

Comparison Biopreparat Treatments on Plant Growth of Potted Gerbera (*Gerbera jamesonii*)

Bulent AKBUDAK¹⁺ and Senay MURAT²

¹ Department of Horticulture, Faculty of Agriculture, Uludag University, Gorukle Campus, Nilufer, 16059 Bursa, Turkey

² Black Sea Agricultural Research Institute, 55300 Tekkek öy, Samsun, Turkey

Abstract. In this study, effect of control, biopreparat, calcium (Ca) and fungicide treatments made in planting seedlings and development period to gerbera was examined. Trichoderma and Mycorrhiza was applied on the bottom of seedlings the mixture of 20 mL to each pot. Ca (1%) and Teldor (1 mL/1 L) was applied in the form of spray to parts of the stalk for improvement of the flower buds. Teldor was the best treatment in terms of leaves length. Trichoderma was the best treatment in terms of leaves width but not significant different from other treatments. Moreover, the same treatment delayed flowering and led to formation of uniform flowering. Trichoderma treatments have given successful results in parameters of the number of leaf, flower, bud and leaf relative water content; Ca treatments have given successful results in parameters of colour of leaf top, petal leaf rupture force, flower colour and vase life.

Keywords: Biopreparat, growing, potted gerbera, production, quality.

1. Introduction

Herb production has to work to strict timescales and product specifications in which plants of a certain size have to be ready for market at a certain time, be pest and disease-free, while maintaining antioxidant and essential oil levels that impart the expected flavour. These are heavy demands to place upon any plant and thus factors that may affect plant production [1].

Mycorrhizal association enhances plant growth and productivity by increasing nutrient elements uptake. They also impart other benefits to plants including enhanced enzymatic production, increased rate of photosynthesis, enhancement of nitrogen fixation by symbiotic or associative N₂-fixing bacteria, osmotic adjustment under drought stress, increased resistance to pests, tolerance to various abiotic stress factors and improving soil aggregation and thus improved soil physical properties and stability [2]. Trichoderma spp. are common soil fungi used as biocontrol agents due to their capacity to produce antibiotics, induce systemic resistance in plants and parasitize phytopathogenic fungi of major agricultural importance. The biocontrol mechanism exerted by Trichoderma spp. is comprised by different mechanisms, including the production of antibiotics, competition for space and nutrients with other rhizosphere microorganisms, as well as the direct attack of phytopathogenic fungi by means of mycoparasitism. Moreover, root growth induced by Trichoderma spp. increases nutrient uptake, drought and soil packing tolerance [3]. Calcium (Ca), which is essential for plant growth and development, is a macro element having significant roles in cell growth and development process, adjustment of membrane permeability, stabilization of tissues and gaining of the quality parameters. The effect of Ca, which is a principal element in plant nutrition, has been reported by many researches. The decreases in Ca content of soils due to various reasons are effective especially at generative phase and it affects development negatively [4]-[6]. Fenhexamid, a hydroxyanilide derivative, is

⁺ Corresponding author. Tel.: +90 224 2941476; fax: +90 224 4429098
E-mail address: bakbudak@uludag.edu.tr

one of the recently introduced fungicides with a high preventive activity against plant pathogens. Preventive treatments of a commercial formulation of fenhexamid, Teldor 50 WP, were effective against lesion development on plant tissues [7]. Mycorrhizas are found naturally in about 80% of vascular plants worldwide including many agricultural crop plants. They are soil based, forming a symbiotic relationship with their plant partner, and they can provide a variety of benefits to the plant host including improved nutrient uptake and plant defenses [1].

The purpose of this study was to investigate the effect of different treatments like plant nutrition element, biopreparate and fungicide on plant growth and to define the best treatment for plant growing. For this purpose, the effect of Ca, which is a plant nutrition element, Mycorrhiza and Trichoderma, which are biopreparates, and Teldor, which is a commercial fungicide, on plant development was investigated.

2. Materials and Methods

The 'Scarlet Shades Dark Center' variety gerbera seedlings were obtained from a commercial company in Mustafakemalpaşa, Bursa. The seedlings were transplanted to 18 cm pots and classified into 5 groups and various treatments were done: 1) nothing was done to control group seedlings; 2) Mycorrhiza was applied during seeding. In order to do this, 15.74 g Mycorrhiza was dissolved in 4.2 L water and 20 mL mixture was applied to the bottom of seedlings, 3) 70 g of Trichoderma and 1/4 of the activators in packages were dissolved in 4.2 L water and 20 mL mixture was applied to the bottom of the seedlings, 4) one month after the first flower buds were seen 1% Ca was sprayed in one week intervals, 5) one month after the first flower buds were seen Teldor 10 mL/10 L water was sprayed in one week intervals. After the seedlings were transplanted regular watering, plant nutrition, weed control were done. Five month after plant transplanting, several analyses were done on leaves and flowers to determine the plant development and the effects of treatments:

The length and width of the biggest leaves were measured via digital calliper gauge (Mitutoyo, CD-20CPX, Japan) on 30 plants from each group.

Leaf, flower and bud counts in pots were determined.

Leaf relative water content (LRWC) at midday was determined with the formula:

$$\text{LRWC} = 100 \times [(\text{FW} - \text{DW}) / (\text{TW} - \text{DW})]$$

Where FW = fresh weight, DW = dry weight, and TW = turgid weight. LRWC was calculated with TW determined after fully hydrating fresh leaves in darkness at 4 °C for 18 hours [8].

The color of top and bottom leaf, flower and stem colors of gerbera were determined by two readings on the two different symmetrical faces of the flower in each replicate, using Minolta CR-300 (Konica-Minolta, Osaka, Japan).

The petal leaf rupture force (PLRF) properties of the flowers were estimated by performing compressive stress strain experiments by means of a biological material test device. The device was equipped with a 50 N capacity load cell (Sundoo 50 SH Digital Push Pull Gauge, Wenshou, China). Hooked tips were mounted on the measuring device to measure the petal leaf rupture force of the gerberas. The flower was placed on the hook and the petal leaf was pulled vertically by hand. The force values as the petal leaf broke off from the flowers were recorded. The accuracy of N was 0.01.

Vase life of flowers was determined as the day.

The research was established according to the randomized plots factorial experimental design. The analyses were made in three replicates, with ten plants (uniform by flower quality) in each replicate. The results obtained from the study were analysed using ANOVA and means were compared using the least significant difference (LSD) test ($P < 0.05$).

3. Results and Discussion

When the effect of treatments performed in the study is evaluated in terms of leaf length and width it was determined that the biggest leaves belong to the plants on which Teldor 16.71 cm and Trichoderma 16.64 cm was applied, respectively. Compared to the control group Mycorrhiza treatment had no effect on leaf size

(Table 1). Studies have been made on the subject of Trichoderma application that stimulates the production of plant phytohormones and IAA -related indoles, and thus found that the positive effects on growth. Data obtained in this study supports the positive effect of Teldor which was also reported by the former studies [3], [7], [9]. In studies on Mycorrhiza were determined that it increases the intake of nutrients in the soil and has a positive effect on plant growth. In this study, Mycorrhiza treatments to be lower than other applications in this study are thought to be related to treatment concentration [1].

Trichoderma treatment caused larger number of leaves, flower and buds when compared to controls. It was also observed that Ca and Teldor treatments had no effect of leaf, flower and bud number (Table 1). This might be attributed to the delaying effect of Ca and Teldor treatments on flowering. It was determined that the number of flower is higher in Trichoderma treatment than the other groups. This shows that Trichoderma treatment is effective on increasing the number of flowers and supports the findings of another study [10]. However, when compared with the control, Mycorrhizat also have a positive impact on the number of leaves, but it was determined that not to be cause to an increase in the number of flowers and buds. In previous studies, Mycorrhiza to inhibit the synthesis of ethylene in plants, so it is stated that the effect of a regulatory flowering [1], [11].

When the study is evaluated in terms of LRWC, which is an indicator of leaf viability, the samples on which Trichoderma was applied were effective than Mycorrhiza by a LRWC of 80.90% (Table 1). And there was no significant difference among all treatment but Mycorrhiza. Trichoderma was only better than Mycorrhiza, but not significant different from other treatments and control. In similar studies, plants treated with Mycorrhiza were provided by the better development of the vascular structure. Therefore have positive effects of plant viability. In this study, the effect of Mycorrhiza application on LRWC as described previously thought to result from the application dose. This positive effect of Trichoderma treatments on plant viability has been also determined in another study [10].

Table 1. Leaf length and width, the number of leaf, the number of flower, the number of bud and leaf relative water content of gerbera.

| Treatment | Leaf length (cm) | Leaf width (cm) | The number of leaf | The number of flower | The number of bud | LRWC ^a (%) |
|-----------------|-----------------------|-----------------|--------------------|----------------------|-------------------|-----------------------|
| Control | 15.00 ab ^c | 10.32 a | 15.40 b | 2.87 ab | 0.67 a | 71.97 ab |
| Ca ^b | 15.44 ab | 10.73 a | 18.80 a | 2.40 b | 0.93 a | 79.59 ab |
| Teldor | 16.71 a | 10.62 a | 17.87 ab | 2.40 b | 0.53 a | 78.32 ab |
| Mycorrhiza | 14.67 b | 10.65 a | 19.33 a | 2.60 ab | 0.53 a | 70.73 b |
| Trichoderma | 16.64 a | 11.38 a | 19.60 a | 3.40 a | 1.00 a | 80.90 a |
| LSD | 1.89 | 1.15 | 2.83 | 0.94 | 0.84 | 9.18 |

^a LRWC: leaf relative water content; ^b Ca: Calcium; ^c Different letters in the same column indicate significant differences $P < 0.05$. LSD, least significant difference.

When the color of leaf top was examined it was determined that the leaves of the control applied samples were green darker than the others with 30.11 L. And Trichoderma treatment was no significant different from control (Table 2). Also, when the determined the bottom leaf color, the dark color was determined to be Trichoderma with 38.95 L, but it did not show a statistically significant difference. Many studies performed on the effect of plant growth and development showed that Ca treatment prevents leaves from turning yellow [4], [6], [12].

Table 2. The color of leaf top and bottom and petal leaf rupture force of gerbera.

| Treatment | Colour of leaf top | | | Colour of leaf bottom | | | Petal leaf rupture force (N) |
|-----------------|----------------------|----------|---------|-----------------------|--------|---------|------------------------------|
| | L | a | b | L | a | b | |
| Control | 30.11 b ^b | 9.78 b | 11.05 a | 41.35 a | 8.79 a | 11.53 a | 1.85 a |
| Ca ^a | 35.22 a | 11.89 a | 13.79 a | 41.26 a | 8.90 a | 11.87 a | 1.87 a |
| Teldor | 32.65 ab | 10.82 ab | 12.46 a | 40.55 a | 8.60 a | 11.25 a | 1.70 a |
| Mycorrhiza | 34.46 ab | 11.60 ab | 13.78 a | 42.56 a | 8.92 a | 11.87 a | 1.32 a |
| Trichoderma | 30.19 b | 9.95 ab | 10.81 a | 38.95 a | 8.73 a | 10.60 a | 1.80 a |
| LSD | 4.37 | 2.02 | 3.55 | 3.92 | 0.72 | 1.33 | 0.71 |

^a Ca: Calcium; ^b Different letters in the same column indicate significant differences $P < 0.05$. LSD, least significant difference.

Ca treatment was found as the most effective treatment against defoliation with a petal defoliation force of 1.87 N (Table 2). And there was no significant difference among all treatments. In another study

performed on the topic, it was reported that Ca treatment forms a resistance against defoliation by decreasing the abscisic acid level in leaves [12]. When compared to control groups Mycorrhiza treatment in the study had no effect on increasing the petal defoliation force. This result is consistent with the ones in another study performed by Besmer and Koide [11].

When color changes in flower and stem were examined it was determined that the flowers of the samples on which control and Teldor treatments were done are darker in color, respectively (Table 3). However, this color difference is not statistically significant. Thus, it can be said that the treatments had no significant effect on differences in flower and stem color. Furthermore, it can be considered that these differences were due to differences in flowering times. It has been determined in former studies that Ca treatment increases ATPase activity on petals and hence it causes a delay in ageing of petals and color paleness [4].

Ca and Teldor treatments increased the vase life compared to other groups. The vase life was determined as 12 days for Ca and Teldor treatments (Table 3). In studies, Ca applications delays reduce of phospholipid and membrane proteins, increases aging and age-related the ATPase activity of petals, inhibits production C_2H_4 and was found to have a positive effect on the life of the vase. Studies conducted show that Teldor application is effective in improving the vase life. According to the results obtained in studies of the application of Teldor and perishable products to protect against fungal diseases in order to provide a good storage facility have been identified. Similarly, the effect of Ca and Teldor Increasing the vase life determined by the number of studies has also been. In the similar way, the vase life increasing effect of Ca and Teldor has also been determined by the number of studies [4], [7], [12]. Mycorrhiza treatment had no positive effect on vase life as 9 days compared to control.

Table 3. Flower and stem colour and vase life of gerbera.

| Treatment | Flower colour | | | Stem colour | | | Vase life (day) |
|-----------------|----------------------|---------|---------|-------------|----------|---------|-----------------|
| | L | a | b | L | a | b | |
| Control | 35.24 a ^b | 47.90 a | 19.48 a | 43.36 a | 12.72 b | 18.19 a | 10.00 bc |
| Ca ^a | 38.08 a | 49.67 a | 20.57 a | 44.48 a | 12.94 ab | 18.00 a | 12.00 a |
| Teldor | 36.10 a | 47.53 a | 20.60 a | 43.11 a | 12.97 ab | 17.63 a | 12.00 a |
| Mycorrhiza | 37.55 a | 46.33 a | 21.05 a | 45.06 a | 13.67 ab | 18.75 a | 9.00 c |
| Trichoderma | 37.45 a | 49.94 a | 20.96 a | 46.60 a | 14.56 a | 19.95 a | 11.00 ab |
| LSD | 5.33 | 7.87 | 3.94 | 5.69 | 1.80 | 2.78 | 1.81 |

^a Ca: Calcium; ^b Different letters in the same column indicate significant differences $P < 0.05$. LSD, least significant difference.

When the study, which investigates various treatments on potted gerbera growth and development was evaluated in general it was determined that the positive effect of Teldor treatment on plant growth and development was higher than the other treatments. Furthermore, it was also found that Trichoderma treatment is a promising one in terms of quality criteria such as leaf size, LRWC and the number of leaf, flower and bud. It is considered that the reason that Mycorrhiza treatment is not as effective as other treatments might be related to the concentration of the treatment. Therefore, further and more detailed studies are needed to be planned towards treatments of different concentrations especially related to the bio-preparats.

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5. References

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