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Effect of Plant Bio-Regulators on Vegetative and Floral Attributes of Chamomile (*Matricaria chamomilla* L.) cv. CIM Sammohak

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ABSTRACT

The present investigation was carried out at Medicinal Research and Development Centre, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, during Novemberr 2016 to April 2017 to evaluate the effect of plant bio-regulators viz., NAA, IAA and gibberelic acid, each at three concentrations (25, 50 and 100 mg l^{-1}) on chamomile (Matricaria chamomilla L.). The experiment was laid out in Randomized Block Design (RBD) with three replications and ten treatments. During the study, observations were taken for various vegetative and floral parameters like plant height (cm), number of branches per plant, plant spread (cm), total number of roots per plant, total biomass of plants, stem diameter (mm), days taken to first bud initiation, flower diameter (cm), number of flowers per plant and fresh and dry weight of flowers per plant (g). Among the different treatments, GA_3 at 100 mg l^{-1} was found to be the best treatment for most of the parameters viz., plant height (44.54 cm), number of branches per plant (38.20), plant spread (54.00 cm), days taken to first bud initiation (15.53), flower diameter (2.57 cm), number of flowers per plant (368.93), fresh weight of flowers per plant (35.56 g) and dry weight of flowers per plant (6.96 g), whereas, NAA at 100 mgl^{-1} proved to be the best for stem diameter (6.76 mm). GA_3 @ 100 $mgl^{-1}$was found to be the most effective for most of the vegetative and floral characteristics of chamomile cv. CIM Sammohak.

Key words: *Chamomile, IAA, GA_3, NAA, Vegetative growth, Floral traits*

INTRODUCTION

Chamomile (*Matricaria chamomilla* L.) is an annual plant belonging to the Asteraceae family often referred to as the "Star among medicinal species"[19]. It is one of the important medicinal herb native to southern and eastern Europe[18]. Over 120 components have been identified in chamomile essential oil, while α-bisabolol, chamazulene, α- and β-bisabolol oxides, farnesene and α-bisabolonoxide A are the most important ones[12]. Chamomile is known to be its anti-inflammatory, anti-spasmodic, anti-bacterial, and antiseptic properties[10].

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Indole acetic acid (IAA), a natural auxin, is one of the auxins biosynthesized within plant organs and affects many physiological processes, mainly required for cell-elongation. Besides involved in apical dominance, cell division and cell enlargement shoot and root growth, auxin play specific role in growth, flowering, seed germination, etc. On the other hand, another prominent phyto-hormone, gibberellic acid (GA_3), has the potential control on growth and flowering processes. In addition, GA_3 application increases petiole length, leaf area and delays petal abscission and colour fading (senescence) by the hydrolysis of starch and sucrose into fructose and glucose[8].

Naphthalene acetic acid belongs to the auxin group of bio-regulators. It is a synthetic auxin. Actually auxins are synthesised in the stem and root apices and transported through the plant axis. They are characterized principally by their capacity to stimulate stem elongation in excised stem.

Recognizing the potential of medicinal plants sectors, workers have reoriented their research priorities on medicinal crops. Moreover, under *Tarai* conditions, the applicability of plant bio-regulators in the flower production of chamomile is scanty. A crop of much importance, chamomile still lacks popularity and preference under field condition. So, keeping in view, the present study was aimed to investigate and compare the effect of plant bio-regulators (IAA, GA_3 and NAA) on vegetative growth, floral attributes and quality flower production of chamomile and to find out the best treatment of plant bio-regulator for qualitative and quantitative production of chamomile.

MATERIAL AND METHODS

The present investigation was conducted at Medicinal Research and Development Centre, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, during November 2016 to April 2017. The region is characterized by sub-tropical humid climate with dry hot summers, cold winters and intense rainy season. The experiment was plotted according to Randomized Block Design with three replications for each treatment. The planting of uniform sized seedlings was done in raised beds in November, 2016. The seedlings were transplanted at a spacing of 30 cm x 30 cm from plant to plant and row to row accommodating 36 plants per meter square area. The plants were watered immediately after transplanting and afterwards at weekly intervals during growing period.

Stock solutions of known concentration were prepared only before use. The bio-regulators, IAA, GA_3 and NAA were first dissolved in a minimum volume HCl and NaOH/KOH of 0.1 N, respectively and required volume was made up with distilled water to make stock solutions. Freshly prepared aqueous solution of IAA, GA_3 and NAA from stock solutions were applied twice by foliar application, 1st after one moth of transplanting and 2nd spray after 10 days of 1st one. Wetting agent (Tapol, 1 ml l^{-1}) was added to the freshly prepared solution of growth regulators before spraying on plant foliage till running (20 ml per plant) using plastic automizer. Each growth regulator had three concentrations of IAA, GA_3 and NAA i.e., 25, 50 and100 mg l^{-1}. In addition, untreated plants were spread with distilled water and wetting agent to serve as control.

Five samples were drawn from all treatments with three replications at full flowering stage. Plant height, number of branches per plant, plant spread, stem diameter, total biomass of plants, total number of roots per plant, days taken to first bud initiation, flower diameter, number of flowers per plant and fresh and dry weight of flowers per plant were determined at full flowering stage.

The average of the obtained data of one season was subjected to statistical analysis using F test according to the procedure of Gomez and Gomez[11]. Critical difference at 5% was calculated to compare the mean value of determined criteria of different treatments.

RESULTS AND DISCUSSION

It is evident from the data presented in Table 1 that the maximum plant height (44.54 cm) was found in T_6 (100 ppm GA_3) followed by T_5 i.e. 50 ml l^{-1} GA_3 (42.70 cm) while control (T_0) recorded minimum plant height of 29.26 cm. The increased plant height in plants treated with GA_3 might be due to enhanced cell division, cell enlargement and promotion of protein synthesis coupled with higher dry matter accumulation in the plants. These results were also in close conformity with the findings of Fatma Reda *et al.* [9] in chamomile, Maurya and Nagda[16] in gladiolus and Dutta *et al*.[6] in sweet flag. The plant bio-regulators also had stimulatory effect on number of branches per plant with maximum (38.20) number of branches per plant recorded in T_6 (100 ml l^{-1} GA_3) followed by T_5 i.e. 50 ml l^{-1} GA_3 (36.13) while the minimum number of branches was found in T_0 i.e. control (23.06) which was at par with T_1 (25 ml l^{-1} NAA) which recorded 23.43 branches per plant. Present results are in parallel line with the investigation of Ebeem[7] and Fatma Reda *et al.*[9] who also found increase in number of branches per plant with GA_3 treatment in carnation and chamomile, respectively. The application of 100 ml l^{-1} GA_3 (T_6) resulted in maximum plant spread (54.0 cm) followed by T_5 (50 ml l^{-1} GA_3), however control recorded minimum plant spread (38.13 cm) among all the treatments. This might be due to increase in length of internodes which may be attributed to promotion in protein synthesis, faster cell division and cell enlargement in the treated plants. Dalal *et al*.[3], in chrysanthemum and Sehrawat *et al.*[20] in marigold also reported similar results with the application of GA_3. Foliar application of 100 ml l^{-1} NAA (T_9) and T_0 (Control) exhibited maximum (6.76) and minimum (5.19 mm) stem diameter, respectively which might be due to the fact that at low plant height, better growth was observed due to less vegetative growth, sufficient space and less competition among the adjacent plants. Singh *et al.*[21], also investigated the similar stimulatory effects with the application of NAA in long pepper and chilli. The total number of roots per plant and total biomass of plant were increased to maximum 21.86 and 25.46 g in plants treated with 100 ml l^{-1} NAA and 100 ml l^{-1} GA_3, respectively while they were recorded minimum in control with 16.80 roots per plant and 16.20g biomass of plant. Davis and Haissing[4] reported that increased number of roots due to auxin application is a common feature in many herbaceous perennial crops. According to Kumar *et al.*[14], increase in total dry matter production was higher at GA_3 application in carnation. The possible reason may be increased translocation of carbohydrates. Bharathy *et al.*[1] in carnation reported stimulatory effect in earliness in rooting, rooting percentage and number of roots per plant with NAA @ 500 ml l^{-1} application.

A perusal of data presented in Table 2 reveals that application of plant bio-regulators also had stimulatory effect on flowering parameters of chamomile. Application of 100 ml l^{-1} GA_3 resulted in first bud initiation at 15.53 days which was earliest among all the treatments. However, application of 25 ml l^{-1} IAA had insignificant effect on first bud appearance as it required same number of days (19.86 days) as that of observed in control. The reason may be attributed to GA_3 replaced the long photoperiod requirement and induced early bud initiation. Maurya and Nagda[16] in gladiolus, Swaroop *et al*.[23] and Sunitha *et al.*[22] in African marigold cv. Pusa Narangi Gainda also reported decline in number of days with GA_3 application. Significant increase in number of flowers per plant and number of flowers per m^2 were recorded with maximum in T_6 (100 ml l^{-1} GA_3) i.e. 368.93 and 3404 followed by T_5 (50 ml l^{-1} GA_3) i.e. 361.80 and 3370.0 while minimum in control (264.46, 2476.0), respectively. The reason might be enhanced photosynthesis and reproductive efficiency due to increased cell division, cell enlargement and promotion of protein synthesis. Negi and Kumar [17] reported increase in number of inflorescence and length of inflorescence stalk with application of plant bio-regulators in rose geranium. Kumar *et al*.[14] demonstrated that foliar application of plant

bio regulator increases number of flowers per plant in African marigold cv. Pusa Narangi Gainda. Fatma Reda *et al*.[9] observed that flower yield in chamomile was increased by the application of GA_3 @ 100 ml l^{-1} . The slight increase in flower diameter was also reported over control in treated plants. Maximum size of flower (2.57 cm diameter) was found in T_6 (100 ml l^{-1} GA_3) while minimum was reported in control (2.26 cm). The increased diameter might be due to cell division and cell enlargement in the floral meristematic region, promotion of protein synthesis coupled with high dry matter accumulation. These findings are in close conformity with those of Karaguzel *et al.*[13] in gladiolus, Delvadi *et al.*[5] in gallardia and Bhattacharjee[2] in dahlia. The fresh and dry weight of flowers per plant were found maximum in T_6 (500 ml l^{-1} GA_3) i.e. 35.56 and 6.96 g, respectively, while minimum were recorded in control i.e. 25.57 g of fresh flower and 4.97 g of dry flowers per plant. Fatma Reda *et al*.[9] also reported increase in dry weight of flowers per plant with GA_3 application.

Table 1: Effect of plant bio-regulators on vegetative characters of chamomile (*Matricaria chamomilla* L.)

Treatments	Plant height (cm)	No. of branches per plant	Total no. of roots /plant	Plant spread (cm)	Stem diameter (cm)	Total biomass of plant (g)
T_o (Control)	29.26	23.06	16.80	38.13	5.19	16.20
T_1 (IAA 25 mg l^{-1})	31.93	23.43	19.13	39.80	5.28	20.40
T_2 (IAA 50 mg l^{-1})	32.47	24.90	20.73	41.53	5.86	20.53
T_3(IAA 100 mg l^{-1})	34.09	30.83	21.73	45.73	6.45	22.06
T_4 (GA_3 25 mg l^{-1})	38.58	33.73	19.00	49.93	5.26	22.80
T_5 (GA_3 50 mg l^{-1})	42.70	36.13	19.33	53.60	5.31	25.20
T_6 ($GA_3$100 mgL^{-1})	44.54	38.20	20.86	54.00	5.57	25.46
T_7 (NAA 25 mg l^{-1})	31.83	24.73	19.73	39.73	5.32	20.33
T_8 (NAA 50 mg l^{-1})	32.55	28.76	21.13	42.93	5.99	21.33
T_9 (NAA100 mg l^{-1})	36.10	32.23	21.86	49.59	6.76	22.60
C.D. at 5%	1.63	4.35	2.46	4.31	0.56	2.28

Table 2: Effect of plant bio-regulators on flowering of chamomile (*Matricaria chamomilla* L.)

Treatments	Days taken to first bud initiation	No. of flowers per plant	Flower diameter (cm)	Fresh weight of flower/plant (g)	Dry weight of flower/plant (g)	No. of flowers per m^2
T_o (Control)	19.86	264.46	2.26	25.27	4.97	2476.0
T_1 (IAA 25 mg l^{-1})	19.86	268.06	2.35	25.85	5.15	2492.0
T_2 (IAA 50 mg l^{-1})	19.33	285.46	2.40	27.35	5.51	2732.0
T_3(IAA 100 mg l^{-1})	18.06	330.53	2.48	31.66	6.38	2914.0
T_4 (GA_3 25 mg l^{-1})	17.46	312.00	2.46	29.90	5.95	2783.0
T_5 (GA_3 50 mg l^{-1})	15.73	361.80	2.54	35.17	6.95	3370.0
T_6 ($GA_3$100 mg l^{-1})	15.53	368.93	2.57	35.56	6.96	3404.0
T_7 (NAA 25 mg l^{-1})	19.53	275.53	2.39	26.46	5.26	2662.0
T_8 (NAA 50 mg l^{-1})	18.53	307.46	2.42	29.86	5.93	2741.0
T_9 (NAA100 mg l^{-1})	16.66	334.40	2.52	32.29	6.40	2938.0
C.D. at 5%	0.91	17.10	0.10	1.73	0.38	217.43

CONCLUSION

On the basis of experimental findings, it can be concluded that that the GA3 and NAA at 100 mg l^{-1} can be recommended for obtaining higher herbage and flower yield of chamomile cv. CIM Sammohak under *Tarai* conditions of Uttarakhand.

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