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Effect of biostimulants on growth, flower yield and quality of marigold (*Tagetes patula* L.)

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Abstract

The present investigation entitled “Effect of Biostimulants on growth, flower yield and quality of Marigold (*Tagetes patula* L.)” was conducted at Horticulture Research and Instructional Farm, Department of Horticulture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during the year 2023-24. The experiment was laid out in Completely Randomized Design with three replications comprising ten treatments viz. T₁ control, T₂ *Trichoderma* @ 10 ml, T₃ *Pseudomonas* @ 10 ml/ T₄ PSB (Phosphorus Solubilizing Bacteria) @ 10 ml, T₅ *Azotobacter* @ 10 ml, T₆ *Azospirillum* @ 10 ml, T₇ *Trichoderma* @ 10 ml + *Pseudomonas* @ 10 ml, T₈ *Trichoderma* @ 10 ml + *Azotobacter* @ 10 ml, T₉ *Trichoderma* @ 10 ml + *Azospirillum* @ 10 ml, T₁₀ *Trichoderma* @ 10 ml + PSB @ 10 ml + *Pseudomonas* @ 10 ml. The result indicated that all the plant growth, flowering and root growth parameters were significantly affected by biostimulants. Maximum plants growth, flowering and root growth observed under T₁₀ (*Trichoderma* @ 10 ml + PSB @ 10 ml + *Pseudomonas* @ 10 ml), which was followed by T₇ (*Trichoderma* @ 10 ml + *Pseudomonas* @ 10 ml) in French Marigold.

Keywords: French marigold (*Tagetes patula* L.), biostimulants, *Trichoderma*, *Pseudomonas*, PSB, *Azospirillum*, *Azotobacter*

Introduction

French marigold (*Tagetes patula* L.) is one of the most popular ornamental plants in the horticulture industry, being used for planting and shaping beds, as potted flowers (dwarf varieties), and as cut flowers (tall varieties). It is a widely grown plant in gardens and pots, used for rockery, edging, hanging baskets and window boxes. highly suitable as a bedding plant, herbaceous border and shrubberies to provide color and to fill the space (Choudhary *et al.* 2014) [2]. Leaf extract is a successful treatment for earache. Flower extract is an effective blood purifier and treatment for blood piles, ulcers, and eye problems. Marigold plants' leaves have a characteristic odoriferous oil. Essential oil of marigold is widely used in perfumery industries. The oil contains bronchodilating, tranquilizing, anti-inflammatory, and juvenile hormone properties, as well as insect repellent properties against flies, ants, and mosquitos. The term bio-fertilizer has been coined to include soil micro-organism which fix nitrogen, mobilize or conserve plant nutrients. The term bio-fertilizers or microbial inoculants can be define as the preparations containing strains of micro-organism which can augment the microbiological process viz. nitrogen fixation, phosphate solubilisation or mineralization, extraction of plant growth promoting substances or cellulose or lignin biodegradation in soil, compost or other environment.

Materials and Methods

The experiment was conducted at Horticulture Research and Instructional Farm, Department of Horticulture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during the year 2023-24. The experiment was laid out in Completely Randomized Design with three replications comprising ten treatments viz. T₁ control, T₂ *Trichoderma* @ 10 ml, T₃ *Pseudomonas* @ 10 ml/ T₄ PSB (Phosphorus Solubilizing Bacteria) @ 10 ml, T₅ *Azotobacter* @ 10 ml, T₆ *Azospirillum* @ 10 ml, T₇ *Trichoderma* @ 10 ml + *Pseudomonas* @ 10 ml, T₈ *Trichoderma* @ 10 ml + *Azotobacter* @ 10 ml, T₉ *Trichoderma* @ 10 ml + *Azospirillum* @ 10 ml, T₁₀ *Trichoderma* @ 10 ml + PSB @ 10 ml + *Pseudomonas* @ 10 ml. The application of bio-fertilizers in marigold through cutting dip treatment up to 25 minutes of various

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biostimulants and its combination at the time of transplanting in T₂, T₃, T₅, T₆, T₇, T₈, T₉, and T₁₀. Seedling treatments. and use some cultural practices like irrigations, weeding and plant protection among all treatments.

Results and Discussion

Vegetative Growth Parameters

The different biostimulants affected various vegetative parameters of French marigold (Table 1). The treatment T₁₀ *Trichoderma* @ 10 ml + PSB @ 10 ml + *Pseudomonas* @ 10 ml. had the maximum plant height (45.86 cm), number of

primary branches/plant (22.95) and number of secondary branches/plant (39.66), plant spread (34.26 cm). Biostimulants like *Azotobacter* and PSB may have been beneficial by fixing atmospheric nitrogen and solubilizing fixed phosphorous in the soil, making it available to plants, and also by secretion of growth substances like auxin which might have stimulated plant metabolic activity and photosynthetic efficacy leading to better growth and development. These results are in conformity with the findings of Mittal *et al.* 2010^[5] and Mohanty *et al.* in marigold.

Table 1: Effect of different biostimulants on Plant height (cm), Number of primary branches, Number of secondary branches and Plant spread (cm).

Tr. No	Plant height (cm)	Number of primary branches	Number of secondary branches	Plant spread (cm)
T ₁	30.92	20.11	24.00	22.26
T ₂	34.53	20.22	29.56	24.30
T ₃	33.79	20.98	30.82	26.50
T ₄	44.28	21.48	36.71	29.30
T ₅	38.57	21.95	36.58	28.68
T ₆	45.02	21.75	35.79	28.13
T ₇	45.45	22.82	38.22	29.80
T ₈	40.47	21.95	37.72	28.76
T ₉	45.18	22.26	37.62	29.52
T ₁₀	45.86	22.95	39.66	34.26
SEm±	0.207	0.389	0.331	0.099
C.D. at 5%	0.614	1.156	0.984	0.293

Flowering and Yield Attributes

The data on flowering traits are presented in Table 2. It is clearly showing that T₁₀ recorded with least number of Days for 50% flowering (35.33 days) followed by T₇ (36.33 days) whereas, maximum number of Days for 50% flowering (47.33 days) were recorded with T₁ (control). Similar findings were noted by Thumar *et al.* 2006^[9] in African marigold. Treatment T₁₀ resulted in maximum Number of flower per plant (50.66) which was at par T₇ (49.00) whereas, T₁ was reported for minimum (27.66). The effect of China aster (*Callistephus chinensis* (L.) on Applying 50% recommended NPK, vermicompost, *Azospirillum*, and PSB led to the highest flower output (11.71 t/ha) and number of flowers per plant (46.60). examined Chaitra and Patil's 2007^[1] Data clearly showed that T₁₀ resulted in greater diameter of flower (3.73 cm) followed by T₉ (3.29 cm) while, control plants recorded minimum diameter of flower (2.07 cm). The increase in flower diameter. The current results with

marigold are comparable to those of Sharma *et al.*^[7] and Gupta *et al.* 1999^[3] With PSB applied, the flower's maximum diameter of 6.18 cm was achieved.

The maximum average weight of flower per plant of (2.72) was recorded in treatment T₁₀, followed by treatment T₇ (2.62) The minimum (1.31) average weight of flower per plant was noticed in T₁ (control). Maximum duration of flowering (57.07 days) was recorded under T₁₀ followed by T₇ (days) whereas, minimum duration of flowering (38.91 days) was observed with T₁. Maximum flower longevity (42.74 days) which results in earlier flower initiation and longer blossom duration. In petunia, Mina Zarghami Moghadam *et al.* (2013)^[6] observed the similar outcome. The maximum flower yield was observed T₁₀ (137.0) followed by treatment T₇ (137.0). Were as minimum flower yield (36.23) was observed in T₁ (control). which results the increase in flower yield, as they were suitable for growth and yield (Kumar *et al.* 2009)^[4].

Table 1: Effect of different biostimulants of days for 50% flowering, Number of flower per plant, flower diameter (cm), Average weight of flower per plant (g), Duration of flowering (days) and Flower yield per pot (g)

Tr. No	Days for 50% flowering	Number of flower per plant	Flower diameter (cm)	Average weight of flower per plant (g)	Duration of flowering (days)	Flower yield per pot (g)
T ₁	47.33	27.66	2.07	1.31	44.04	36.23
T ₂	44.00	33.33	2.70	1.58	47.84	52.61
T ₃	42.83	31.33	2.72	1.80	49.91	56.39
T ₄	37.33	35.66	3.22	2.54	53.66	90.42
T ₅	36.66	38.00	3.05	2.15	55.60	81.70
T ₆	37.34	40.33	3.13	2.33	55.33	93.96
T ₇	36.33	49.00	3.07	2.62	56.33	137.0
T ₈	37.60	42.00	3.18	2.40	55.73	100.0
T ₉	37.00	48.00	3.29	2.46	53.33	118.0
T ₁₀	35.33	50.66	3.73	2.72	57.07	137.0
SEm±	1.169	1.592	0.148	0.040	1.087	0.117
C.D. at 5%	3.471	4.728	0.439	0.084	3.228	0.347

Root growth characters

The data on flowering traits are presented in Table 3. It is clearly showing that The different biostimulants affected of root growth characters on French marigold. The treatment T₁₀ *Trichoderma* @ 10 ml + PSB @ 10 ml + *Pseudomonas* @ 10 ml had the maximum on total number of roots (77.69) which was followed by T₇ (64.36) Were as minimum total number of roots (30.32) was observed in T₁ (control). The maximum on length of longest root T₁₀ (35.60 cm) which was followed by T₇ (30.41 cm) Were as minimum length of longest root (12.07 cm) was observed in T₁ (control).

T₁₀ treatment had the maximum fresh root weight (7.65) .which was statistically at par with T₇ (7.49 g) were as minimum fresh root weight (6.15g) was observed in T₁ (control). The maximum dry root weight was observed T₁₀ (3.56) followed by treatment T₇ with (3.40). Were as minimum dry root weight (2.11) was observed in T₁ (control). Which results On *Trichoderma harzianum* addition shown greater root growth. Further, root fresh and dry weights were continuously raised in comparison to the control group and rice seedling shoot dry weight was improved (Sivalingam *et al.* 2007) [8].

Table 3: Effect of different biostimulants of Total number of roots, Length of longest root (cm), Fresh root weight (g) and Dry root weight (g)

Tr. No	Total number of roots	Length of longest root (cm)	Fresh root weight (g)	Dry root weight (g)
T ₁	30.32	12.07	6.15	2.11
T ₂	61.53	29.03	7.12	3.28
T ₃	35.66	14.44	6.61	3.23
T ₄	38.32	16.33	7.13	3.10
T ₅	43.93	18.31	6.80	2.98
T ₆	46.05	22.34	6.95	2.66
T ₇	64.36	30.41	7.49	3.40
T ₈	62.60	29.60	7.30	3.39
T ₉	62.80	30.32	7.40	3.30
T ₁₀	77.69	35.60	7.65	3.56
SEm±	0.479	0.432	0.100	0.072
C.D. at 5%	1.424	1.282	0.296	0.215

Author Contributions

Pooja Gupta, Major advisor of the thesis research work carried out; Preeti, Student who carried out this masters' thesis research work; Ashwarya Lalit Tandon, Member, advisory committee of the thesis research work carried out.

Conclusion

The results showed that T₁₀ *Trichoderma* @ 10 ml + PSB @ 10 ml + *Pseudomonas* @ 10 ml was noted to be the best amongst all the treatments to better vegetative growth, flowering yield and root growth of French Marigold. The application of biostimulants can ensure the production of high-quality ornamental plants by increasing the resilience of plants to temperature stress and improving the uptake of nutrients.

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