Applied Biological Research 28(3): 420-427; (2026)
DOI: 10.48165/abr.2026.28.01.43

EFFECTS OF FOLIAR APPLICATION OF IRON, ZINC AND BORON ON FLOWERING AND POSTHARVEST QUALITY OF PEACE LILY [*Spathiphyllum cochlearispathum* (Liebm.) Engl.]

Pooja Sahu[1*], Kaberi Maharana[1], Siddharth Kumar Palai[1], Pradyumna Tripathy[2], Kailash Chandra Samal[3], Sashikala Beura[4], Mayank Parihar[1,] Ashutosh Sahoo[1], Jaya Bijaya Biraja Das[1], and Choudhury Bagmee Barenya[1]

[1]*Department of Floriculture and Landscaping,* [2]*Department of Vegetable Science, College of Agriculture, Odisha University of Agriculture and Technology (OUAT), Bhubaneswar, Odisha - 751 003 (India)*
[3]*College of Horticulture, OUAT, Chiplima - 768 025, Odisha (India)*
[4]*Department of Floriculture and Landscaping, Siksha 'O' Anusandhan University, Bhubaneswar, Odisha - 768 025 (India)*
*****e-mail: *poojasahu.rs21@ouat.ac.in*

(Received 1 July, 2026; Accepted 8 September, 2026)

ABSTRACT

A pot experiment was conducted at the Bio-Technology-cum-Tissue Culture Centre, Department of Floriculture and Landscaping, OUAT, Bhubaneswar, India during 2022-23 and 2023-24 to evaluate the effects of foliar application of iron, zinc and boron on flowering and postharvest quality of peace lily (*Spathiphyllum cochlearispathum* (Liebm.) Engl.). Twenty-seven treatments comprising individual and combined applications of Fe, Zn and B at two concentrations were evaluated in a completely randomized design with three replications. Foliar sprays were applied at 30-day intervals, and observations were recorded on days to flower-bud appearance, number of flowers plant^{-1} month^{-1}, spathe length, spathe breadth and vase life. Combined micronutrient treatments generally performed better than individual nutrient treatments and the control. Treatment T_{26}, comprising Fe @ 0.6 + Zn @ 0.5 + B @ 0.6 mg L^{-1}, resulted in the earliest flower-bud appearance, at 163.80 and 165.80 days, and the highest number of flowers, at 3.83 and 3.67 flowers plant^{-1} month^{-1}, during 2022-23 and 2023-24, respectively. Treatment T_{27}, comprising Fe @ 0.6 + Zn @ 0.6 + B @ 0.5 mg L^{-1}, produced the longest spathes, greatest spathe breadth and maximum vase life. The corresponding values for spathe length were 21.79 and 23.71 cm, for spathe breadth were 11.27 and 11.87 cm, and for vase life were 4.80 and 4.42 days during the two seasons, respectively. Under the conditions of the experiment, combined foliar application of Fe, Zn and B improved flowering and postharvest quality of peace lily.

Keywords: Boron, iron, cut spathe, micronutrients, peace lily, ornamental aroid, *Spathiphyllum cochlearispathum*, vase life, zinc

INTRODUCTION

Peace lily [*Spathiphyllum cochlearispathum* (Liebm.) Engl.], belongs to the family Araceae, is an evergreen perennial herb native to Central and Southern Mexico, where it occurs primarily in wet tropical habitats (Royal Botanic Gardens, Kew, 2026). It is widely cultivated as an ornamental foliage and flowering pot plant because of its attractive dark-green foliage and distinctive white spathe

surrounding the spadix. The species is valued for its shade tolerance, relatively low maintenance requirements and long-lasting inflorescences, which contribute to its popularity as an indoor and ornamental plant (Henny *et al.,* 2004). The combination of attractive foliage and conspicuous inflorescences enhances its ornamental and commercial value and supports its importance in the potted ornamental plant industry.

The global ornamental plant industry has shown significant expansion in recent decades, with its monetary value steadily increasing and promising further growth in domestic and international markets. Among these, *Spathiphyllum cochlearispathum* stands out as a highly popular potted ornamental plant. Its distinctive white spathe, combined with dense clusters of dark green leaves that arise directly from rhizomatous shoots, makes it a remarkable foliage plant. Flowering usually begins with the arrival of spring and the blossoms are notable for their longevity, adding to their decorative appeal. Because of its aesthetic charm, ease of cultivation and long-lasting inflorescences, Worldwide demand for Peace lily has increased significantly. presently it holds a key position as one of the most preferred pot plants, playing an important role in major ornamental plant imports and exports around the world (Rout *et al.,* 2006).

The genus *Spathiphyllum* comprises around 41 species, each known for its appealing exposed leaf spathes that enhance its ornamental value (Chen *et al.,* 2003). According to Henny and Chen (2004), Peace lily (*Spathiphyllum* spp.), also referred to as snow flower or spathe flower, is among the top-selling foliage plants in Florida and is highly valued for its ornamental appeal, being commercially cultivated for both potted plant production and cut flower use.

Beyond their striking beauty, *Spathiphyllum* flowers hold deep symbolic meanings that enhance their cultural and ornamental appeal. These qualities, combined with their decorative charm and adaptability, make them highly sought after in both domestic and international markets, securing a strong place in agri-horticultural ventures worldwide (Chen *et al.,* 2003) However, despite their popularity and commercial importance, Peace lily faces several challenges. Studies from regions such as India report susceptibility of Peace lily to fungal, bacterial and viral pathogens. These diseases compromise the quality and longevity of their foliage and flowers, diminishing visual value and lowering market potential, thereby posing significant threats to their overall economic worth in the ornamental plant trade (Mounika, 2017). Hence, the present study was aimed to evaluate the effects of individual and combined foliar application of iron, zinc and boron on flowering behaviour and postharvest quality of peace lily under shade net.

MATERIALS AND METHODS

Experimental site and plant material

The experiment was conducted in two consecutive growing seasons, 2022-23 and 2023-24, at the Bio-Technology-cum-Tissue Culture Centre, Department of Floriculture and Landscaping, College of Agriculture, OUAT, Bhubaneswar, India. Uniform, healthy and disease-free plants of *Spathiphyllum cochlearispathum* (Liebm.) Engl., with an initial plant height of 15-20 cm, were selected. Planting was carried out on 15 October 2022 in 20 cm unglazed clay pots, with one plant per pot. The growing medium consisted of soil, sand, farmyard manure (FYM) and cocopeat in a 2:1:1:1 ratio (v/v/v/v). The components were cleaned of debris and thoroughly mixed before use. Crocks were placed over the drainage holes to prevent blockage and facilitate proper drainage. The pots were filled with the prepared growing medium, leaving approximately 2.5 cm space below the rim. Plants were placed centrally, and the growing medium was gently pressed around the root zone to ensure proper root-medium contact and eliminate air pockets. The plants were thoroughly irrigated immediately after planting to facilitate establishment.

The plants were maintained under a shade-net structure providing 50-60% shade throughout the experimental period. The plants were irrigated as and when required, while adequate drainage was maintained to prevent waterlogging. Basal NPK fertilizer was applied uniformly as per the recommended package of practices. Weeding, removal of senescent leaves and other routine cultural operations were performed uniformly throughout the experiment. Meteorological observations were recorded at the experimental site during two growing seasons. In 2022-23, maximum and minimum temperatures ranged from 28.0-40.4°C and 13.4-27.5°C, respectively, while relative humidity ranged from 79-96% at 7:00 h and 32-94% at 14:00 h. In 2023-24, maximum and minimum temperatures ranged from 25.0-40.4°C and 12.8-27.5°C, respectively, while relative humidity ranged from 81-95% at 7:00 h and 32-85% at 14:00 h. All plants received uniform environmental, irrigation, nutritional and cultural management throughout the experiment, except for the respective Fe, Zn and B treatments.

Experimental design and treatments

The experiment comprised 27 treatments arranged in a completely randomized design (CRD) with three replications. Each replication consisted of five potted plants, with one plant per pot. Individual plants produced multiple flowers; however, flowers from the same plant were not considered independent experimental units. Observations were recorded at plant level and the replication was considered the experimental unit for statistical analysis. The treatments included a control, individual applications of Fe, Zn and B at 0.5 and 0.6 mg L^{-1}, and their different combinations as under:

Treat-ments	Foliar application (mg L^{-1})	Treat-ments	Foliar application (mg L^{-1})	Treat-ments	Foliar application (mg L^{-1})
T_1	Control (water spray)	T_{10}	Fe @ 0.5 + B @ 0.5	T_{19}	Zn @ 0.6 + B @ 0.6
T_2	Fe @ 0.5	T_{11}	Fe @ 0.5 + B @ 0.6	T_{20}	Fe @ 0.5 + Zn @ 0.5 + B @ 0.5
T_3	Fe @ 0.6	T_{12}	Fe @ 0.6 + Zn @ 0.5	T_{21}	Fe @ 0.5 + Zn @ 0.6 + B @ 0.6
T_4	Zn @ 0.5	T_{13}	Fe @ 0.6 + Zn @ 0.6	T_{22}	Fe @ 0.6 + Zn @ 0.5 + B @ 0.5
T_5	Zn @ 0.6	T_{14}	Fe @ 0.6 + B @ 0.5	T_{23}	Fe @ 0.6 + Zn @ 0.6 + B @ 0.6
T_6	B @ 0.5	T_{15}	Fe @ 0.6 + B @ 0.6	T_{24}	Fe @ 0.5 + Zn @ 0.6 + B @ 0.5
T_7	B @ 0.6	T_{16}	Zn @ 0.5 + B @ 0.5	T_{25}	Fe @ 0.5 + Zn @ 0.5 + B @ 0.6
T_8	Fe @ 0.5 + Zn @ 0.5	T_{17}	Zn @ 0.5 + B @ 0.6	T_{26}	Fe @ 0.6 + Zn @ 0.5 + B @ 0.6
T_9	Fe @ 0.5 + Zn @ 0.6	T_{18}	Zn @ 0.6 + B @ 0.5	T_{27}	Fe @ 0.6 + Zn @ 0.6 + B @ 0.5

Preparation and application of micronutrient solutions

Micronutrient spray solutions were prepared in distilled water using ferrous sulphate heptahydrate ($FeSO_4 \cdot 7H_2O$), zinc sulphate heptahydrate ($ZnSO_4 \cdot 7H_2O$) and boric acid (H_3BO_3) as the sources of Fe, Zn and B, respectively. The required quantity of each chemical source was dissolved in 1 L distilled water as per treatment. For combined treatments, the required quantities of respective chemical sources were dissolved together in 1 L distilled water. The final pH of spray solutions ranged from 5.6 to 6.0. The prepared solutions were applied as foliar sprays at 30-day intervals using a hand-operated sprayer fitted with an adjustable mist-trigger nozzle. Each pot contained one plant, and 1 L of respective spray solution was applied to each plant. Foliar application was carried out under shade-net structure in morning hours under calm environmental conditions. The spray was uniformly distributed over the foliage until runoff. Control plants received 1 L distilled water spray. The same procedure was followed for all treatments to ensure uniformity of application.

Observations recorded

Days to first flower-bud appearance were recorded as the number of days from planting to the appearance of first visible flower bud on each plant. The number of flowers $plant^{-1}$ $month^{-1}$ was recorded at 180 days after planting (DAP) by counting the newly opened inflorescences produced during the specified observation period. Spathe length and spathe breadth were recorded at 210 DAP from fully developed inflorescences at a uniform developmental stage. Spathe length was measured from base to the tip of the spathe, while spathe breadth was measured at its widest portion.

For postharvest evaluation, fully opened inflorescences of uniform size and maturity were harvested in early morning at uniform developmental stage, defined by full expansion of spathe. The inflorescence stalks were cut to approximately 15-20 cm using a sterilized sharp blade and immediately transferred to uniform 250 mL capacity narrow-mouth conical flasks containing 150-200 mL tap water. One inflorescence was placed in each flask. The mouth of each flask was wrapped with paraffin film around the stalk to provide support and minimize excessive evaporation. The tap water had a pH of 6.5 and an electrical conductivity (EC) of >0.8 mS cm^{-1}. The flasks were maintained at room temperature (20-25°C) under natural light, away from direct sunlight. Vase life was determined as the number of days from harvest to first visible symptoms of senescence, discolouration or browning of spathe. The mean vase life was calculated from the observations recorded for the three replications of each treatment.

Statistical analysis

The data recorded for each character was subjected to the analysis of variance (ANOVA) appropriate for a completely randomized design separately for each growing year. Treatment effects for each year were tested using F-test. The standard error of mean (SEm±) was calculated, and treatment means compared using critical difference at 5% probability level. For pooled analysis, observations of two growing years were combined to estimate the overall treatment response, and pooled means subjected to ANOVA under CRD framework. Following a significant F-test, the pooled treatment means were compared using Duncan's multiple range test (DMRT) at 5% probability level. Statistical significance was assessed at $p \leq 0.05$.

RESULTS AND DISCUSSION

Flowering and postharvest quality parameters

Foliar application of Fe, Zn and B, either individually or in combination, significantly influenced flowering and postharvest quality traits of *Spathiphyllum cochlearispathum* during 2022-23 and 2023-24 (Table 1 & 2). In general, combined micronutrient treatments performed better than control and several individual nutrient treatments. The magnitude of response varied among traits, with Fe @ 0.6 + Zn @ 0.5 + B @ 0.6 mg L^{-1} (T_{26}) displaying best performance for early flower bud appearance and flower production, whereas Fe @ 0.6 + Zn @ 0.6 + B @ 0.5 mg L^{-1} (T_{27}) proving superior for spathe dimensions and vase life. Peace lily is a shade-adapted ornamental species in which foliage and inflorescence quality are important components of its ornamental and commercial value. The present results indicate that under protected cultivation foliar application of Fe, Zn and B improved important flowering and postharvest attributes of Peace lily**.** Under protected cultivation iron is associated with electron transport and chloroplast-related functions, Zn participates in enzyme activity and plant developmental processes, while B has important role in cell-wall formation and reproductive development (Broadley *et al.,* 2007; Hänsch and Mendel, 2009; Marschner, 2012). The superior performance of the selected combined-treatments suggests that balanced micronutrient supplementation may be more beneficial than individual application for some flowering and quality traits of peace lily.

Days to flower bud appearance

Micronutrient application significantly affected the number of days required for flower bud appearance. The treatment Fe @ 0.6 + Zn @ 0.5 + B @ 0.6 mg L^{-1} recorded earliest flower bud appearance, at 163.8 and 165.8 days during 2022-23 and 2023-24, respectively, followed by treatment Fe @ 0.6 + Zn @ 0.6 + B mg L^{-1} @ 0.5 (164.67 and 167.13 days). Control (T_1) required the longest period of 186.13 and 181.18 days, respectively. The earliness in flowering under micronutrient treatments may be attributed to the enhanced physiological activity, improved carbohydrate accumulation, and better hormonal balance. Zinc plays a key role in auxin metabolism and enzyme activation, which accelerates floral induction, while boron is essential for pollen

Table 1: Effect of foliar application of iron, zinc and boron on flowering characteristics of peace lily during 2022-23, 2023-24 and pooled analysis

Treatment details (mg L^{-1})	Days to flower bud appearance			No. of flowers plant^{-1} month^{-1}			Spathe length (cm)		
	2022-23	2023-24	Pooled mean	2022-23	2023-24	Pooled mean	2022-23	2023-24	Pooled mean
Control	186.13	181.18	183.66^{a}	2.28	2.07	2.18^{h}	15.24	15.22	15.23^{i}
Fe @ 0.5	185.63	180.67	183.15^{ab}	2.73	2.73	2.73^{defg}	16.46	16.40	16.43^{fghi}
Fe @ 0.6	179.07	178.40	178.73^{bcde}	2.93	2.92	2.93^{cde}	15.96	15.95	15.96^{ghi}
Zn @ 0.5	178.20	178.20	178.20^{cdef}	2.60	2.59	2.60^{fg}	16.42	16.38	16.40^{fghi}
Zn @ 0.6	183.00	180.00	181.50^{abc}	2.60	2.59	2.60^{fg}	15.48	16.13	15.80^{ghi}
B @ 0.5	175.73	179.07	177.40^{cdef}	2.67	2.66	2.66^{efg}	15.34	15.33	15.33^{i}
B @ 0.6	178.53	179.20	178.87^{bcd}	2.93	2.93	2.93^{cde}	15.52	15.50	15.51^{hi}
Fe @ 0.5 + Zn @ 0.5	175.60	177.93	176.77^{cdef}	2.67	2.65	2.66^{efg}	17.33	17.31	17.32^{defg}
Fe @ 0.5 + Zn @ 0.6	176.00	174.67	175.33^{def}	2.93	2.83	2.88^{cdef}	16.41	17.39	16.90^{fgh}
Fe @ 0.5 + B @ 0.5	175.07	174.73	174.90^{def}	2.60	2.57	2.58^{fg}	16.77	17.75	17.26^{efg}
Fe @ 0.5 + B @ 0.6	177.40	177.07	177.23^{cdef}	2.87	2.83	2.85^{cdef}	16.98	16.97	16.97^{fgh}
Fe @ 0.6 + Zn @ 0.5	174.80	174.47	174.63^{def}	2.80	2.77	2.78^{defg}	17.27	17.24	17.26^{efg}
Fe @ 0.6 + Zn @ 0.6	175.60	175.27	175.43^{def}	3.13	3.07	3.10^{c}	16.65	16.63	16.64^{fghi}
Fe @ 0.6 + B @ 0.5	175.07	174.73	174.90^{def}	2.93	2.90	2.92^{cde}	16.87	16.83	16.85^{fgh}
Fe @ 0.6 + B @ 0.6	179.13	178.80	178.97^{bcd}	2.67	2.63	2.65^{efg}	17.92	17.90	17.91^{cdef}
Zn @ 0.5 + B @ 0.5	175.20	174.87	175.03^{def}	2.67	2.60	2.63^{efg}	17.94	17.92	17.93^{cdef}
Zn @ 0.5 + B @ 0.6	178.47	178.13	178.30^{cdef}	2.87	2.80	2.83^{cdef}	18.66	18.63	18.65^{cde}
Zn @ 0.6 + B @ 0.5	176.87	176.53	176.70^{cdef}	2.53	2.50	2.52^{g}	18.53	18.51	18.52^{cde}
Zn @ 0.6 + B @ 0.6	175.33	174.33	174.83^{def}	2.80	2.77	2.78^{defg}	19.19	19.18	19.19^{bc}
Fe @ 0.5 + Zn @ 0.5 + B @ 0.5	177.87	177.20	177.53^{cdef}	3.00	2.97	2.98^{cd}	18.87	18.52	18.70^{cde}
Fe @ 0.5 + Zn @ 0. 6 + B @ 0.6	177.07	176.73	176.90^{cdef}	2.87	2.80	2.83^{cdef}	18.69	18.99	18.84^{c}
Fe @ 0.6 + Zn @ 0.5 + B @ 0.5	176.07	175.73	175.90^{def}	2.73	2.67	2.70^{defg}	18.83	18.79	18.81^{cd}
Fe @ 0.6 + Zn @ 0.6 + B @ 0.6	170.58	168.47	169.53^{gh}	3.00	2.97	2.98^{cd}	19.07	19.76	19.41^{bc}
Fe @ 0.5 + Zn @ 0.6 + B @ 0.5	174.07	173.40	173.73^{efg}	3.00	2.97	2.98^{cd}	18.95	19.27	19.11^{bc}
Fe @ 0.5 + Zn @ 0 .5 + B @ 0.6	173.40	173.07	173.23^{fg}	2.93	2.90	2.92^{cde}	19.27	19.58	19.43^{bc}
Fe @ 0.6 + Zn @ 0.5 + B @ 0.6	163.80	165.80	164.80^{i}	3.83	3.67	3.75^{a}	20.25	20.55	20.40^{b}
Fe @ 0.6 + Zn @ 0.6 + B @ 0.5	164.67	167.13	165.90^{hi}	3.50	3.43	3.47^{b}	21.79	23.71	22.75^{a}
SEm±	3.25	2.58	2.10	0.17	0.19	0.13	0.89	0.95	0.65
$CD_{0.05}$	6.92	5.50	-	0.36	0.40	-	1.91	2.02	-

The mean values superscripted with the same letter in the same column statistically do not differ from each other.

pollen viability and reproductive development. Iron contributes to improved photosynthetic efficiency, indirectly supporting early reproductive transition (Randhawa and Mukhopadhyay, 1986; Arora *et al.,* 2010; Mishra *et al*., 2012). Similar findings were reported in ornamental foliage plants and flowering ornamentals, where micronutrient supplementation advanced flowering time due to improved metabolic efficiency and assimilate partitioning (Bose and Yadav, 2007; Singh *et al.*, 2011). The delayed flowering in control plants reflects nutrient stress conditions, which prolong vegetative growth phase due to limited assimilate availability (Naik and Barman, 2005).

Number of flowers plant^{-1} month^{-1}

Foliar application of Fe, Zn and B significantly increased the number of flowers produced plant^{-1} month^{-1} compared to the control. Treatment Fe @ 0.6 + Zn @ 0.5 + B @ 0.6 mg L^{-1} recorded highest flower production, with 3.83 and 3.67 flowers plant^{-1} month^{-1} during 2022-23 and 2023-24, respectively. Treatment Fe @ 0.6 + Zn @ 0.6 + B @ 0.5 mg L^{-1} ranked second, with 3.50 and 3.43 flowers plant^{-1} month^{-1}, whereas the control recorded 2.28 and 2.07 flowers plant^{-1} month^{-1}, respectively. The increased flower production may be attributed to the improved photosynthetic efficiency, enhanced assimilate translocation and better hormonal regulation. Zinc enhances enzymatic activity related to reproductive development, boron improves pollen tube growth and flower retention, while iron supports carbohydrate synthesis required for flower formation (Arora *et al*., 2010; Mishra *et al*., 2012).

Table 2: Effect of foliar application of iron, zinc and boron on spathe characteristics and vase life of peace lily during 2022-23, 2023-24 and pooled analysis

Treatment details (mg L^{-1})	Spathe breadth (cm)			Vase life (days)		
	2022-23	2023-24	Pooled mean	2022-23	2023-24	Pooled data
Control	7.71	6.75	7.23^{j}	1.73	1.71	1.72^{j}
Fe @ 0.5	7.77	7.77	7.77^{ij}	1.87	1.82	1.85^{ij}
Fe @ 0.6	8.21	8.51	8.36^{ghi}	1.93	1.91	1.92^{hij}
Zn @ 0.5	8.32	8.25	8.29^{hi}	2.45	2.42	2.44^{fghij}
Zn @ 0.6	8.20	8.84	8.52^{fghi}	2.87	2.85	2.86^{defgh}
B @ 0.5	8.37	8.34	8.36^{ghi}	2.80	2.78	2.79^{defghi}
B @ 0.6	8.71	8.69	8.70^{efghi}	2.13	2.08	2.11^{ghij}
Fe @ 0.5 + Zn @ 0.5	9.14	8.79	8.96^{cdefgh}	2.60	2.59	2.59^{efghij}
Fe @ 0.5 + Zn @ 0.6	8.12	8.43	8.27^{hi}	2.47	2.44	2.45^{fghij}
Fe @ 0.5 + B @ 0.5	8.19	8.17	8.18^{hij}	2.60	2.58	2.59^{efghij}
Fe @ 0.5 + B @ 0.6	8.41	8.39	8.40^{ghi}	2.67	2.56	2.61^{efghij}
Fe @ 0.6 + Zn @ 0.5	8.43	8.41	8.42^{ghi}	2.80	2.76	2.78^{defghi}
Fe @ 0.6 + Zn @ 0.6	7.99	9.30	8.65^{efghi}	3.13	3.09	3.11^{bcdef}
Fe @ 0.6 + B @ 0.5	8.36	9.01	8.69^{efghi}	3.20	2.95	3.08^{cdefg}
Fe @ 0.6 + B @ 0.6	9.07	8.72	$8.89^{cdefghi}$	3.43	2.84	3.14^{bcdef}
Zn @ 0.5 + B @ 0.5	8.50	8.47	8.49^{ghi}	3.53	3.16	3.35^{bcdef}
Zn @ 0.5 + B @ 0.6	8.17	9.48	8.83^{defghi}	3.73	3.01	3.37^{bcdef}
Zn @ 0.6 + B @ 0.5	9.90	9.55	9.73^{bcde}	3.53	2.76	3.15^{bcdef}
Zn @ 0.6 + B @ 0.6	9.62	9.59	9.61^{bcdef}	3.53	2.81	3.17^{bcdef}
Fe @ 0.5 + Zn @ 0.5 + B @ 0.5	9.31	9.61	9.46^{bcdefg}	3.20	3.27	3.23^{bcdef}
Fe @ 0.5 + Zn @ 0. 6 + B @ 0.6	9.72	9.70	9.71^{bcde}	3.27	3.23	3.25^{bcdef}
Fe @ 0.6 + Zn @ 0.5 + B @ 0.5	9.45	9.77	9.61^{bcdef}	3.87	3.18	3.52^{bcde}
Fe @ 0.6 + Zn @ 0.6 + B @ 0.6	9.88	9.85	9.87^{bcd}	3.87	3.18	3.52^{bcde}
Fe @ 0.5 + Zn @ 0.6 + B @ 0.5	9.98	9.95	9.97^{bc}	4.07	4.04	4.05^{abc}
Fe @ 0.5 + Zn @ 0 .5 + B @ 0.6	10.32	10.31	10.31^{b}	3.67	3.63	3.65^{bcd}
Fe @ 0.6 + Zn @ 0.5 + B @ 0.6	9.95	10.18	10.06^{b}	3.93	4.25	4.09^{ab}
Fe @ 0.6 + Zn @ 0.6 + B @ 0.5	11.27	11.87	11.57^{a}	4.80	4.42	4.61^{a}
SEm±	0.58	0.74	0.47	0.60	0.58	0.42
$CD_{0.05}$	1.23	1.58	-	1.29	1.25	-

*The mean values superscripted with the same letter in the same column do not statistically differ from each other as per DMRT (Duncan's Multiple Range Test); significance at $p < 0.05$ level

Spathe length

The application of Fe, Zn and B significantly influenced spathe length in peace lily. The maximum spathe length was recorded in treatment Fe @ 0.6 + Zn @ 0.6 + B @ 0.5 mg L^{-1}, measuring 21.79 and 23.71 cm during 2022-23 and 2023-24, respectively. The improvement in spathe length indicates enhanced floral organ development under balanced micronutrient nutrition. This response can be attributed to improved cell expansion and carbohydrate availability. Zinc and boron play critical roles in cell division, elongation, and reproductive tissue development, while iron enhances photosynthetic efficiency, supporting better floral growth (Singh *et al.*, 2011; Mishra *et al.*, 2012). Similar improvements in floral morphological traits due to micronutrient application have been reported by Reddy and Rajput (2003) in ornamental crops. The lower spathe length in control plants reflects restricted floral organ development due to nutrient limitation (Naik and Barman, 2005). Similar responses have been reported in several ornamental crops. In Gerbera jamesonii, micronutrient application improved flower stalk growth and floral characters due to better nutrient availability and physiological activity (Kumar *et al*., 2013).

Spathe breadth

Spathe breadth was also significantly affected by the micronutrient treatments. The highest spathe breadth was recorded in treatment Fe @ 0.6 + Zn @ 0.6 + B @ 0.5 mg L^{-1}, with values of 11.27 and 11.87 cm in 2022-23 and 2023-24, respectively. The increase in spathe breadth indicates better floral quality



Fig. 1: Flowering response of peace lily in three experimental replicates



T_{18} T_{19} T_{20} T_{21} T_{22} T_{23} T_{24} T_{25} T_{26} T_{27}

Fig. 2: Vase life and floral quality of peace lily

and improved ornamental value. Boron plays a vital role in cell wall formation and expansion, while zinc regulates enzymatic processes involved in floral development. Iron indirectly supports floral growth by enhancing carbohydrate synthesis and translocation (Arora *et al.*, 2010; Singh *et al.*, 2011). The inferior performance of control plants confirms that micronutrient deficiency restricts floral organ expansion and reduces aesthetic quality (Randhawa and Mukhopadhyay, 1986).

Vase life of flowers

The vase life was significantly influenced by foliar application of Fe, Zn and B. Treatment Fe @ 0.6 + Zn @ 0.6 + B @ 0.5 mg L^{-1} recorded the maximum vase life, with 4.80 and 4.42 days during 2022-23 and 2023-24, respectively. Treatments Fe @ 0.5 + Zn @ 0.6 + B @ 0.5 mg L^{-1} and Fe @ 0.6 + Zn @ 0.5 + B @ 0.6 mg L^{-1} also recorded comparatively higher vase life, whereas control exhibited minimum vase life of 1.73 and 1.71 days, respectively. The longer vase life observed under micronutrient treatments indicates improved postharvest performance of the inflorescences under the conditions of present study. This indicates a strong influence of micronutrients on post-harvest quality of peace lily. The improvement in vase life may be attributed to enhanced carbohydrate reserves, reduced ethylene sensitivity and improved membrane stability. Zinc and boron contribute to maintain cellular integrity, while iron supports metabolic processes that delay senescence (Arora *et al.*, 2010; Mishra *et al.*, 2012). The lowest vase life in control plants confirms poor physiological status and rapid senescence under nutrient deficiency conditions (Randhawa and Mukhopadhyay, 1986).

Conclusion: The present study demonstrated that foliar application of iron, zinc and boron significantly improved the flowering behaviour and postharvest quality of *Spathiphyllum cochlearispathum*. Combined micronutrient treatments consistently outperformed individual applications and the untreated control, indicating a synergistic effect on floral development and quality. Among the treatments, Fe @ 0.6 + Zn @ 0.5 + B @ 0.6 mg L^{-1} was particularly effective in promoting early flower bud appearance and increasing the number of flowers $plant^{-1}$ $month^{-1}$, whereas treatment Fe @ 0.6 + Zn @ 0.6 + B @ 0.5 mg L^{-1} produced superior spathe dimensions and vase life. Under the conditions of the present experiment, these treatments may be considered promising for improving flowering and postharvest quality of peace lily.

Acknowledgements: The authors are thankful to the Department of Floriculture and Landscaping, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha, India, for providing the experimental field and facilities required to carry out this research during 2022-24.

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