	2.85 [d]
T_3	2.58	3.12	3.17	3.53	3.10 [c]
T_4	2.71	3.08	3.58	3.54	3.23 [b]
T_5	1.92	2.62	2.39	3.06	2.50 [e]
Mean	2.47 [d]	2.95 [c]	3.17 [b]	3.49 [a]	
For comparing the means of	SEm±		CD @ 5%		
N (Factor A)	0.06		0.19		
T (Factor B)	0.07		0.21		
N X T	0.14		NS		

N: Nitrogen, T: weed management practices, N × T: Nitrogen and weed management practices, N_1: 0kg/ha, N_2: 75kg/ha, N_3: 150kg/ha, N_4: 180kg /ha, T_1: Black and silver polythene mulch (40 microns), T_2: Paddy straw mulch, T_3: Pendimethalin 1kg *a.i.* /ha + weeding 30 DAT, T_4: Weed free control, T_5: Control (without weeding).

Table 4: Effect of nitrogen levels, weed management practices and their interaction on flower yield per hectare of Gaillardia Cv. Local red (with yellow tip)

Treatment	Flower yield per hectare (q)				
	N1	N2	N3	N4	Mean
T1	129.35	153.36	180.31	194.56	164.39 [a]
T2	110.63	128.89	141.70	151.03	133.02 [c]
T3	119.63	141.40	147.81	156.98	141.46 [b]
T4	126.18	143.72	157.04	171.18	149.53 [b]
T5	90.26	122.40	111.23	151.91	118.95 [d]
Mean	115.18 [d]	137.95 [c]	147.62 [b]	165.13 [a]	
For comparing the means of	SEm±			CD @ 5%	
N (Factor A)	3. 08			8.83	
T (Factor B)	3. 45			9.8	
N X T	6. 90			NS	

N: Nitrogen, T: weed management practices, N × T: Nitrogen and weed management practices, N_1: 0kg/ha, N_2: 75kg/ha, N_3: 150kg/ha, N_4: 180kg /ha, T_1: Black and silver polythene mulch (40 microns), T_2: Paddy straw mulch, T_3: Pendimethalin 1kg *a.i.* /ha + weeding 30 DAT, T_4: Weed free control, T_5: Control (without weeding).

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