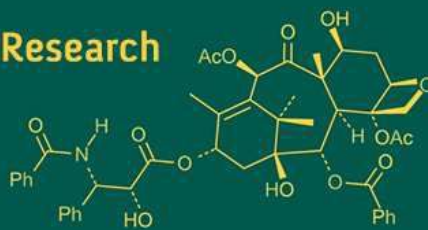


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Manipulation in canopy structure using plant growth retardant in cosmos (*Cosmos sulphureus*)

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Abstract

An experiment titled Manipulation in Canopy Structure using Plant Growth Retardant in Cosmos (*Cosmos sulphureus*) was carried out to study the effect of different growth retardants on cosmos plant at the Horticultural Research cum Instructional Farm, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G) during the year 2024-2025. The study confirmed that cosmos plants treated with foliar application of Ethephon at 900 ppm (T_8) significantly reduced plant height 70.47 cm at 60 DAT and 104.65 cm at 90 DAT, increased stem diameter 15.98 mm at 60 DAT and 18.62 mm at 90 DAT and increased flower diameter (4.96 mm) comparing with all other treatments whereas, Paclobutrazol soil drenching at 5 ppm (T_1) recorded highest number of primary branches per plant at both 60 DAT (16.60 branches) and 90 DAT (23.71 branches), maximum number of secondary branches per plant (23.46 branches) at 60 DAT and (80.20 branches) at 90 DAT, maximum plant spread (E-W) 74.89 cm and (N-S) 71.48 cm, Maximum number of flowers per plant 5.5 flowers at 60 DAT and 84.3 flowers at 90 DAT and days taken to 50% flowering (62.7 days) and full flowering (74.3 days) was recorded early.

Keywords: Cosmos, paclobutrazol, ethephon, cycocel, vegetative and flowering

Introduction

Cosmos sulphureus is commonly known as yellow cosmos or Sulfur cosmos belongs to family of Asteraceae. The word Cosmos derived from Greek language which means order, harmony or the world. It is native to Mexico and the chromosome number is $2n = 24$. Cosmos plants are annual herbaceous, excellent ornamental crop which is commonly used as bedding annuals, screening purpose and to attract butterflies. Cosmos has been used in traditional herbal remedies for jaundice, intermittent fever and splenomegaly. Triterpene alcohols found in the cosmos such as helianol have been shown to have anti-inflammatory properties (Paniagua *et al.* 2015) [11].

Plant growth retardants have been used to regulate the growth and flowering of annuals. They are used to shorten the length of a plant's shoots in a controlled manner without affecting developmental patterns or being phytotoxic. The application of synthetic growth retardants like paclobutrazol, cycocel and ethephon slows down the cell division or inhibits the gibberellin biosynthesis and cell elongation. Their application has reduced plant height, improved stem diameter and leaf number, altered root architecture directly contributed to yield increase and indirectly reduced the event of lodging (Syahputra *et al.* 2016) [18]. These chemicals used in many ornamental crops to produce more compact and aesthetically pleasing plants by reducing shoot length. Though the cosmos plants are highly attractive and good ornamental value but due to its tall growing nature it leads to bending and make unsuitable for growing in pots. Therefore, keeping in view of foregoing consideration the investigation was carried to study the effect of growth retardants on growth and flowering attributes in cosmos.

Materials and Methods

The present study entitled Manipulation in Canopy Structure using Plant Growth Retardant in Cosmos (*Cosmos sulphureus*) was conducted at the Horticultural Research cum Instructional Farm, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur

(C.G) during the year 2024-2025. Cosmos seedlings were procured from horticulture nursery, IGKV. Healthy seedlings were transplanted 25 days after sowing at 7th December, 2024. Field preparation was done with repeated ploughing and incorporated rotavator to obtain fine tilth. Organic manures such as Farm yard manure 50 kg and vermicompost 15 kg mixed together and applied.

The experiment was laid out in Randomized Block Design (RBD) with 3 replications under open field condition. Each replication consists of 9 treatments and treated with the following growth retardants; (T₀) Control (Water), (T₁) PBZ SD at 5 ppm, (T₂) PBZ SD at 7.5 ppm, (T₃) PBZ SD at 30 ppm, (T₄) PBZ SD at 40 ppm, (T₅) Cycocel FS at 750 ppm, (T₆) Cycocel FS at 1000 ppm, (T₇) Ethephon FS at 600 ppm and (T₈) Ethephon FS at 900 ppm 30 days after transplanting dated January 5, 2025. Different concentration of treatment was prepared and paclobutrazol 5 ppm and 7.5 ppm were drenched in soil remaining all other treatments were sprayed on foliage of individual plants. Control plants were sprayed with distilled water. Different vegetative and flowering parameters were recorded at 60 DAT and 90 DAT. The recorded data were statistically analysed by the randomized block design analysis of variance (ANOVA) as suggested by Fischer (1954) in his book "Design of Experiment".

Results and Discussion

Effect of growth retardants on vegetative attributes of cosmos

Cosmos plants treated with different growth retardants showed significant variation among different vegetative and flowering parameters. Table 1 indicating that the application of ethephon foliar spray at 900 ppm (T₈) resulted in the minimum plant height, with measurements of 70.47 cm at 60 DAT and 104.65 cm at 90 DAT. Whereas maximum plant height was recorded in (T₀) control 106.87 cm at 60 DAT and 157.0 cm at 90 DAT. These findings are

accordance with previous studies, those by Deshmukh (2005) ^[3] in gaillardia, Haque *et al.* (2007) ^[5] in chrysanthemum, Ramrao (2010) in gaillardia, Spitzer and Bilovsky (2017) ^[17] in poppy and Kumar *et al.* (2022) ^[8] in dahlia. This reduction is due to the action of ethephon, functioning as an ethylene-releasing compound, which upon breakdown, elevates ethylene level in plant tissues, thereby suppressing gibberellin activity and auxin transport. This resulted in shortened internodes and height.

The maximum plant spread (E-W) 74.89 cm and (N-S) 71.48 cm was observed with the application of paclobutrazol soil drenching at 5 ppm (T₁). On the other hand, plants treated with (T₈) ethephon foliar spraying at 900 ppm (E-W) 49.33 cm and (N-S) 46.90 cm recorded lowest plant spread. This finding is related with Kumar *et al.* (2022) ^[8] in cosmos The highest number of primary branches per plant was resulted in (T₁) PBZ SD at 5 ppm at both 60 DAT (16.60 branches) and 90 DAT (23.71 branches). Conversely, minimum number of primary branches per plant was recorded from ethephon FS 900 ppm (T₈), with values of 9.27 branches per plant at 60 DAT and 13.65 branches per plant at 90 DAT. The maximum number of secondary branches were observed in (T₁) PBZ SD at 5 ppm (23.46 branches) at 60 DAT and (80.20 branches) at 90 DAT. Minimum number of secondary branches per plant was recorded from ethephon FS 900 ppm (T₈), with values of 10.77 branches per plant at 60 DAT and 43.80 branches per plant at 90 DAT. These results are in agreement with the findings of Abdella (2005) ^[1] in snapdragon, Mishra *et al.* (2005) ^[9] in china aster, Singh *et al.* (2016) ^[16] in geranium, Hemlata and Singh (2017) ^[7] in marigold and Sharaf-Eldien *et al.* (2017) ^[14] in zinnia. The effect of paclobutrazol soil drenching at 5 ppm on branches, plant spread and number of leaves due to the suppression of GA₃ biosynthesis by paclobutrazol, resulting in hormonal changes that favor bud initiation and branching.

Table 1: Effect of growth retardants on vegetative attributes of cosmos

Notation	Treatments	Plant height 60 DAT (cm)	Plant height 90 DAT (cm)	Plant spread (E-W) (cm)	Plant spread (N-S) (cm)	Primary branches 60 DAT	Primary branches 90 DAT	Secondary branches 60 DAT	Secondary branches 90 DAT
T ₀	Control	106.87	157.00	67.67	64.17	13.40	18.20	19.52	64.86
T ₁	PBZ SD at 5 ppm	102.53	146.00	74.89	71.48	16.60	23.71	23.46	80.20
T ₂	PBZ SD at 7.5 ppm	93.40	140.33	70.00	68.41	13.47	22.00	19.83	79.43
T ₃	PBZ FS at 30 ppm	99.07	128.84	59.55	60.35	10.33	17.27	10.56	49.13
T ₄	PBZ FS at 40 ppm	94.40	127.73	58.54	55.21	9.53	15.30	13.80	54.20
T ₅	CCC FS at 750 ppm	91.60	122.64	55.45	53.38	9.40	15.24	13.45	52.00
T ₆	CCC FS at 1000 ppm	89.37	119.30	54.74	52.51	9.30	14.00	11.20	48.99
T ₇	Ethephon FS at 600 ppm	70.80	107.73	51.33	50.61	9.93	15.03	11.00	49.00
T ₈	Ethephon FS at 900 ppm	70.47	104.65	49.33	46.90	9.27	13.65	10.77	43.80
C.D at 5%		12.45	8.24	8.60	5.05	2.68	2.60	3.48	8.79

Table 2 indicating that the highest stem diameter 15.98 mm at 60 DAT and 18.62 mm at 90 DAT and the minimum internodal length 4.81 cm at 60 DAT and 7.12 cm at 90

DAT was recorded in (T₈) ethephon FS at 900 ppm. These findings are consistent with those of Deshmukh (2005) ^[3] in gaillardia, Spitzer and Bilovsky (2017) ^[17] in poppy and

Kumar *et al.* (2022) ^[8] in dahlia. The maximum number of leaves per plant was recorded in plants treated with PBZ SD at 5 ppm treatment (T₁) 68.2 leaves at 60 DAT and 89.08 leaves at 90 DAT. Similar results were reported by El-Sadek (2016) ^[4] in hibiscus, Hemlata and Singh (2017) ^[7] in marigold, Asgarian *et al.* (2013) ^[2], Sharaf-Eldien (2017) ^[14]

in Zinnia and Singh and Bist (2003) ^[15] in rose. The application of PBZ SD at 5 ppm (T₁) resulted in the largest leaf area (31.22 cm²). In contrast, the smallest leaf area (18.50 cm²) was observed in the treatment (T₆) cycocel foliar spraying at 1000 ppm. This finding is consistent with those of Kumar *et al.* (2022) ^[8] in cosmos.

Table 2: Effect of growth retardants on vegetative attributes of cosmos

Notation	Treatments	Leaf area (cm ²)	Number of leaves per plant 60 DAT	Number of leaves per plant 90 DAT	Stem diameter (mm) 60 DAT	Stem diameter (mm) 90 DAT	Internodal length (cm) 60 DAT	Internodal length (cm) 90 DAT
T ₀	Control	28.08	56.7	68.69	13.60	14.62	9.44	13.56
T ₁	PBZ SD at 5 ppm	31.22	68.2	89.08	13.76	14.75	8.43	12.31
T ₂	PBZ SD at 7.5 ppm	29.22	57.2	71.40	14.20	15.47	7.87	11.64
T ₃	PBZ FS at 30 ppm	26.00	43.4	51.53	14.17	14.78	8.19	9.20
T ₄	PBZ FS at 40 ppm	24.89	46.9	56.90	14.33	15.06	7.93	8.63
T ₅	CCC FS at 750 ppm	24.13	40.6	48.98	14.82	16.09	7.94	9.12
T ₆	CCC FS at 1000 ppm	18.50	38.4	46.80	15.24	16.49	6.57	8.23
T ₇	Ethephon FS at 600 ppm	25.08	40.4	47.85	15.84	17.34	5.91	7.56
T ₈	Ethephon FS at 900 ppm	23.17	38.7	45.62	15.98	18.62	4.81	7.12
C.D at 5%		4.75	10.30	3.74	1.37	2.07	1.06	0.77

Effect of growth retardants on flowering attributes of cosmos

Table 3 indicating that the days taken to 50% flowering (62.7 days) and full flowering (74.3 days) was recorded early in (T₁) PBZ SD at 5 ppm. These findings align with the results reported by Mishra *et al.* (2005) ^[9] in china aster, Wei *et al.* (2017) in *Camellia chrysantha* and Sharaf-Eldien *et al.* (2017) ^[14] in zinnia. Maximum number of flowers per plant was recorded in (T₁) PBZ SD at 5 ppm recorded 5.5 flowers at 60 DAT and 84.3 flowers at 90 DAT). These findings align with the results reported by El-Sadek (2016) ^[4] in hibiscus, Hemlata and Singh (2017) ^[7] in marigold, Asgarian *et al.* (2013) ^[2], Sharaf-Eldien (2017) ^[14] in Zinnia, Singh and Bist (2003) ^[15] in rose. This is likely due to the inhibition of gibberellin (GA₃) biosynthesis by paclobutrazol, when the synthesis of gibberellin is blocked, there is an accumulation of precursors in the terpenoid

pathway, which are redirected to enhance the synthesis of abscisic acid (Rademacher, 2000) ^[12].

The shortest pedicel length measuring 18.14 cm and the maximum flower diameter (4.96 mm) was observed in plants treated with ethephon FS at 900 ppm (T₈). This observation is in line with the findings of Singh and Bala (2017) in chrysanthemum. Maximum flower longevity (105.3 days) was observed in plants treated with ethephon FS at 900 ppm (T₈). This finding related to Hayashi *et al.* (2001) in herbaceous perennials (*Achillea*, *Echinacea*, *Leucanthemum*, *Monarda*), Spitzer and Bilovsky (2017) ^[17] in poppy and Singh and Bala (2017) in chrysanthemum. These effects of ethephon are likely due to ethylene suppressing vegetative growth, which redirects energy from vegetative processes to reproductive growth, thereby promoting flower development (Mishra and Yadava, 2011) ^[10].

Table 3: Effect of growth retardants on flowering attributes of cosmos

Notation	Treatments	Number of days taken to 50% flowering	Number of days taken to full flowering	Number of flowers per plant at 60 DAT	Number of flowers per plant at 90 DAT	Peduncle length (cm)	Flower diameter (cm)	Days taken to flower withering from transplanting
T ₀	Control	64.7	75.0	4.1	57.8	22.53	4.10	99.3
T ₁	PBZ SD at 5 ppm	62.7	74.3	5.5	84.3	19.32	4.15	101.0
T ₂	PBZ SD at 7.5 ppm	66.7	79.7	4.8	83.5	18.79	4.33	100.7
T ₃	PBZ FS at 30 ppm	66.0	83.0	3.0	57.5	21.88	4.77	102.0
T ₄	PBZ FS at 40 ppm	66.7	80.7	2.7	54.3	18.82	4.60	102.3
T ₅	CCC FS at 750 ppm	68.0	81.7	3.1	53.9	21.71	4.56	102.0
T ₆	CCC FS at 1000 ppm	68.3	86.0	3.1	48.9	20.79	4.84	102.3
T ₇	Ethephon FS at 600 ppm	70.7	87.3	2.4	37.6	18.66	4.85	103.0
T ₈	Ethephon FS at 900 ppm	71.7	88.7	2.4	44.1	18.14	4.96	105.3
C.D at 5%		3.65	4.73	0.68	9.53	2.39	0.35	2.20

Conclusion

Based on the findings of the field study, it can be concluded that, foliar spraying of ethephon at 900 ppm (T₈) effectively reduced plant height, increased flower diameter, stem diameter and flower longevity while, soil drenching of

paclobutrazol at 5 ppm significantly enhanced various growth and reproductive parameters, including increased primary and secondary branches, plant spread, early flowering and number of flowers per plant.

The results suggested that cosmos plants, when treated with foliar application of ethephon at 900 ppm, develop a stronger canopy structure with reduced plant height and increased stem diameter. These characteristics make them well-suited for use as ornamental hedges, especially useful in container gardening, urban landscapes, and bedding plants, where compact plant size with showy and long-lasting flowers are desirable. Such characteristics significantly contribute to enhancing the aesthetic appeal of gardens and landscapes in ornamental horticulture.

Paclobutrazol at 5 ppm promotes more branching, wider plant spread, earlier flowering, and more flowers per plant, making it ideal for mass planting, borders, and cut flower production.

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