International Journal of Plant & Soil Science

Volume 37, Issue 7, Page 227-234, 2025; Article no.IJPSS.139079
ISSN: 2320-7035

Effect of Different Seed Priming Techniques on Growth, Flowering and Seed Attributes in Balsam (*Impatiens balsamina*)

Anjana Sisodia, Sahil [a*], Anil K. Singh [a], Devendra Kumar [a], Arun Kumar Maurya [a] and Anurag Srivastav [a]

[a] *Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/ijpss/2025/v37i75567

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://pr.sdiarticle5.com/review-history/139079

Received: 28/04/2025
Accepted: 01/07/2025
Published: 08/07/2025

Original Research Article

ABSTRACT

The present experiment was carried out at the Horticulture Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, in balsam (*Impatiens balsamina*) using Factorial Randomized Block Design (RBD) comprising of 5 genotypes and 5 seed priming treatments *viz*., control, biopriming with *Trichoderma* (1mg/g of seeds), thiourea (50 ppm), thiourea (50 ppm) + *Trichoderma* (1mg/g of seeds) and hydropriming with distilled water. The findings concluded that maximum plant height (82.67 cm), maximum plant spread (81.22 cm), highest number of leaves per plant (618.12), earliest flowering (48.74 days), longest flowering duration (64.12 days), flowers per plant (283.41), number of seeds per pod (11.62 seeds), number of pods per plant (302.22) and number of seeds per plant (2977.89) were recorded

**Corresponding author: E-mail: sahilkakrod@bhu.ac.in;*

***Cite as:** Sahil, Anjana Sisodia, Anil K. Singh, Devendra Kumar, Arun Kumar Maurya, and Anurag Srivastav. 2025. "Effect of Different Seed Priming Techniques on Growth, Flowering and Seed Attributes in Balsam (Impatiens Balsamina)". International Journal of Plant & Soil Science 37 (7):227-34. https://doi.org/10.9734/ijpss/2025/v37i75567.*

with the treatment including thiourea (50 ppm) + *Trichoderma* (1mg/g of seeds). Present study showed that pre-sowing treatment of balsam seeds with thiourea (50 ppm) + *Trichoderma* (1mg/g of seeds) for 24 hours significantly improved the vegetative, flowering and seed attributes.

Keywords: Priming; balsam; Trichoderma; thiourea.

1. INTRODUCTION

Balsam (*Impatiens balsamina*) is generally grown as an ornamental plant and the flowers bloom in the upper axils and resemble those of roses or camellias, appearing in a range of colours such as scarlet, red, pink, white, purple and rose (Singh and Sisodia, 2017). Traditionally, most *Impatiens balsamina* species are native to tropical and subtropical areas (Grey-Wilson, 1980), although some can also be found in the temperate zones of Northern Asia, North America and Europe (Song *et al.*, 2003). It is widespread in countries such as China, India, Korea, Indonesia and other parts of Asia (Qian *et al.*, 2023). Balsam is an upright annual herb, usually cultivated as an ornamental flowering plant, native of the Himalayas, India (Yadav *et al*., 2024). It can withstand heavy rain and high humidity conditions in atmosphere (Pal *et al*., 2023). The oil of seeds can be utilized for burning lamps and also in surface coating industry (Singh *et al*., 2018). This annual plant is an excellent choice for garden beds, mixed borders and walkways, while its compact dwarf varieties are ideal for container gardening in patios, balconies and other small spaces (Pal *et al*., 2018).

Seed priming is a water-based method that regulates seed temperature and moisture to trigger early metabolic activity without initiating full germination, enhancing germination rate and seed quality (Sisodia *et al.*, 2018). Priming efficiently creates the germinating stage without causing radicle emergence, which may leads to improved germination percentage and uniformity (Sung *et al*, 2008). Seed priming promotes cross-tolerance that assists enhanced germination percentage and seedling establishment under adverse climatic conditions (Chen *et al*., 2012). Seed priming aims to synchronize emergence for uniform crop establishment, speed up germination and protect seeds from environmental stress during early seedling growth (Sisodia *et al.*, 2018).

Seed priming methods are classified based on the compounds used, including hydropriming, hormone priming, osmopriming, chemopriming, solid matrix priming, nutripriming, thermopriming and biopriming (Sher *et al*., 2019). Biopriming with *Trichoderma* boosts production of phytohormones, secondary metabolites and osmoprotectants, which help maintain cell water balance during drought stress without disrupting normal metabolism (Anjum *et al.*, 2014). Plant growth regulators like thiourea have played significant role in ornamental crops in terms of growth and breaking dormancy (Singh *et al*., 2018). Thiourea helps in breaking seed dormancy and also stimulates seed germination and early growth of seedlings (Padhi *et al*., 2018). Hydropriming treatment (distilled water) significantly improved the germination capacity of fungus-infected seeds at the first and second count and the proportion of diseased seedlings and dead seeds was seen to have decreased (Vidyashree and Patil, 2021). Priming is done in balsam to enhance seed germination, improve seedling vigor, and ensure uniform and faster emergence. It helps break seed dormancy, activates essential metabolic processes before sowing and prepares the seed to grow more efficiently once planted. Since very meager or no work has been done so far on balsam seed priming therefore, in this study effect of seed priming on growth and development of balsam has been investigated.

2. MATERIALS AND METHODS

The present experiment was carried out during rainy season of July 2024-25 at the Horticulture Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh. In this experiment, balsam (*Impatiens balsamina*) seeds were primed with different priming agents to study their impact on growth, flowering and seed attributes. Five balsam genotypes were chosen for the experiment (JB-1, JB-2, JB-3, JB-4 and JB-5), that were procured from Department of Horticulture, College of Agriculture, J.N.K.V.V., Jabalpur, Madhya Pradesh. These genotypes were treated with five levels of treatments with five replications. The treatments are T_1 (Control), T_2 (*Trichoderma* 1mg/g of seeds), T_3 (Thiourea 50 ppm), T_4 (*Trichoderma* 1mg/g of seeds + Thiourea 50ppm) and T_5 (Hydropriming). After the seeds were treated they were sown in the nursery bed with a row to row spacing of 15 cm followed by light irrigation. Seedlings were transplanted to earthen pots after 30 days of sowing. Plants were irrigated thrice in a week to keep soil moisture at the field capacity. The experiment was carried out using a Factorial Randomized Block Design (RBD), incorporating two factors: the first comprising five genotypes and the second consisting of five treatments, as previously described. Each treatment combination was replicated five times. Various parameters such as plant height, plant spread, number of leaves per plant, days to flowering, flowering duration, total flowers per plant, number of seeds per pod, number of pods per plant and number of seeds per plant were observed and analyzed statistically. All recorded observations were analyzed using the OP-STAT computer software. The Factorial Randomized Block Design analysis of variance was used to test the effect of different seed priming techniques on balsam genotypes. The mean difference was evaluated by CD at 5% level of significance.

3. RESULTS AND DISCUSSION

Significant differences were observed in various plant growth and development parameters, aiding in the assessment of plant suitability for specific purposes. These results are consistent with previous studies on ornamental plants and highlight the diverse applications of different plant types in horticulture.

3.1 Growth Parameters

Significant variations were observed in the plant growth parameters, including plant height, plant spread and number of leaves. Treatment T_4 (82.67 cm) significantly recorded the highest average plant height comparing to others. The minimum average plant height was observed under control (72.90 cm) (Table 1). Whereas, the maximum average plant spread was observed in treatment T_4 (81.22 cm) which was significantly higher than other treatments (Table 1). The maximum number of leaves were observed in treatment T_4 (618.12 leaves), significantly higher than other treatments (Table 2). This could be related to enhanced photosynthetic activity and nutrient uptake by thiourea and *Trichoderma* improved tolerance of the plants against the biotic and abiotic stresses. Similar findings were observed in *Eustoma grandiflorum* by Maliha *et al*. (2023), by Kaur *et al*. (2023) in *Gladiolus grandiflorus* L. and by Thakur and Garg (2024) in *Viola tricolor*.

3.2 Flowering Parameters

Annuals and ornamental herbs enhance garden aesthetics with their vivid colors, varied forms and textures. Their versatility suits borders, beds, containers and hanging baskets. Significant differences were observed in various flowering parameters under different treatments. Treatment T_4 (48.74 days) resulted in the significantly earliest flowering in comparison to T_3 (48.97 days), T_5 (49.86 days) and T_2 (51.00 days) (Table 3). Treatment T_4 (64.12 days) showed the significantly longest flowering duration, closely followed by T_3 (63.90 days) and minimum flowering duration was observed in treatment T_1 (56.42 days) showing that seed priming enhances flowering duration (Fig. 1). Whereas, total flowers per plant were maximum in treatment T_4 (283.41 flowers) which was significantly higher than others (Table 3). This highlights the positive influence of seed priming, particularly the combination of *Trichoderma* and Thiourea. This could be result of increased uptake of essential minerals like potassium (K^+) and calcium (Ca^{2+}) and enhanced auxins synthesis by thiourea that ultimately increase cell division. Similar findings were observed by Pawar *et al*. (2018) in *Gladiolus grandiflorus* L.

3.3 Seed Parameters

Significant differences were observed in seed parameters under various treatments given in Table 2 and Table 4. Among the treatments, T_4 significantly produced the highest number of seeds per pod (11.62 seeds) whereas T_1 (8.60 seeds) and T_5 (8.77 seeds) exhibited the minimum seeds per pod. Number of pods per plant was maximum in treatment T_4 (302.22) and treatment T_1 had minimum, 219.34 pods per plant. Treatment T_4 results in the significantly highest number of seeds per plant (2,977.89 seeds/plant). In contrast, T_1 (2007.31 seeds/plant) had the lowest number of seeds per plant. This might be due to thiourea priming which supported plant growth by maintaining better water balance, improving stomatal conductance and serving as a compatible osmolyte, thereby aiding in the production of quality seeds. It may also be due to biotic and abiotic stress tolerance induced in plants by thiourea and *Trichoderma.* Similar results were also observed by Oyebamiji *et al*. (2024), Negi *et al*. (2019) and Dayma *et al*. (2024) in french bean (*Phaseolus vulgaris* L.).

Table 1. Effect of seed priming treatment on growth parameters in balsam

	Plant Height (cm)					Plant Spread (cm)				
Treatment / Genotype	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**
JB-1	71.60	76.71	74.42	76.54	77.93	64.09	76.93	70.07	79.25	70.42
JB-2	74.20	75.62	75.00	85.02	87.90	71.88	73.05	84.88	82.21	74.97
JB-3	74.00	75.59	74.32	82.51	82.10	68.99	71.60	83.34	78.48	67.33
JB-4	74.60	74.74	77.68	85.20	86.70	73.77	74.34	84.67	83.03	74.87
JB-5	69.90	78.08	77.69	77.70	78.70	71.48	79.91	70.20	83.15	73.14
Mean	72.90	76.15	75.82	81.39	82.67	70.04	75.17	78.63	81.22	72.16
C.D. (0.05)										
G	3.02					3.67				
T	3.02					3.67				
G × T	N/A					8.20				

T_1 = Control, T_2 = *Trichoderma*, T_3 = Thiourea, T_4 = *Trichoderma* + Thiourea, T_5 = Hydropriming

Table 2. Effect of seed priming treatment on growth and seed parameters in balsam

	Number of leaves per plant					Number of pods per plant				
Treatment / Genotype	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**
JB-1	358.27	479.24	610.40	632.44	464.46	202.75	224.33	229.26	305.67	257.17
JB-2	321.48	550.48	589.65	625.36	531.26	206.40	289.71	298.32	308.69	256.12
JB-3	426.31	489.88	588.54	608.42	464.79	178.58	288.36	241.41	265.01	290.15
JB-4	371.19	536.63	582.29	637.73	526.60	252.85	295.52	304.92	315.84	250.70
JB-5	369.07	503.57	607.35	586.65	494.87	256.13	148.57	278.00	315.88	252.72
Mean	369.26	511.96	595.64	618.12	496.39	219.34	249.30	270.38	302.22	261.37
C.D. (0.05)										
G	N/A					11.92				
T	55.77					11.92				
G × T	N/A					26.66				

T_1 = Control, T_2 = *Trichoderma*, T_3 = Thiourea, T_4 = *Trichoderma* + Thiourea, T_5 = Hydropriming

Table 3. Effect of seed priming treatment on flowering parameters in balsam

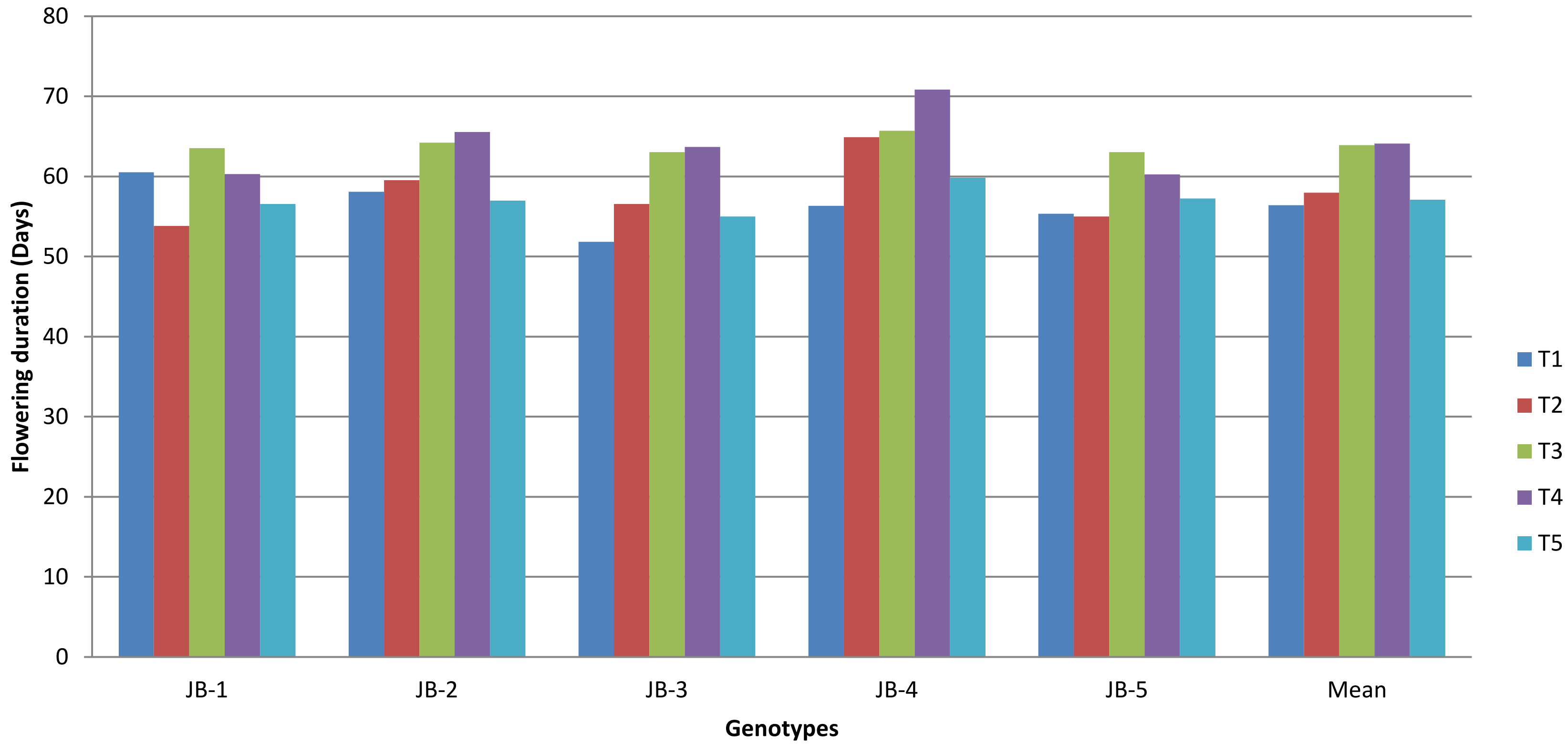
	Total flowers per plant					Days to flowering				
Treatment / Genotype	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**
JB-1	208.54	228.73	267.62	273.13	212.49	49.32	53.34	51.30	49.67	48.22
JB-2	234.22	273.89	289.60	297.35	264.48	48.84	52.09	47.56	49.57	49.14
JB-3	228.36	240.27	265.74	298.77	220.06	55.69	51.94	48.01	47.78	48.66
JB-4	260.92	289.43	298.87	302.73	284.40	50.08	47.78	47.45	47.78	50.91
JB-5	239.85	252.18	288.00	245.08	229.66	54.22	50.84	50.53	48.91	52.38
Mean	234.38	256.90	281.96	283.41	242.22	51.63	51.00	48.97	48.74	49.86
C.D. (0.05)										
G	25.76					1.85				
T	25.76					1.85				
G × T	N/A					4.14				

T_1 = Control, T_2 = *Trichoderma*, T_3 = Thiourea, T_4 = *Trichoderma* + Thiourea, T_5 = Hydropriming

Table 4. Effect of seed priming treatment on seed parameters in balsam

	Number of seeds per pod					Number of seeds per plant				
Treatment / Genotype	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**
JB-1	7.78	9.48	10.07	11.14	8.26	1,787.23	2,020.41	2,181.67	3,257.22	2,236.44
JB-2	9.68	8.83	9.83	11.93	9.53	2,217.33	2,339.85	2,830.54	3,116.95	2,015.67
JB-3	8.51	7.88	10.60	10.87	7.99	2,205.19	1,901.78	2,079.57	3,077.31	2,479.72
JB-4	8.64	9.86	11.62	12.34	9.30	1,867.29	2,660.73	2,772.35	2,653.97	3,082.44
JB-5	8.42	9.35	9.43	11.82	8.77	1,959.53	2,328.31	2,684.28	2,784.00	1,740.66
Mean	8.60	9.08	10.31	11.62	8.77	2,007.31	2,250.22	2,509.68	2,977.89	2,310.99
C.D. (0.05)										
G	0.72					133.84				
T	0.72					133.84				
G × T	N/A					299.29				

T_1 = Control, T_2 = *Trichoderma*, T_3 = Thiourea, T_4 = *Trichoderma* + Thiourea, T_5 = Hydropriming



T_1 = Control, T_2 = *Trichoderma*, T_3 = Thiourea, T_4 = *Trichoderma* + Thiourea, T_5 = Hydropriming

Fig. 1. Effect of seed priming treatment on flowering duration in balsam

4. CONCLUSION

The present study demonstrates that seed priming significantly enhances the growth, flowering, and seed yield attributes of balsam (*Impatiens balsamina*). Among the treatments, the combination of *Trichoderma* and thiourea consistently outperformed other treatments across all parameters, including plant height, spread, leaf number, flowering duration and seed yield. These findings highlight the potential of integrated seed priming approaches to improve plant vigour, uniformity and productivity in ornamental crops.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Anjum, N. A., Aref, I. M., Duarte, A. C., Pereira, E., Ahmad, I. and Iqbal, M. (2014). Glutathione and proline can coordinately make plants withstand the joint attack of metal(loid) and salinity stresses. *Frontiers in Plant Science, 5*, 662. https://doi.org/10.3389/fpls.2014.00662

Chen, K., Fessehaie, A., and Arora, R. (2012). Dehydrin metabolism is altered during seed osmopriming and subsequent germination under chilling and desiccation in *Spinacia oleracea* L. cv. Bloomsdale: Possible role in stress tolerance. *Plant Science, 183*, 27–36. https://doi.org/10.1016/j.plantsci.2011.11.009

Dayma, M., Sharma, O. P., Dhaker, D. L. and Choudhary, R. S. (2024). Effect of seed priming chemicals on growth and yield of cowpea. *Annals of Agricultural Research,* 45(4), 391–397.

Grey-Wilson, C. (1980). *Impatiens of Africa* (p. 3). CRC Press.

Kaur, K., Jhanji, S. and Kaur, G. (2023). Assessment of priming of cormels with plant growth substances on vegetative growth and cormel-associated traits in gladiolus. *Annals of Plant and Soil Research, 25*(2), 304–309.

Maliha, M., Husna, M. A., Sultana, M. N., Singh, K. and Uddin, A. F. M. J. (2023). Influence of thiourea concentrations on growth. *International Journal of Business, Social and Scientific Research,* 11(1), 1–6.

Meenu, B., Neeraja, E. D., Rejimon, G. R. and Varghese, A. V. (2015). *Impatiens balsamina*: An overview. *Journal of Chemical and Pharmaceutical Research,* 7(9), 16–21.

Negi, S., Bharat, N. K., and Kumar, M. (2021). Effect of seed biopriming with indigenous PGPR, *Rhizobia* and *Trichoderma* sp. on growth, seed yield and incidence of diseases in French bean (*Phaseolus vulgaris* L.). *Legume Research,* 44(5), 593–601. https://doi.org/10.18805/LR-4577

Oyebamiji, Y. O., Adigun, B. A., Shamsudin, N. A. A., Ikmal, A. M., Salisu, M. A., Malike, F. A. and Lateef, A. A. (2024). Recent advancements in mitigating abiotic stresses in crops. *Horticulturae, 10*(2), 156. https://doi.org/10.3390/horticulturae10020156

Padhi, M., Sisodia, A., Pal, S., Kapri, M. and Singh, A. K. (2018). Growing media, GA_3 and thiourea stimulates growth and rooting in gladiolus cormels cv. Tiger Flame. *Journal of Pharmacognosy and Phytochemistry, 7*(3), 1919–1922.

Pal, S., Singh, A. K. and Sisodia, A. (2023). Effect of physical and chemical mutagens on flowering and seed attributes of balsam (*Impatiens balsamina*). *The Pharma Innovation Journal, 12*, 4318–4326.

Pal, S., Singh, A. K., Sisodia, A., Pal, A. K. and Tiwari, A. (2018). Evaluation of double whorled balsam (*Impatiens balsamina* L.) genotypes for growth, flowering and seed attributes. *Journal of Pharmacognosy and Phytochemistry,* 7(2), 2901–2904.

Pawar, A., Chopde, N. and Nikam, B. (2018). Thiourea and salicylic acid influences growth, yield and quality of gladiolus. *Journal of Pharmacognosy and Phytochemistry, 7*(5), 970–972.

Qian, H., Wang, B., Ma, J., Li, C., Zhang, Q. and Zhao, Y. (2023). *Impatiens balsamina*: An updated review on ethnobotanical uses, phytochemistry and pharmacological activity. *Journal of Ethnopharmacology, 303*,115956. https://doi.org/10.1016/j.jep.2022.115956

Sher, A., Sarwar, T., Nawaz, A., Ijaz, M., Sattar, A. and Ahmad, S. (2019). Methods of seed priming. In M. Hasanuzzaman & V. Fotopoulos (Eds.), *Priming and Pretreatment of Seeds and Seedlings: Implication in Plant Stress Tolerance and Enhancing Productivity in Crop Plants* (pp. 1–10). Springer.

Singh, A. K. and Sisodia, A. (2017). *Textbook of floriculture and landscaping* (pp. 135–141). New India Publishing Agency.

Singh, A. K., Sisodia, A. and Tiwari, A. (2018). Studies of genetic variability, heritability and genetic advance in balsam (*Impatiens balsamina* L.). *Journal of Applied and Natural Science,* 10(2), 810–812.

Singh, A. K., Sisodia, A., Padhi, M., Pal, A. K. and Barman, K. (2018). Effect of various growing media, GA_3 and thiourea on growth and root characters in gladiolus. *Journal of Hill Agriculture,* 9(4), 408–412.

Sisodia, A., Padhi, M., Pal, A. K., Barman, K., and Singh, A. K. (2018). Seed priming on germination, growth and flowering in flowers and ornamental trees. In: A. Rakshit & H. B. Singh (Eds.), *Advances in Seed Priming* (pp. 263–288). Springer.

Song, Y., Yuan, Y. M. and Kupfer, P. (2003). Chromosomal evolution in Balsaminaceae, with cytological observations on 45 species from Southeast Asia. *Caryologia, 56*(4), 463–481. https://doi.org/10.1080/00087114.2003.10589349

Sung, Y., Cantliffe, D. J., Nagata, R. T. and Nascimento, W. M. (2008). Structural changes in lettuce seed during germination at high temperature altered by genotype, seed maturation temperature and seed priming. *Journal of the American Society for Horticultural Science,* 133(2), 300–311.

Thakur, T. and Garg, A. (2024). Seed priming and media for enhanced seedling growth in pansy (*Viola tricolor*). *Asian Journal of Soil Science and Plant Nutrition,* 10(2), 261–268.

Vidyashree, S. and Patil, S. (2021). Seed packaging and priming in ornamental plants. *Environment and Ecology,* 39(4), 769–774.

Yadav, S., Sisodia, A., Singh, A. K. and Sisodia, V. (2024). Evaluation of balsam genotype for pot culture and bedding purpose. *Environment and Ecology,* 42(4), 1736–1741.

Peer-review history:
The peer review history for this paper can be accessed here:
https://pr.sdiarticle5.com/review-history/139079