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Application of Microorganisms Compared with Nanoparticles of Silver, Humic Acid and Gibberellic Acid on Vase Life of Cut Gerbera Goodtimming

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Abstract

Gerbera one of 10 important cut flowers in the world and Iran. One of the most problems is low-life after harvest and neck bending. Producers want to increase longevity of these flowers with using chemical solutions. With the aim of achieving the best chemical treatments to increase flower vase life gerbera Goodtimming, nano silver (5 mg l^{-1}), humic acid (50 mg l^{-1}), gibberellic acid (2.5 mg l^{-1}) and Lactobacillus plantarum 110 CFU m l^{-1} and *Lactococcus lactis* 1^{10} CFU ml^{-1} with sucrose (4%) compared with controls. This study in carried out with 6 replications. Cut flowers recutted to 35 ± 2 cm, and then tested in different solutions for 20 days. The results showed that silver nanoparticles (5 mg l^{-1}) + sucrose 4% + gibberellic acid 2.5 mg l^{-1} with the 19.5 days vase life compared with controls (17.67days) had the highest durability. Distilled water + sucrose 4% with 5.98 mm stem diameter was better than control (5.49 mm) ($P \leq 0.01$), while humic acid 50 mg l^{-1} + sucrose 4% + gibberellic acid 2.5 mg l^{-1} had lowest average daily stem diameter (5.44 mm), respectively. Highest water uptake observed in silver nanoparticles 5 mg l^{-1} + sucrose 4% + gibberellic acid 2.5 mg l^{-1} treatment (8.78 ml g^{-1} F.W.). Silver nanoparticles 5 mg l-1 + sucrose 4% + gibberellic acid 2.5 mg l^{-1} had highest fresh weight per day (24.89 g) and dry weight (4.96 g), respectively.

Keywords: Gerbera, Gibberellic acid, Humic acid, Lactobacillus plantarum, Lactococcus lactis, Nanoparticles of silver.

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INTRODUCTION

Gerbera (Asteraceae) is indigenous of south Africa. It is a perennial, tropical plant. One of the most important problems of postharvest of this plant is bent neck and less vase life. Nano technology is a fast growing science which is creating engineered particle in 1-100 nm. Nano-silver are include this particle and can have more chemical and biological activities in order to small size, NSPs enter to cell, tissue and organs, so they can replace with silver salts in preservative solution. Nano-silver inhibits the respiration and key metabolism of electron transfer system and material transfer in microbial cell membrane (Paull and Lyons, 2008; Bernhard, 2008).

In a study on Gerbera 'Dune', it recognized that flowers which maintain in 5 or 10 mg l^{-1} SNP, had more vase life comparing to control plants. There was not significant difference between treatments and the best concentration was 5 mg l^{-1}. Also, application of 1mg l^{-1} of SNP with 6% sucrose had been considered as the best treatment (Solgi, *et al*, 2009). Silver ions because of small size, have more contact with outer space and influence more on environment. SNPs, in comparison with silver ions, showed anti-microbial property with the least concentration. (Fig 2).

Application of humic acid increases Ca accumulation in the stem and then vase life will be increased and stem bent will be reduced. Also, cytokinins can improve vase life of cut flowers. Humic acid improves food uptake and hormonal effects (Nikbakht *et al*., 2008).

The effect of humic acid on micro elements uptake in low pH is more than high pH. In low pH, high concentration of humic material cause to reduce buds fresh weight and may be it is because humic material in low pH, become toxic. This is less identified in high pH (Kreij and Basar, (1995). Emongor (2004) reported that 2.5- 7.5 mg l^{-1} GA can used in preservative solution of cut Gerbera. So, GA in 5- 7.5 ml g l^{-1} in cut Gerbera, increases the number of opened floret after 6 days comparing to flowers maintain in water.

Lactobacillus is in form of long/ tall and narrow and sometimes bent tubes, and chain form. This bacteria's are lacking spore and are positive gram. Their intracellular granules are observed with staining by gram or methylen blue method. Lactobacillus is micro aerofilik, namely their growth will be increased in a solid medium , usually in aerobic condition with reduced oxygen and present 5-10 % CO_2. Some of the Lactobacillus are aerobic just in the early divition. The appropriate temperature to growth Lactobacillus are about 30-40°C. The suitable pH for their growth is 4.5- 5.5 Lactobacillus grow in all liquid medium but after the growth stop, cells are deposited.

In a study on *Lilium cutflowers* (Lilium condidum) has been indicated that there is positive correlation between Lactobacillus concentration and vase life (Hadavi and Alinejad, 2009). The effect of lactic acid bacterials (LAB), which use fresh fruit and vegetables as a bio-control element against phyto-pathogenic of bacterials and fungi, had been investigated. Although in previous reports, anti-fungal property was due to lactic acid. Among the bacteria which applied as bio-control material, strains *Genera pantoea*, *Bacillus* and *pseudomonas* had been described as suitable bio-control materials. Also *invitro* studies had been indicated that lactic acid bacteria can effect on pathogens which cause to influence on plants and serve as preservative material and although their optimal growth is in 25°C, they can grow in a wide crops (Trias *et al*., 2008). Because of production some acids, lactic acid bacteria can cause to prevent most other bacterias.

In some studies were indicated that among 25 microorganisms, which are found in Dianthus *caryophyllus* L. 'Improved white sim', three of them reduced vase life of them. Some of these microorganisms reduced cut rose "cara mia", *chrysanthemum x morifloium* Ramat. 'May Shoesmith' and other carnation cultivars, 'Improved Red Sim' and 'Improved Pink Sim' Vase life. They also reported that it is possible that genetic structure of microorganisms which cause to reduce vase life of cut flower, allow us to introduce a stimuli which cause to begin reduce vase life process. Understanding the starting stage of this process can delay senescence and increase vase life of cut flowers (Zagory and Reid, 1986).

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In this stusy, effects of sucrose, SNP, Humic acid, GA, *Lactobasillus plantarum* and *Lactococus lactis* on vaselife and quality of cut *Gerbera* ‘Goodtiming’ were evaluated.

MATERIALS AND METHODS

This experiment carried out in RCBD with 6 replications and in each plot was one flower. In this experiment, 10 treatments including control were compared:

1- Distilled water (control)
2- Distilled water + Sucrose 4 %
3- SNP 5mg l^{-1} +Sucrose 4%
4-Humic acid 50 mg l^{-1} + Sucrose 4%
5- GA 2.5 mg l^{-1} + Sucrose 4%
6-SNP 5 mg l^{-1} + Sucrose 4% + GA 2.5 mg l^{-1}
7- Humic acid 50 mg l^{-1} + Sucrose 4% + GA 2.5 mg l^{-1}
8- SNP 5 mg l^{-1} + Sucrose 4% + Humic acid 50 mg l^{-1}
9- *Lactobacillus plantarum* 1^{10} CFU mg l^{-1} + Sucrose 4%
10- *Lactococus lactis* 1^{10} CFU mg l^{-1} + Sucrose 4%

Harvested cut flowers were similar in diameter, color, pedicel light and weight. Two rows of florets were opened and their stamen were appeared. After reaching to laboratory, the stem of plants recuted in a 35±2 cm height. Environmental condition of vase life room was 21±1°C, 60-65 % RH and 12 hrs period. Light intensity was 15- 20 µmol s-1 m-2 from fluoresent lamps. The evaluated characteristics including to:

Vase Life

The end of vase life is defined as when the plant show some symptoms of wilting or inrolling, stem benting (>90) or break.

Flower and Stem Diameter

Flower diameter, was measured in day zero (before treatments) 3, 6, 9, 11 ,13 and 16th day after treatments by verniar caliper. Diameter of bottom, mid and end of flowering stem was measured in day zero (before treatments) and 3,6,9,11,13 and 16th day after treatments by verniar caliper.

Water uptake

In order to determine of evaporation from preservative solutions, 6 dishes with 250 ml distilled water and one cut Gerbera were weighted and had been placed between the dishes containing cut flowers. These dishes were weighted daily and compared with the previous days, surface evaporation rate is obtained. In this research, water uptake measured by measuring reduced content of solution in the dishes and reducing surface evaporation rate from it.

Relative Fresh Weight (RFW) and Dry Matter (DM)

In this experiment, fresh weight of flowers measured in days 0, 3, 6, 9, 11, 13, 16 and finally the changes of plant fresh weight in the mentioned days expressed as a percent to early weight.

RFW (%) = (fresh weight in mentioned day/fresh weight in day zero) × 100

For determination dry weight, each flower placed in oven in 105 °C for 48 hr and finally dry matter measured.

DM (%)= (DW/FW) × 100

Data Analysis

Statistical analysis of data was carried out by using SPSS and MSTATC software. Comparison of means was carried out by using DNMRT.

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RESULTS AND DISCUSSION

The results showed that effects of treatments on vase life had been significant ($P \leq 0.01$). SNP (5 mg l^{-1}) + sucrose 4% + GA 2.5 mg l^{-1} with 19.50 days was the best treatment (Fig 1).

Our results were supported by Solgi *et al* (2009) and Etesami and Kafi (2006). Summing from above findings, it seems that although SNP can finally cause to increase vase life, but may have negative effects on plant physiology and in combination with other compounds, reduced bad effects on plant tissues and improves vase life of cut flowers. Application of SNP is not seem recommendable. The effect of *Lactobacillus plantarum* 1^{10}CFU m1^{-1} + sucrose 4% and *Lactococus lactis* 1^{10}CFU ml^{-1} + sucrose 4% had not significant effect on vase life.

Results of flower diameter indicated that, the effect of treatments on flower diameter was significant ($P \leq 0.01$). SNP (5 mg l^{-1}) + sucrose 4% with 106.61 mm was better than control (105.75 mm). *Lactococes lactis* 1^{10} CFU ml^{-1}+ sucrose 4% had the least flower diameter (92.65 mm) (Fig 4).

Differnet treatments had not significant effect on stem diameter, but distilled water + sucrose 4% with 5.98 mm in comparing with control flowers (5.49 mm) was better. While humic acid 50 mg l^{-1} + sucrose 4% +GA 2.5 mg l^{-1} had the least stem diameter (5.44 mm) (Fig 5). The flower diameter is a suitable index to flower opening and the stem diameter is important factor of flower quality and play important role in flower marketing. The results indicated that the effect of treatments on water uptake was significant ($P \leq 0.01$).

The greatest water uptake was to SNP(5 mg l^{-1}) + sucrose 4% +GA 2.5 mg l^{-1} (8.78 ml g^{-1} F.W) which had significant differences with control treatment (6.11 ml g-1 F.W) (Fig 6). About water uptake, also SNP in combination with other compounds had positive effect.

Treatments had not significant effects on relative fresh weight, but SNP (5 mg l^{-1}) + sucrose 4% + GA 2.5 mg l^{-1} (24.89 g) and humic acid 50 mg l^{-1} + sucrose 4% + GA 2.5 mg l^{-1} (24.89 g) were two best fresh weight, while humic acid 50 mg l^{-1} + GA 2.5 mg l^{-1} had the least relative fresh weight (20.22 g) (Fig 7). One of the most effective parameters on vase life and quality of cut flowers is fresh weight of them. Pre-harvest factors have direct effect on fresh weight of cut flowers. Evaporation and transpiration are two important factors that cause to reduce fresh weight. Reducing of fresh weight play important role to determine vase life. Wilting of petals reduces their ornamental value. As it supported in the experiment results. SNP in combination with other compounds had the greatest fresh weight.

The greatest dry matter was related to SNP 5 mg l^{-1} 5 + sucrose 4% +GA 2.5 mg l^{-1} (4.69 g) and the least dry weight was related to control treatment (2.6 g) and humic acid 50 mg l-1 + sucrose 4% + GA 2.5 mg l^{-1} (3.30 g) and Lactobacillus plantarum 1^{10} CFU m l^{-1} + sucrose 4% (3.3 g) (Daeschel *et al.*, 1990)

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Figures

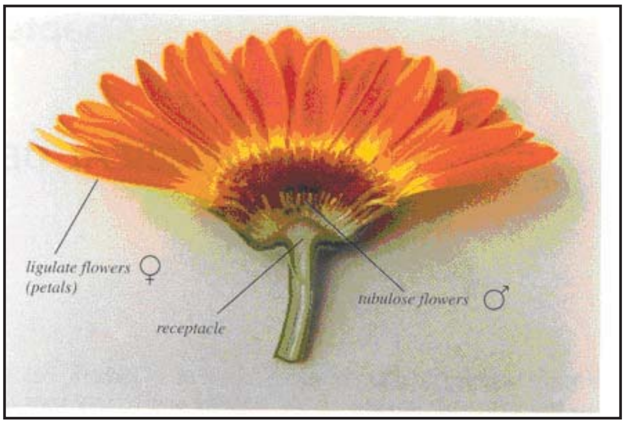

Fig.1. Cut gerbera

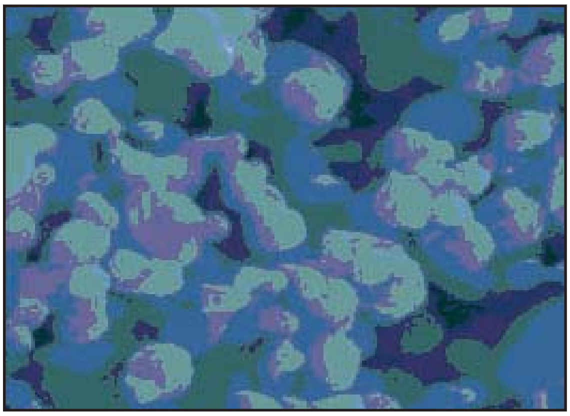

Fig. 2. Silver Nano Particles (SNPs)

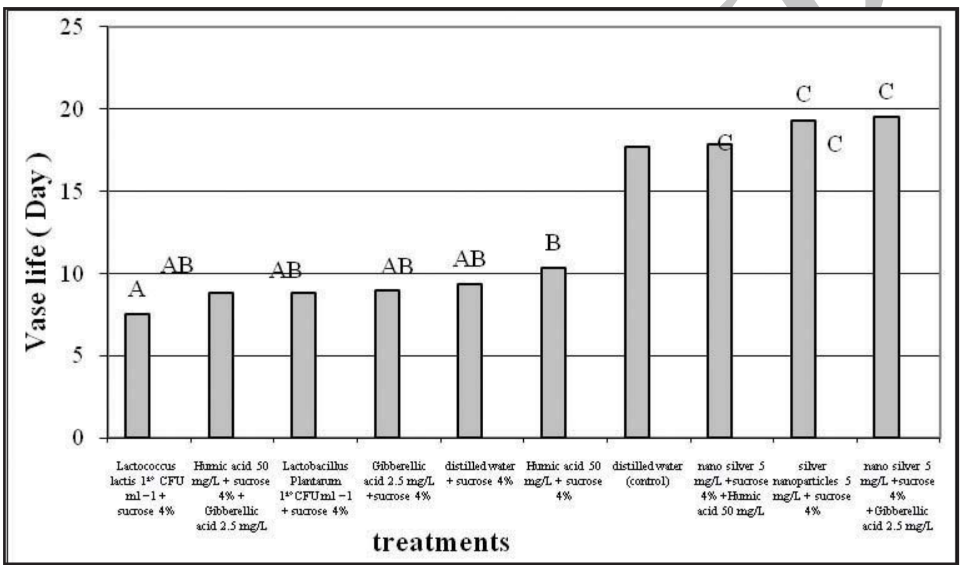

Fig. 3. Effects of different treatments on vase life

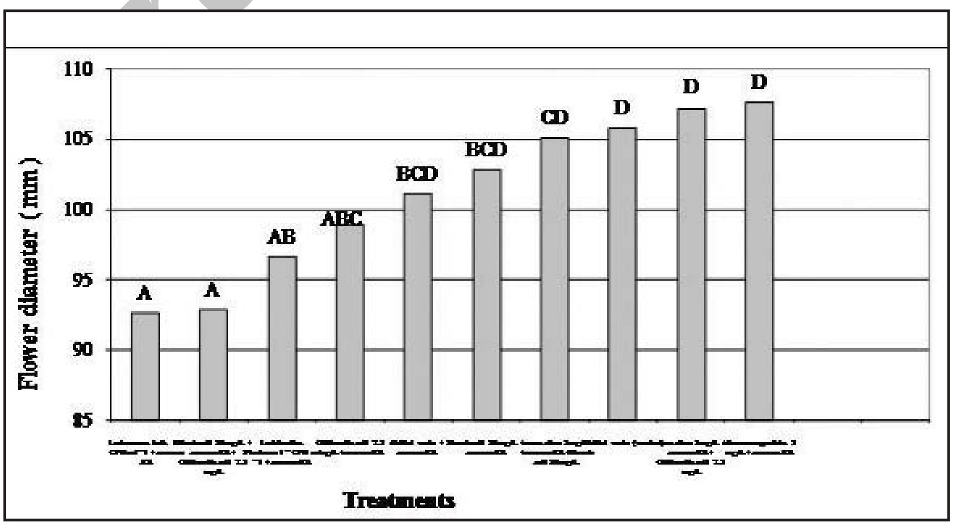

Fig. 4 . Effects of different treatments on flower diameter

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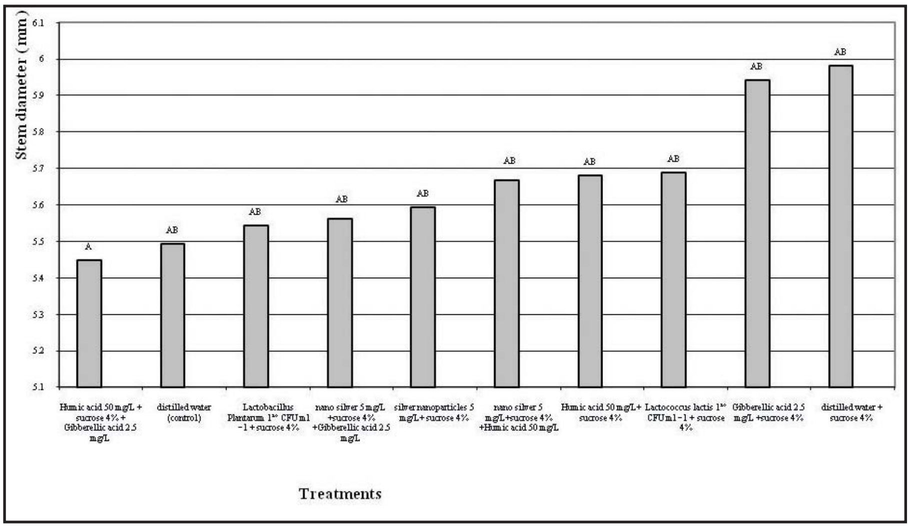

Fig. 5 . Effects of different treatments on stem diameter

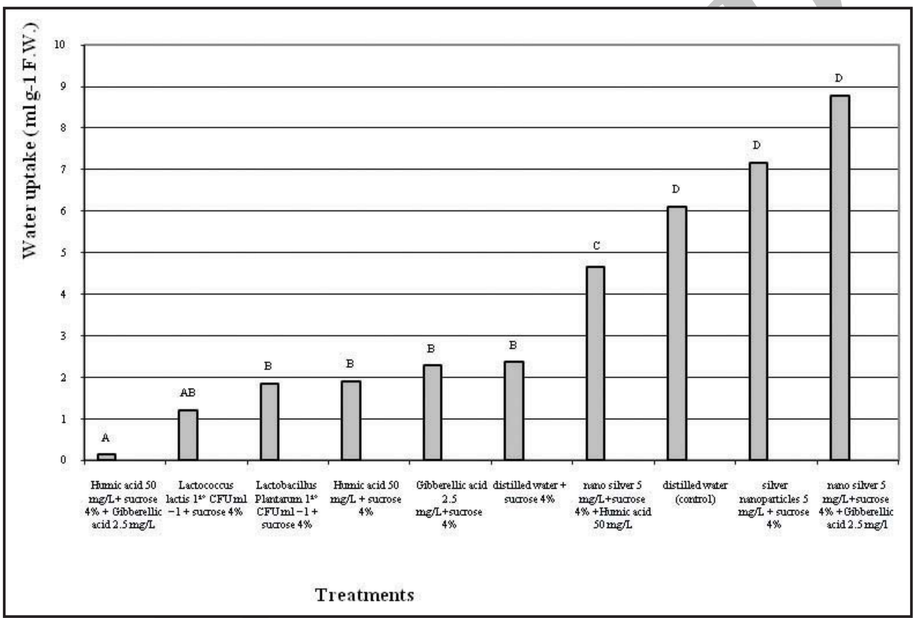

Fig. 6. Effects of different treatments on water uptake

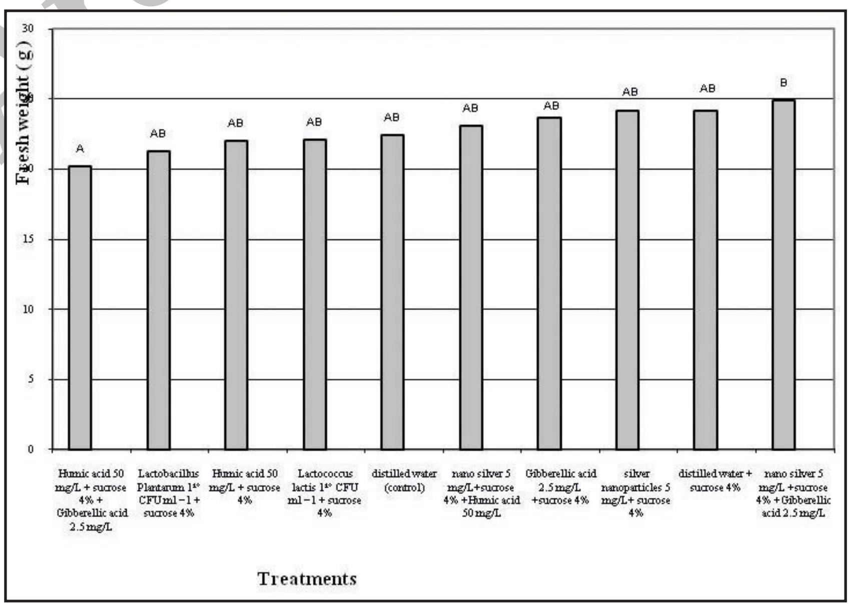

Fig. 7. Effects of different treatments on fresh weight

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