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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; SP-12(10): 733-736

www.thepharmajournal.com
Received: 04-07-2023
Accepted: 11-08-2023

Effect of plant growth regulators on vegetative growth of Gaillardia

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Abstract
The present experiment entitled "Effect of plant growth regulators on vegetative growth of Gaillardia" was conducted at experimental farm, Pt. Kishori Lal Shukla College of Horticulture and Research Station, Pendri, Rajnandgaon Chhattisgarh during the year 2022-2023. The experiment was laid out in Randomized Block Design (RBD) with thirteen treatments and three replications. The treatment includes, T_1 control (Distilled water), T_2 (GA_3 100 ppm), T_3 (GA_3 200 ppm), T_4 (GA_3 250 ppm), T_5 (NAA 100 ppm), T_6 (NAA 150 ppm), T_7 (NAA 200 ppm), T_8 (CCC 500 ppm), T_9 (CCC 750 ppm), T_{10} (CCC 1000 ppm), T_{11} (MH 50 ppm), T_{12} (MH 100 ppm) and T_{13} (MH 150 ppm).
The results showed significant effect on vegetative parameters such as maximum plant height (78.30 cm), number of branches per plant (75.20), plant spread N-S (65.71 cm), E-W (64.62 cm) was recorded in treatment T_2 (GA_3 100 ppm). Whereas minimum plant height (45.23 cm) was recorded in treatments T_{11} (MH 50 ppm), while lowest number of branches (57.66), minimum plant spread N-S (39.90 cm), E-W (39.38 cm) obtained in treatment T_1 (control).

Keywords: Plant growth, vegetative growth, Randomized Block Design (RBD)

Introduction

Gaillardia (*Gaillardia pulchella* L.) is a member of Asteraceae family native to North and South America and chromosome number is 2n = 36. It is popularly referred to as the blanket flower due to it's colour and spreading habit. The leaves are alternately arranged typically branched stem that grows to maximum height of around 30 cm. Flower colour comprises of very attractive bright yellow, purple, cream, yellow or orange, scarlet, copper or bronze and durable. Out of the 30 species *G. pulchella, G. aristata and G. grandiflora* hold significant horticultural importance being annual, biennial and perennial forms.

Among the flower used for domestic market, gaillardia is one of the important commercial flowers. It is mostly cultivated for its profuse flowers, some of which are used to make garlands for religious ceremonies. It is widely marketed as loose flower and also suitable for cut flowers. The plants are grown in herbaceous borders and flower beds. In addition to aesthetic value in landscape *Gaillardia pulchella* is useful for controlling erosion in coastal dune areas (Carig, 1977) [3]. *Gaillardia aristata* is well suited for dryland areas and require low maintenance (Cox and Klett,1984) [4]. The nematicidal property of gaillardia was also observed when planted as catch crop and green manure (Panchaude, 1990) [15]. It is widely marketed as loose flower and often as substitute for marigold and chrysanthemum whenever these flowers are short supply or out of season.

Gaillardia shows much potential to capture flower market and economical growth of farmer. In Chhattisgarh gaillardia is cultivated as a loose and cut flowers and it is mainly cultivated in district Bilaspur, Mungeli, Dantewada, Raigarh and Raipur. In Chhattisgarh it cover an area of 184 ha with annual production of 1108 MT and productivity 6.02 MT/ha (Anonymous 2018-19) [2].

Gaillardia is rapidly gaining importance as a commercial crop because of its wide range of adaptability to different soil and climate conditions, better resistance to diseases and pests, hardy nature, long duration of flowering and appealing flower colour. To achieve a continuous flowering throughout the year, seeds can be sown in nursery beds or in pots from January to October. Seeds of *G. pulchella* can be sown all the year round (De souza, 1958) [7].

The prosperous commercial cultivation of the crop relies on various factors, including genetic, environmental and management. Scientists have focused their attention in recent years on the concept of regulating plant growth, yield and quality by applying plant growth regulators in different ways. Several aspect of plant growth and development such as height and flower initiation are controlled by the application of plant growth regulators.

Several plant growth regulators (PGRs) have been found to interfere with the physiological pathway of hormones and enzymes, leading to disruptions in normal growth. These disruptions ultimately have an impact on plant growth, flower quality and yield. When applied as foliar spray the plant growth regulators were observed by the leaves and quickly translocated in xylem and phloem tissues, leading to dispersion throughout the plant system.

Gibberellic acid has been found to play a significant role in promoting plant growth by stimulating the development of an increased number of primary and secondary branches and contributes to enhancing flower quality by ensuring uniformity in flower size and number this effect ultimately leads to higher flower production (Acharya *et al*. 2021) [1].

Gibberellic acid and Naphthalene acetic acid play vital role in improving the vegetative growth characters of the plant as it enhance the elongation and cell division by promoting the DNA synthesis in the cell. It reduced the juvenile phase due to increase in photosynthesis and respiration with enhanced CO2 fixation in the plant.

In floricultural crops-controlled plant size is crucial characteristics that can be obtained genetically, environmentally, culturally or chemically through plant growth regulators. Maleic hydrazide is utilized as a height regulator for majority of potted plants in floriculture because it slow down the division and elongation of plant cells. Plant growth retardants such as Cycoceal can effectively decrease the height of some ornamental plants while potentially enhancing their quantity and quality attributes (Garner, 2004).

The present investigation was carried out to know the effect of different plant growth regulators on vegetative growth of gaillardia.

Materials and Methods

The experiment was conducted at experimental farm, under Pt. Kishori Lal Shukla College of Horticulture and Research Station, Pendri, Rajnandgaon Chhattisgarh during the year 2022- 2023. The experiment was laid out in Randomized Block Design (RBD) with thirteen treatments and three replications. The treatment includes, T_1 control (Distilled water), T_2 (GA_3 100 ppm), T_3 (GA_3 200 ppm), T_4 (GA_3 250 ppm), T_5 (NAA 100 ppm), T_6 (NAA 150 ppm), T_7 (NAA 200 ppm), T_8 (CCC 500 ppm), T_9 (CCC 750 ppm), T_{10} (CCC 1000 ppm), T_{11} (MH 50 ppm), T_{12} (MH 100 ppm) and T_{13} (MH 150 ppm).

The experimental area was ploughed with the help of power tiller, than harrowing was done to break the clods, followed by leveling. The promising genotype of gaillardia "Miraj" was collect from University of Horticultural sciences, Bagalkot Karnataka. The seedling were transplanted after 30 days of sowing. The transplanting was done in the evening time to avoid direct sunlight. Seedling were transplanted in the plot of (2 × 1.5 m) at the space of 40 × 30 cm. The recommended cultural practices (Weeding, irrigation, manuring and plant protection etc.) were followed to experimental plots. Three foliar application was done at 30, 45 and 60 days after transplanting. The observations on growth parameters viz; plant height (cm), number of branches per plant and plant spread N-S (cm) and E-W (cm) were recorded and analyzed statistically as procedure described.

Results and Discussion Plant height (cm)

Findings on effect of different plant growth regulators on plant height of gaillardia has been presented in Table 1.

It is clear from the table that the application of different plant growth regulators, showed significant effect in plant height. The maximum plant height (52.87 cm and 78.30 cm) at 60 DAT and 90 DAT was recorded in treatment T_2 (GA_3 100 ppm), which was statically at par with treatments T_3 (GA_3 200 ppm), T_4 (GA_3 250 ppm), T_7 (NAA 200 ppm). Whereas, minimum plant height (21.91 cm and 45.23 cm) at 60 and 90 DAT respectively were recorded in treatment T_{11} (MH 50 ppm).

The maximum plant height (78.30 cm) was recorded in treatment T_2 (GA_3 100 ppm) might be due to GA_3 was discovered to increase the plant height by affect the internodal length, attributes to both cell division and cell elongation (Reddy and Sulladmath, 1983) [18]. Increased auxin content was reported due to the application of GA_3 caused apical dominance and may also have contributed to the increased plant height (Scott *et al*, 1967) [19].

The result were also reported by Sonu kumar *et al*. (2018) [21] in china aster, Delvadia *et al*. (2009) [6] and Ghadage *et al*. (2013) [9] and Makwana (1999) [14] in gaillardia. Whereas, plant height (41.35 cm) was retarded by treatments T_{11} MH (50 ppm). might be due to the antiauxin effect on MH with stimulation of dwarfing qualities and nullification of apical dominance (Crafts *et al*., 1950) [5]. MH reduce plant height by preventing cell division in the sub-apical meristem without impacting the apical meristem. The result in accordance with the findings of Khimani *et al*. (1994) [12] and Patel (1997) [16] in gaillardia.

Number of branches per plant

Findings on effect of different plant growth regulators on number of branches per plant of gaillardia has been presented in Table 1.

The result revealed that the application of different plant growth regulators, showed significant effect on number of branches per plant. The maximum number of branches per plant (37.53 and 75.20) at 60 DAT and 90 DAT was recorded in treatment T_2 (GA_3 100 ppm), which was statistically at par with treatments T_3 (GA_3 200 ppm), T_4 (GA_3 250 ppm), T_9 (CCC 750 ppm) and T_{10} (CCC 1000 ppm). While, minimum number of branches (25.20 and 57.66) at 60 and 90 DAT respectively were recorded with treatment T_1 (control).

The maximum number of branches per plant (75.20) was recorded in treatments T_2 (GA_3 100 ppm) may be as result of GA_3 increased amount of internode and capacity of the plant to photosynthesize more effectively due to an increase in chlorophyll. As a result, these nodes produced more dormant buds from where the primary branches may have originated (Krishna Kumar and Ughreja, (1998)) [13]. The minimum number of branches (57.66) was recorded with treatments T_1 (Control). Similar result were reported by Vijay kumar *et al*. (2017) [22] in China aster, Delvadia *et al*. (2009) [6] and Ghadage *et al*. (2010) [9] in gaillardia, Kanwar and Khandelwal (2013) [11] in marigold and Shinde *et al*. (2010) [20] in chrysanthemum.

Plant spread N-S (cm), E-W (cm): Findings on effect of different plant growth regulators on Plant spread N-S (cm), E-W (cm) gaillardia has been presented in Table 1.

The table showed that the application of different plant growth regulators had significant effect in plant spread N-S (cm), E-W (cm). The maximum plant spread N-S (39.38 cm and 65.71 cm), E-W (36.32 cm and 64.62 cm) at 60 DAT and 90 DAT was recorded in treatment T_2 (GA_3 100 ppm), which was statistically at par with treatments T_3 (GA_3 200 ppm), T_9 (CCC 750 ppm) and T_{10} (CCC 1000 ppm). However, minimum plant spread N-S (27.52 cm and 37.90 cm), E-W (28.99 cm and 37.38 cm) at 60 and 90 DAT respectively were recorded in treatment T_1 (control).

Increased plant spread N-S (65.71 cm) and E-W (64.62 cm) recorded in treatments T_2 (GA_3 100 ppm) may be as result of rise in the size and mass of cells generated and formation of new cells in specific location known as meristem (Verma, 1991) [23]. Similar findings were reported by Patil (2002) [17], Delvedia *et al.* (2009) [6] and Ghadage *et al.* (2010) [9] in gaillardia.

Table 1: Effect of different plant growth regulators on vegetative growth of gaillardia

Treatment notation	Treatment Details	Plant height (cm)		Number of branches per plant		Plant spread N-S (cm)		Plant spread E-W (cm)	
		60 DAT	90 DAT	60 DAT	90 DAT	60 DAT	90 DAT	60 DAT	90 DAT
T_1	Control (Distilled water)	26.10	58.34	25.20	57.66	27.52	37.90	28.99	37.38
T_2	GA_3 100 ppm	52.87	78.30	37.53	75.20	39.38	65.71	36.32	64.62
T_3	GA_3 200 ppm	49.86	73.29	35.13	73.93	35.56	64.20	35.84	63.26
T_4	GA_3 250 ppm	48.07	72.41	34.53	71.80	32.39	62.79	32.98	60.46
T_5	NAA 100 ppm	40.86	65.58	29.40	61.03	29.85	42.94	29.97	44.57
T_6	NAA 150 ppm	44.05	66.48	29.46	62.06	30.69	45.14	30.27	46.80
T_7	NAA 200 ppm	47.05	67.42	30.20	66.53	30.92	46.54	30.86	47.41
T_8	CCC 500 ppm	22.24	50.84	30.30	70.73	33.08	54.16	33.98	55.87
T_9	CCC 750 ppm	23.37	51.08	31.53	69.60	34.25	55.40	34.52	56.33
T_{10}	CCC 1000 ppm	24.04	53.96	32.00	71.49	35.98	59.33	36.07	59.44
T_{11}	MH 50 ppm	21.91	45.23	30.10	64.13	30.92	47.84	28.09	49.54
T_{12}	MH 100 ppm	22.11	47.43	30.40	69.46	31.63	49.66	30.78	51.81
T_{13}	MH 150 ppm	22.24	48.38	30.73	70.06	32.60	53.60	32.72	53.67
S.E(m±)		2.30	1.49	2.03	2.74	1.76	3.04	1.46	2.69
CD(P=0.05)		6.75	4.38	5.97	8.06	5.18	8.93	4.30	7.91
CV		11.66	4.31	11.25	7.00	9.36	9.98	7.82	8.75

Conclusion

According to the research findings application of different plant growth regulators had a significant impact on vegetative growth of gaillardia. Among the different plant growth regulators, application of GA_3 100 ppm (T_2) recorded the maximum plant height (cm) at 60 and 90 DAT, number of branches per plant at 60 and 90 DAT, plant spread N-S(cm) at 60 and 90 DAT and E-W (cm) at 60 and 90 DAT.

Considering the effect of different plant growth regulators, the treatment T_2 (GA_3 100 ppm) showed a significant impact on vegetative growth of gaillardia over the rest of the treatment. Hence, the treatment T_2 (GA_3 100 ppm) may be recommended as foliar spray for improvement of vegetative growth of gaillardia.

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