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Effects of copper nano-particles (CNPs) on vase life of cut flowers chrysanthemum (*Chrysanthemum morifolium* L. 'White')

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ABSTRACT

In this study, the effect of copper nanoparticles on vase life and postharvest quality of cut chrysanthemum was examined. This study carried out based on completely randomized design with 4 levels of copper nanoparticles (0, 5, 10 and 20 mg l^{-1}) in 3 replications and 12 plots. Traits such as vase life, total chlorophyll, bacterial counts in vase solution and dry matter were measured. According to the results, pretreatment with 5 mg l^{-1} of copper nanoparticles increased the vase life of cut flowers of chrysanthemum 'White' (12.33 days) compared to control (4.33 days).

Keywords: Copper nanoparticles (CNPs), Vase life, Chrysanthemum, Total chlorophyll.

INTRODUCTION

Chrysanthemum, with the scientific name of *Chrysanthemum morifolium* from Asteraceae family is one of the five most important cut flowers in the world [6]. Stem end blockage by microorganisms is a postharvest problem that reduces the vase life of the cut chrysanthemum [2]. Accordingly, the use of antimicrobial compounds that control the growth and activity of microorganisms can resolve this problem in cut flowers and will increase the quality of them. In this study, we examined the effect of different concentrations of copper nanoparticles on longevity and quality of cut chrysanthemum 'White'.

MATERIALS AND METHODS

Cut chrysanthemum (*Chrysanthemum morifolium* 'White') was prepared from Tehran in the morning and immediately transferred to the postharvest laboratory. Cut flowers were weighted and 4 flowers were placed in 2 liters plastic pots and treated with copper nanoparticles in three for 24 h pulse. After the pulse period, cut flowers were transferred to the vases containing 500 ml of solution 3% sucrose + 200 ppm 8-hydroxyquinoline sulfate. Traits such as vase life, total chlorophyll, bacterial counts of vase solution and dry matter were measured. End of vase life was when flowers were wilted or leaf was discolored [2]. Total chlorophyll content was measured using Mazumdar and Majumder [8]. Bacterial colonies were counted with Van Meeteren et al. [11] method. Dry matter percentage was calculated by this formula:

$$DM(\%) = \frac{\text{Dry weight in end of vase life}}{\text{Fresh weight in end of vase life}} \times 100$$

Data were analyzed using SPSS software and mean comparison was performed by LSD test.

RESULTS AND DISCUSSION

Analysis of variance showed that the effect of CNPs on the vase life and total chlorophyll was statistically significant at 1% and on the bacterial counts in vase solution and dry matter was statistically significant at 5% probability level. Mean comparison showed that the 5 mg l^{-1} CNPs had the maximum vase life as compared to the control (12.33 and 4.33 days, respectively) (Table 1, Fig. 1). Positive effect of CNPs can be attributed to antimicrobial effect of copper containing solution by reducing population of bacteria and help to increase vase life. Edrisi et al. [1] found that the use of 300 mg l^{-1} copper sulfate improved vase life and postharvest quality of cut Pink carnation. Significant impact of CNPs on total chlorophyll content showed that 5 mg l^{-1} CNPs had the highest rate of total chlorophyll (Table 1, Fig. 2). CNPs prevent from the degradation of chlorophyll and inactivate chlorophyllase enzymes [3]. Kazemi and Ameri [5] studied the effect of silver nanoparticles on cut gerbera and concluded that 5 mg l^{-1} silver nano-particles decreased total chlorophyll content. Our results exhibited that the 5 mg l^{-1} CNPs decreased bacterial colonies compared to the control (Table 1, Fig. 3). Positive effect of CNPs on bacterial contamination is due to the antimicrobial properties of copper ion on microorganisms [1-7]. Liu et al. [7] showed that 5 mg l^{-1} silver nano-particles reduced bacterial colonies and extended the vase life of cut gerbera cv. 'Ruikou'. Significant effect of CNPs on dry matter showed that 5 mg l^{-1} CNPs was the best treatment (Table 1, Fig. 4). It seems that CNPs by increasing water absorption prevent oxidative stress and with a decrease in protein degradation and decreased respiration rates has led to an increase in dry matter [9-10]. Hashemabadi [4] found that SNPs increased the amount of dry matter in cut carnation 'Tempo'.

Table 1. Effect of different concentrations of CNPs on measured traits of chrysanthemum.

Treatment	Vase life (days)	Total chlorophyll (mg g^{-1} FW)	Bacterial population in vase solution (Log_{10} CFU ml^{-1})	Dry matter (%)
Control	4.33c	4.67c	70.33a	17.72b
C_1 (5 mg L^{-1} CNPs)	12.33a	32.48a	12.67b	28.87a
C_2 (10 mg L^{-1} CNPs)	10.83ab	15.04b	19.00ab	24.31ab
C_3 (20 mg L^{-1} CNPs)	11.16ab	16.24b	15.00ab	25.46ab

**In each column, means with the same letter are not significantly different based on the LSD test.*

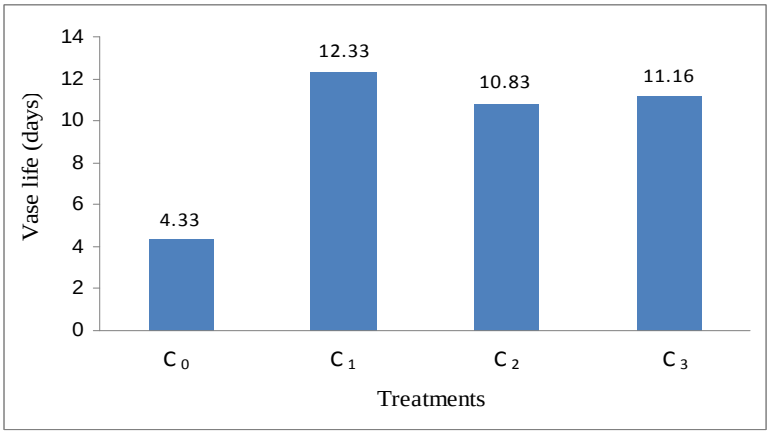

Fig. 1. Effect of CNPs on vase life of cut chrysanthemum

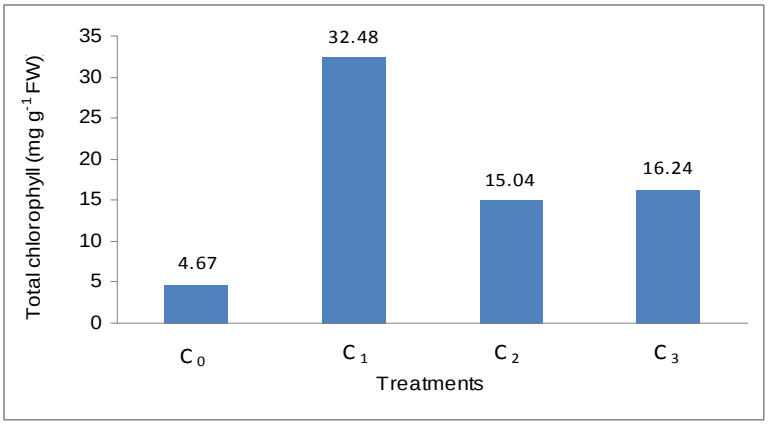

Fig. 2. Effect of CNPs on Total chlorophyll content of cut chrysanthemum

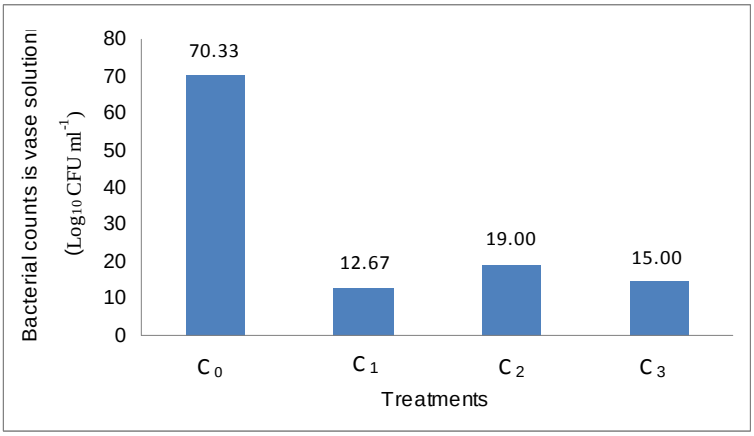

Fig. 3. Effect of CNPs on bacteria counts in vase solution of cut chrysanthemum

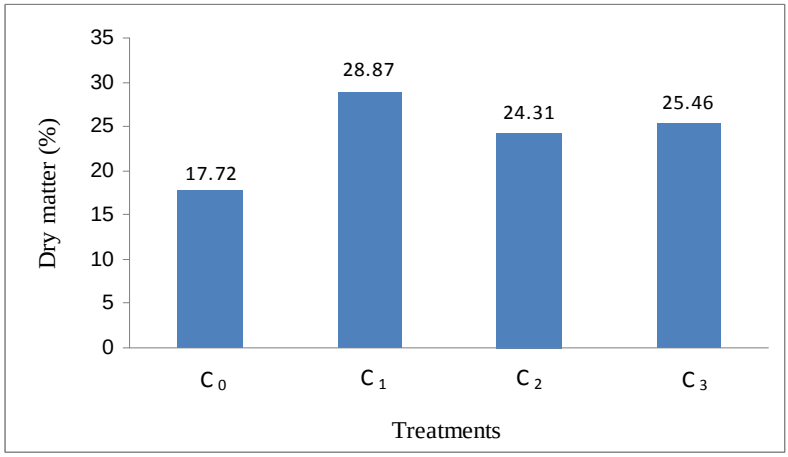

Fig. 4. Effect of CNPs on dry matter of cut chrysanthemum

CONCLUSION

Results suggested that 5 mg L^{-1} CNPs can improves vase life and quality of cut chrysanthemum and decreased leaf yellowing and decreased bacterial contamination in vase solution.

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