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Influence of mulching and bio regulators on yield in gaillardia (*Gaillardia pulchella*)

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Abstract
The field experiment was undertaken at College of Horticulture, Dapoli, Dist. Ratnagiri during *Rabi* season of the year 2021-22 undertaken to assess the influence of mulching and bio regulators on yield of flowers in Gaillardia. The experiment was laid out in Split Plot Design with three replications with three main plot treatments as M_1- Plastic mulch (Black polythene) 30 micron, M_2 - Paddy straw mulch(Organic) and M_3- Control. The sub plot treatments were consisted with bioregulatos viz; T_1- NAA @ 100 ppm, T_2 - NAA @ 150 ppm, T_3 - NAA @ 200 ppm, T_4 - GA_3@ 100 ppm, T_5 - GA_3@ 150 ppm, T_6 - GA_3@ 200 ppm, T_7 – Control. Maximum number of flowers per plant (86.15) were observed in M_1T_4 (Polythene mulch + GA_3@100 ppm). The least number of flowers per plant (59.75) was recorded in M_3T_7 (Control) treatment. Highest flower yield (259.85 gm/plant and 133.41 q/ha) was recorded in the treatment M_1T_4 (Polythene mulch + GA_3 @100 ppm). The lowest flower yield (135.05 gm/plant and 68.61 q/ha) was observed in the treatment M_3T_7 (Control).

Keywords: Gaillardia, mulching, bioregulators, yield

Introduction
Gaillardia is a member of the Asteraceae family and it is Mexican and South Western United States native. The term "blanket flower" is used frequently for gaillardia inflorescence's popular name may also refer to the tendency of wild species to cover the ground with colonies or to the colourful blankets fashioned by local people that resemble it. The gaillardia is mostly planted for its cut flowers, but it is also used for loose flower arrangements at social gatherings and for producing garlands for religious occasions. Its stunningly colourful blooms look best when put in copper bowls or straightforward, neutral-hued vases.

Numerous elements, including genetic, environmental and managerial considerations, are necessary for the crop to be successfully cultivated for commercial purposes. In recent years, scientists have focused increasingly on employing certain bio-regulators to control plant growth, flower output, and quality. Bio-regulators are used to regulate a variety of elements of plant development and growth, including as height, bloom initiation, and fruit set. Several bio-regulators alter hormone and enzyme physiological processes, which interferes with normal development (Danielson, 2005) [2] and eventually affects plant growth, yield, and flower quality. bio-regulators, in particular, slow down cell division and the lengthening of plant aerial parts. Mulching increases the soil temperature and moisture, control the weeds besides improving the chemical and physical properties of soil thereby improving the productivity of the crop. In the era of declining resources, there is need to standardize precision farming technologies for farmers with the aim to enhance the productivity and to reduce water foot print per unit of crop produce. Mulching and its skillful application can lead to improve soil organic matter and other soil characteristics. Gaillardia is a potential crop in the Konkan region and climate of this region is favorable for more growth of crop. To alter the growth habit and to manipulate the flowering, the present investigation was carried out with a view to study the effect of bioregulators and mulching on flowering in gaillardia.

Material and Methods
The experiment was conducted at College of Horticulture, Dapoli, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri during *Rabi* season of the year 2021-22. The experiment was laid out in Split Plot Design with three replications with three main plot treatments as M_1- Plastic mulch (Black polythene) 30 micron, M_2 - Paddy straw mulch (Organic) and M_3- Control. The sub plot treatments were consisted with bioregulatos viz; T_1- NAA @ 100 ppm, T_2 - NAA @ 150 ppm, T_3 - NAA @ 200 ppm, T_4-GA_3 @ 100 ppm, T_5 -

GA_3 @ 150 ppm, T_6 - GA_3 @ 200 ppm, T_7 – Control. The preparatory tillage operations were carried out and the flat beds of 2.70 m X 1.35 m were prepared. The healthy, 30 days old seedlings of gaillardia were transplanted at spacing of 45 cm X 45 cm. Black polythene mulch film cut in size of 2.7m x 1.35 m and laid between two rows of seedlings in such a way that it covers all the area between two rows. The both edge of polythene stripe were buried at either side of flat beds to protect the film against damage by wind. The paddy straw was laid as mulch between the two rows of seedlings in such a way that it covers the area between two rows. Care was taken that maximum area of research plot was covered under mulch. The recommended cultural practices were followed uniformly to experimental plots to grow the crop. As per the treatments, the spraying of different growth regulators in prescribed concentration was done at 30, 45 and 60 days after transplanting. The observations on growth viz: plant height, plant spread, number of branches and leaf area were recorded on randomly selected five plants at 30, 60 and 90 days after transplanting. The observations on The data were statistical analyzed by standard method of analysis of variance as given by Panse and Sukhatme (1985) [6].

Results and Discussion

The data regarding to number of flowers harvested per plant are presented in Table 1 which clearly represent that there was significant variation in number of flowers per plant among the different mulching and bio-regulators treatments. Significantly maximum number of flowers per plant (75.31) were observed in M_1 (Polythene mulch). Whereas minimum number of flowers per plant (73.50) was recorded in M_3 (Control) treatment.

Table 1: Effect of mulching and bio-regulators on number of flowers/plant of gaillardia

Treatment combinations	Number of flowers/plant			
	M_1	**M_2**	**M_3**	**Mean**
T_1	72.17	71.20	70.29	71.22
T_2	69.40	70.32	69.90	69.87
T_3	69.07	68.53	67.47	68.36
T_4	86.15	84.70	82.64	84.50
T_5	85.49	84.17	82.07	83.91
T_6	84.68	83.60	80.75	83.01
T_7	60.23	59.75	61.37	60.45
Mean	75.31	74.61	73.50	74.47
	S.Em±	C.D@5%	Result	
M	0.22	0.88	SIG	
T	0.43	1.23	SIG	
MxT	0.74	2.13	SIG	

The higher number of flowers is mainly due to production of more number of branches with good number of developed flowers on the branches. The mulching is beneficial to improve the soil physical, biological and chemical conditions for better growth. Similar results in flower yield were observed by Malshe *et al.* (2017) [5] and Sikarwar *et al.* (2021) [10] in marigold.

The highest number of flowers per plant (84.50) was observed in the treatment T_4 (GA_3 @100 ppm) and was at par with T_5 (83.91). Minimum number of flowers per plant (60.45) was recorded in the treatment T_7 (Control). Higher number of flowers per plant is attributed to the production of large number of branches at the early stage which than had sufficient time to accumulate reserve carbohydrates for proper bud differentiation. The similar effect of GA_3 on number of flowers per plant was observed by Ramdevputra *et al.* (2009) [7] in marigold, Kadam (2020) [3] and Shirsat *et al.* (2021) [9] in gaillardia.

The interaction effect between mulching and bio-regulators was found significant. Maximum number of flowers per plant (86.15) were observed in M_1T_4 (Polythene mulch + GA_3@100 ppm) which was at par with M_1T_5 (Polythene mulch + GA_3 @150 ppm). The least number of flowers per plant (59.75) was recorded in M_3T_7 (Control) treatment. The higher number of flower per plant was observed in black polythene mulch with GA_3application treatment. The vigour growth of crop in this treatment combination led to produce more number of flowers.

The data on effect of mulching and bio-regulatorson flower yield per plant and per hectare are presented in Table 2. From the data, it is cleared that flower yield in different mulching andbio-regulatorstreatments showed significant variation. The interaction also exhibited significant variation in yield.

From the data, it is cleared that flower yield in mulching treatments showed significant variation. Highest flower yield per plant (219.96 gm) was recorded in the treatment M_1 (Polythene mulch). The lowest flower yield per plant (178.40 gm) was observed in the treatment M_3 (Control). Correspondingly, the maximum flower yield per ha (111.70 q) was noticed in the treatment M_1 (Polythene mulch). The lowest flower yield per ha (90.24 q) was observed in the treatment M_3 (Control).

It is clear that the flower yield in polythene mulch was higher which may be because of all the better growth characters *viz*., plant height, plant spread, number of branches, and diameter of flowers in the respective treatment. The findings were in accordance with the research of Malshe *et al.* (2017) [5], Sikarwar *et al.* (2021) [10] and Shinde *et al.* (2021) [8] in marigold.

Highest flower yield per plant (231.10 gm) was recorded in the treatment T_4 (GA_3 @100 ppm) and it was at par with the treatment T_5 (GA_3 @ 150 ppm) 225.34 g.The lowest flower yield per plant (157.76 gm) was observed in the treatment T_7 (Control). Significantly maximum flower yield per ha (120.12 q) was recorded in the treatment T_4 (GA_3 @100 ppm) which was followed by treatment T_5 (115.22q) per ha. The lowest flower yield per ha (80.04 q) was recorded in the treatment T_7 (Control).

The most impressive yield of flowers per plant, plot and hectare was recorded with treatment GA_3 at 100 ppm. The influence of raising the flower yield was due to improved plant vigour which led to increase in the number of flowers. Similar results were found by Makwana (1999) [4], Ramdevputra *et al.* (2009) [7], and Shirsat *et al.* (2021) [9] in Gaillardia.

Highest flower yield per plant (259.85 gm) was recorded in the treatment M_1T_4 (Polythene mulch + GA_3 @100 ppm). The lowest flower yield per plant (135.05 gm) was observed in the treatment M_3T_7 (Control). The flower yield per ha (133.41 q) was recorded maximum in the treatment M_1T_4 (Polythene mulch+GA_3 @100 ppm). The lowest flower yield per ha (68.61 q) was in the treatment M_3T_7 (Control). The most impressive yield of flowers per plant, plot and hectare was recorded with treatment Polythene mulch with GA_3 at 100 ppm. The higher yield in mulching treatments might be attributed to the large sized flowers with more fresh weight of flowers. The role of GA_3 in crop growth in vegetative and

reproductive phase favours the flowering potential of crop. From the present investigation, it is cleared that the planting of gaillardia with polythene mulching and application of 100 ppm GA_3 at 30, 60 and 90 days after planting exhibited highest yield.

Table 2: Effect of mulching and bio-regulators on yield characters of gaillardia

Treatment combinations	Flower yield per plant (g)				Flower yield per ha (q)			
	M_1	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**
T_1	231.69	215.41	194.50	213.87	118.45	110.42	94.75	107.87
T_2	201.33	197.35	175.82	191.50	101.18	101.71	90.64	97.84
T_3	203.55	181.86	174.23	186.55	104.15	93.37	85.51	94.34
T_4	259.85	228.97	204.49	231.10	133.41	117.67	109.27	120.12
T_5	249.84	233.42	192.75	225.34	129.73	120.68	95.25	115.22
T_6	211.54	214.30	171.99	199.28	103.53	85.70	87.66	92.30
T_7	181.91	156.31	135.05	157.76	91.47	80.04	68.61	80.04
Mean	219.96	203.95	178.40	200.77	111.70	101.37	90.24	101.10
	S.Em±	C.D@5%	Result		S.Em±	C.D@5%	Result	
M	1.51	5.94	SIG		0.57	2.22	SIG	
T	2.50	7.16	SIG		0.83	2.38	SIG	
MxT	4.32	12.39	SIG		1.44	4.13	SIG	

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