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Horticulture

Effect of Foliar Application of Zinc and Copper on Growth and Post-Harvest Life of Lilium (Asiatic hybrid) cv. Albedo

Asmita[1] and Anil K. Singh[2*]

[1]Department of Floriculture and Landscaping, Indian Agricultural Research Institute, New Delhi, India
[2]Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221 005, U.P., India

*Corresponding author: anilksingh_hort@rediffmail.com

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Abstract

An experiment was carried out in the field and Post-harvest Laboratory of Department of Horticulture, Banaras Hindu University, Varanasi, India during 2013-2014 to see the effect of zinc and copper on growth characteristics and post-harvest life in lilium grown under polyhouse condition. The treatments used were Zn 0.2%, Zn 0.4%, Cu 0.2%, Cu 0.4%, Zn 0.2% + Cu 0.2%, Zn 0.2% + Cu 0.4%, Zn 0.4% + Cu 0.2%, Zn 0.4% + Cu 0.4% along with control (distilled water). Foliar application of zinc and copper was done at 30 days after planting. Spraying of nutrients was done to run-off stage and control plants were treated in the same manner with distilled water. Experiment was laid out in a Randomized Block Design (RBD) and replicated thrice. A significant result was observed in all the parameters studied. Among the growth parameter, treatment Zn 0.4% + Cu 0.4% showed significant increase in the leaf area followed by Zn 0.2% + Cu 0.4% whereas, Zn 0.2% + Cu 0.2% recorded maximum chlorophyll content followed by Zn 0.4% + Cu 0.2%. Maximum fresh weight and dry weight of leaves were observed with Zn 0.2% + Cu 0.2%. Among post-harvest parameters maximum weight of cut stem at 2nd, 4th and 6th day was noticed in Zn 0.4% followed by Zn 0.2% + Cu 0.4%. Treatment Zn 0.2% + Cu 0.4% extended the days to opening of 1st and 2nd flower followed by Zn 0.4% + Cu 0.2% and Zn 0.2% + Cu 0.2% while, Zn 0.4% recorded maximum diameter of flower which was statistically at par with Zn 0.2% + Cu 0.4% whereas, longevity of 1st and 2nd flower was maximum with Zn 0.2% + Cu 0.4% followed by Zn 0.4% + Cu 0.2%. Maximum solution uptake and vase life was observed with Zn 0.4% + Cu 0.2% followed by Zn 0.2% + Cu 0.4%.

Highlight

- Foliar application of zinc and copper was found beneficial for growth and post harvest life.
- Treatment Zn 0.2% + Cu 0.4% extended the days to opening of 1st and 2nd flower. It has paramount importance in post-harvest study.
- Maximum solution uptake and vase life was observed with Zn 0.4% + Cu 0.2% which was at par with Zn 0.2% + Cu 0.4% treatment.

Keywords: Lilium, zinc, copper, growth, post-harvest

Lilium is a unique ornamental plant with many colourful flowers which occupies an important place in floriculture as cut flower, in flower pots and as garden plant and is very popular despite being the higher price (Shiravand and Rostami 2009). It is one of the leading cut flowers of the world (Kumar 2007). Being symbol of purity, its economic value has increased in past two decades and has acquired a great potential for continuing cultivation at the future both in international and domestic markets (Rout *et al.* 2006). Lilium has earned its popularity because of its special features such as various colour, flowers perfume, capacity to be preserved, durability to transportation of cut flowers. However, very limited information is available for its successful cultivation and post-harvest handling in the country. Moreover, its cultivation is greatly influenced by the nutrient status present in the soil. Micronutrient such as zinc plays an essential role in physiology of the plant where it activates a number of enzymes related to metabolism of carbohydrates, auxins and ribosome functions. Copper is involved in a number of physiological processes such as the photosynthetic and respiratory electron transport chains (Van Assche and Clijsters 1990). It also acts as a structural element and participates in oxidative stress responses, cell wall metabolism and hormone signaling (Marschner 1995 and Raven *et al.* 1999). Micronutrients deficiency is observed in various parts of India; whereas zinc deficiency was much higher i.e. 46% in Varanasi district (Singh *et al.* 2013).Therefore, keeping in view this situation, present study was conducted to study the effect of zinc and copper on growth and post-harvest life in lilium to increase its economic value for benefit of the growers.

Materials and Methods

The present experiment was conducted under protected condition (Polyhouse Fig. 1) at Horticulture Research Farm, Department of Horticulture, Banaras Hindu University, Varanasi, Uttar Pradesh, India during 2013-2014, whereas post-harvest study was carried out under controlled conditions in the Post-harvest Laboratory of Department of Horticulture.

Fig. 1. Asiatic Lilium cv. Albedo grown in polyhouse

Fig. 2. Lilium cv. Albedo in bud stage

The climate of Varanasi is sub-tropical with dry hot summer and cool winter with average rainfall in this region about 1000 mm per annum. Lilium cv. Albedo bulbs of uniform size were planted in the prepared beds with a spacing of row to row 30 cm and bulb to bulb 15 cm on 22nd October 2013. Treatments consisted of various doses of zinc and copper and their combinations i.e. Zn 0.2%, Zn 0.4%, Cu 0.2%, Cu 0.4%, Zn 0.2% + Cu 0.2%, Zn 0.2% + Cu 0.4%, Zn 0.4% + Cu 0.2% and Zn 0.4% + Cu 0.4% along with control (distilled water). Foliar application of various treatments of zinc and copper was done in standing crop at 30 days after planting. Application of these nutrients was done to run-off stage and control plants were sprayed in same manner with distilled water. Experiment was laid out in a Randomized Block Design with three replications. Uniform cultural practices *viz.* irrigation, weeding, hoeing and staking operations were carried out according to the needs. For post-harvest study flowers were harvested at colour show stage (Fig. 2 & 3) early in the morning with the help of sharp knife and placed in the bucket containing water and were immediately brought to the Post-harvest Laboratory.

Fig. 3. Lilium cv. Albedo in harvesting stage

Fig. 4. Post-harvest study of Lilium cv. Albedo under controlled condition

Stems of flowers were again re-cut and uniform stem length (45 cm) was maintained in all the treatments. Cut flowers of various treatments were placed in the conical flask containing 100 ml holding solution (2% sucrose + 100 ppm 8-HQC) for further study. The observations on each treatment were recorded on the growth and post-harvest characters. Data on growth parameters i.e. leaf

Table 1. Effect of zinc and copper on growth characteristics in Lilium cv. Albedo

Treatment	Leaf area (cm^2)	Chlorophyll content (mg/100 g fresh weight)	Fresh weight of leaves (g)	Dry weight of leaves (g)
Control	523.26	92.67	18.43	2.02
Zn 0.2%	566.18	123.33	19.96	1.88
Zn 0.4%	590.08	118.67	20.61	1.60
Cu 0.2%	674.50	102.67	22.33	1.76
Cu 0.4%	543.89	109.33	18.80	1.80
Zn 0.2% + Cu 0.2%	674.65	143.00	26.52	2.40
Zn 0.2% + Cu 0.4%	691.77	130.00	22.59	2.27
Zn 0.4% + Cu 0.2%	650.46	137.33	24.34	2.13
Zn 0.4% + Cu 0.4%	707.38	128.67	25.07	2.25
CD at 5%	166.11	31.47	6.21	0.81

area, chlorophyll content, fresh weight and dry weight of leaves and post-harvest characteristics i.e. weight of cut stem, days to opening of flower, diameter of flower, longevity of flower, weight after withering of flower, solution uptake and vase life were recorded. Data thus obtained were subjected to statistical analysis.

Results and discussion

Growth parameters

It is evident from the Table 1 that all the growth characteristics were significantly influenced by the foliar application of zinc and copper as compared to control. Maximum leaf area was observed with the treatment combination Zn 0.4% + Cu 0.4% followed by Zn 0.2% + Cu 0.4%, Zn 0.2% + Cu 0.2% and Cu 0.2% while, maximum chlorophyll content was observed with Zn 0.2% + Cu 0.2% followed by Zn 0.4% + Cu 0.2%, Zn 0.2% + Cu 0.4% and Zn 0.4% + Cu 0.4%. Fresh weight of leaves were observed maximum with Zn 0.2% + Cu 0.2% which was statistically at par with Zn 0.4% + Cu 0.4%, Zn 0.4% + Cu 0.2% and Zn 0.2% + Cu 0.4% whereas, dry weight was also recorded maximum in Zn 0.2% + Cu 0.2% followed by Zn 0.2% + Cu 0.4%, Zn 0.4% + Cu 0.4% and Zn 0.2% + Cu 0.4%. The result might be the increased photosynthetic rate due to application of micronutrients. These micronutrients regulate metabolic process and activate several enzymes like catalase, peroxidase, tryptophan synthase, carbonic dehydrogenase, etc. and hence, improved growth characteristics. The role of zinc in endogenous auxin synthesis and its effect on vegetative growth has been well documented. These findings are in close proximity of Lu *et al.* (2011) who worked on lilium plant and found increased fresh weight and dry weight of leaves on the application of micronutrients. Younis *et al.* (2013) reported an increase in the growth characteristic like leaf area and leaf total chlorophyll contents when worked on rose. A significant positive response to the growth characteristics was also in agreement with the findings of Saeed *et al.* (2013) while working on gladiolus.

Post-harvest parameters

Post harvest study was carried out in the Post-harvest Laboratory (Fig. 4) under controlled conditions. Application of various doses of zinc and copper exhibited pronounced effect on different post-harvest characteristics (Table 2 and 3). Weight of cut stem at

Table 2. Effect of zinc and copper on post-harvest parameter of Lilium cv. Albedo

Treatment	Weight at 2nd day (g)	Weight at 4th day (g)	Weight at 6th day (g)	Opening of 1st flower (days)	Opening of 2nd flower (days)
Control	32.53	33.20	31.51	1.67	3.00
Zn 0.2%	41.55	41.56	38.96	2.33	3.33
Zn 0.4%	48.57	49.90	46.26	3.00	4.00
Cu 0.2%	36.21	36.76	35.08	2.33	3.66
Cu 0.4%	34.47	32.76	28.15	1.33	4.00
Zn 0.2% + Cu 0.2%	41.26	42.79	40.01	3.33	4.66
Zn 0.2% + Cu 0.4%	43.49	46.16	42.65	4.00	6.00
Zn 0.4% + Cu 0.2%	43.43	43.46	39.95	3.33	5.00
Zn 0.4% + Cu 0.4%	35.45	34.94	30.29	2.67	4.66
CD at 5%	10.23	11.11	7.50	0.80	0.73

Table 3. Effect of zinc and copper on post-harvest parameter of Lilium cv. Albedo

Treatment	Diameter of 1st flower (cm)	Diameter of 2nd flower (cm)	Longevity of 1st flower (days)	Longevity of 2nd flower (days)	Weight after withering (g)	Solution uptake (ml)	Vase life (days)
Control	15.85	15.20	5.67	6.33	18.81	37.67	9.67
Zn 0.2%	16.63	16.08	7.00	8.33	22.89	44.67	11.67
Zn 0.4%	17.50	17.35	6.33	7.00	23.18	41.67	10.67
Cu 0.2%	16.80	16.03	6.67	7.00	19.26	37.67	10.33
Cu 0.4%	16.25	16.30	6.00	7.67	15.39	34.67	10.67
Zn 0.2% + Cu 0.2%	16.73	16.12	7.00	8.67	20.94	35.67	10.67
Zn 0.2% + Cu 0.4%	17.37	17.18	8.67	9.00	17.07	45.33	11.67
Zn 0.4% + Cu 0.2%	16.38	16.22	8.00	8.33	21.81	46.00	12.67
Zn 0.4% + Cu 0.4%	16.47	16.25	8.00	8.00	17.43	43.33	11.33
CD at 5%	1.50	1.07	1.95	1.08	4.15	8.64	2.34

second day was observed maximum with the treatment Zn 0.4% followed by Zn 0.2% + Cu 0.4%, Zn 0.4% + Cu 0.2% and Zn 0.2%. Maximum weight of cut stem at fourth day was recorded in Zn 0.4% followed by Zn 0.2% + Cu 0.4%, Zn 0.4% + Cu 0.2% and Zn 0.2% + Cu 0.2%. Similarly, weight at sixth day was recorded maximum in the treatment Zn 0.4% followed by Zn 0.2% + Cu 0.4%, Zn 0.2% + Cu 0.2% and Zn 0.4% + Cu 0.2%. Prolonged vase life and slow opening of any cut flower have paramount importance. Treatment Zn 0.2% + Cu 0.4% significantly extended the days to opening of first flower followed by Zn 0.2% + Cu 0.2% and Zn 0.4% + Cu 0.2%. It is interesting to note that same treatment (Zn 0.2% + Cu 0.4%) resulted in maximum days to opening of second flower followed by Zn 0.4% + Cu 0.2%, Zn 0.2% + Cu 0.2% and Zn 0.4% + Cu 0.4%. Longevity of the first flower was also found maximum with the treatment Zn 0.2% + Cu 0.4% followed by Zn 0.4% + Cu 0.2% and Zn 0.4% + Cu 0.4% and it was maintained also in longevity of the second flower was maximum with Zn 0.2% + Cu 0.4% followed by Zn 0.2% + Cu 0.2%, Zn 0.4% + Cu 0.2% and Zn 0.2%. Maximum diameter of the first and second flower was recorded with the treatment Zn 0.4% which was statistically at par with Zn 0.2% + Cu 0.4%. Maximum weight after withering was recorded with Zn 0.4% which at par with Zn 0.2% and Zn 0.4% + Cu 0.2%. Maximum solution uptake and vase life was observed with Zn 0.4% + Cu 0.2% which was statistically at par with the treatments Zn 0.2% + Cu 0.4%, Zn 0.2% and Zn 0.4% + Cu 0.4%.

The positive response of micronutrient might be due to the fact that it binds with the sulphohydral group of membrane protein and protects the phospholipids and proteins thus, maintaining membrane integrity (Aravind and Prasad 2003). This phenomenon would result in reduced membrane leakage which probably increased absorption of more solution thus resulted in enhanced vase life, diameter and longevity of the flowers. These results are experimentally substantiated with the findings of Pratap *et al*. (2008), Singh *et al*. (2012) and Saeed *et al*. (2013) who worked on gladiolus and found a significant response of micronutrients to the post-harvest parameter.

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