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ORAL PRESENTATIONS

The Effect of Some PGPBs on Post-Harvest Weight, Length and Width of Hyacinth Bulbs Planted in Different Areas

Arzu Çığ[1*], Fatih Çığ[2]

[1]*Department of Horticulture, Faculty of Agriculture, Siirt University, Siirt, TURKEY,*

[2]*Department of Field Crops, Faculty of Agriculture, Siirt University, Siirt, TURKEY*

[*]*Corresponding author: arzucig@yahoo.com*

Abstract

The aim of this study is to determine the effect of PGPB and chemical NPK 20:20:20 fertilizer applications on the weight, length and width of the bulbs of hyacinth (*Hyacinthus orientalis* cv. "Delft Blue" plant grown in the laboratory and research-application gardens of Siirt University Faculty of Agriculture. When half and full doses of commercial fertilizer NPK are used, as PGPB, nitrogen-fixing bacteria: *Cellulomonas turbata* (TV54A), phosphate dissolving bacteria: *Bacillus*-GC Group (TV119E) and nitrogen fixing-phosphate dissolving bacteria: *Kluyvera cryocrescens* (TV113C) were used. In addition to the individual use of these bacteria, a dual combination of the bacteria TV54A and TV119E was applied. At the end of the study, the highest values of weights and lengths of hyacinth bulbs grown in laboratory conditions in control (37.09 g and 47.67 mm), ½ (33.79 g and 48.12 mm) and full dose NPK (32.43 and 47.24 mm) applications were obtained while the highest values of the width in the control pots (44.67 mm) were determined and all the average values were found to be statistically significant; When the bacteria were evaluated, all applications were in the same statistical group, but the highest values were obtained from dual combination application on bulb weight, length and width as 23.45 g, 44.03 mm and 36.31 mm ($P<0.001$), respectively. Weight and length of hyacinth bulbs grown in field conditions at $P<0.01$ level; widths were statistically significant at $P<0.05$ level. When the highest values were examined, on the bulb weight, there was no statistically significant difference between control (34.77 g), ½ NPK (32.33 g) and full dose NPK (31.99 g). On the bulb length, the highest values were found on control (47.57 mm) and full dose NPK (46.47 mm). In terms of bulb width, which is the other parameter examined, the highest value was obtained in control (41.54 mm) application. When bacterial applications were evaluated, the highest bulb weight value was determined on phosphate-soluble bacteria: *Bacillus*-GC Group (TV119E) (28.47 g); the highest bulb length (43.69 mm) and width (40.12 mm) values were found on the Kluyvera cryocrescens (TV113C) applications. The lowest values were observed on the combination of TV54A and TV119E bacteria combination applications in all properties.

Keywords: Bulb growth, *Hyacinthus orientalis* L., nitrogen fixing bacteria, ornamental plant, PGPB, phosphate dissolving bacteria.

Introduction

The population of microorganisms is located around the root zone of the plant, which is usually identified in the soil as the rhizosphere. Physicochemical activities are carried out entirely by these microorganisms in the soil. The majority of microorganisms in the soil are composed of bacteria [1].

In the microorganisms (mycorrhiza, fungus, protozoa, actinomycetes, algae, nematodes, bacteria) that operate in the rhizosphere, the effect of bacteria is high and some of them have beneficial and some of them have harmful effects. Some of the root bacteria have beneficial effects and act as stimulants for plant growth, act as biocontrol agents or act as both in some cases [2]. PGPRs are carried out in laboratory, greenhouse and field environments. However, formation of unfavorable environments in studies conducted in the field such as soil pH differences, temperature rises, decrease in precipitation rates, lack of moisture and nutrient deficiencies lead to a decrease in the colonization of microorganisms [3-4]. The use of plant growth-promoting bacteria (PGPB), which is used as bio-fertilizer in plant nutrition, as a bioagent in plant protection against diseases and for its resistance properties against stress factors with different effect mechanisms, is not as common as in other plant species. These bacteria are used for various purposes and thus new data are gathered. The effect of bacterial inoculation on flower and plant quality is generally investigated in ornamental plants, but there are few studies on bulb quality in bulbous-tuberous ornamental plants other than the studies on flower yield. Flower quality and size of bulbous-tuberous plants depends on the healthy, large and high-quality bulbs.

Hyacinth is a plant used in landscaping and commercially produced as a cut flower. If the development in flowers and bulbs are in the desired levels, the market value of hyacinths increases. In this context, this study is important to reveal how hyacinth bulbs are affected by biological fertilizers made with bacteria or inorganic fertilizers.

Material and Method

This study was carried out in two places: Siirt University Faculty of Agriculture Research Application Garden and Horticulture Laboratory. Commercial hyacinth (*Hyacinthus orientalis* L. Delft Blue) bulbs were used as plant material in the study. Bulbs planted in pots in the laboratory were applied as five bulbs in one repetition for 3 replications. The ones planted in the field were used as 3 replications with 12 bulbs in one repetition. The control group bulbs were not treated in any way. NPK fertilizer as inorganic fertilizer is given to the planting soil as 20:20:20, in full and half-doses, with the irrigation water. PGPBs were selected as nitrogen-fixing bacteria: *Cellulomonas turbata* (TV54A), phosphate-dissolving bacteria: *Bacillus*-GC Group (TV119E), nitrogen-fixing and phosphate-dissolving bacteria: *Kluyvera cryocrescens* (TV113C). These bacteria were used individually as well as in combination with the TV54A and TV119E bacteria. In the experiment, within the scope of the TÜBİTAK project numbered TOVAG 108O147, nutrient agar (Merck-VM71680604), which was isolated from Van Lake basin and was previously diagnosed with MIS system, was used as a feed-lot for the multiplication of bacteria, PGPB activity of which was exposed to greenhouse and field conditions. 20 g of nutrient agar was added to one liter of distilled water, adjusted to pH 7.0, and the mixture was sterilized by autoclave for 15 minutes at 121°C. After sterilization, the feed-lots were cooled to 50°C, then transferred to petri plates and allowed to solidify. The stock cultures of the bacteria were planted in nutrient agar medium with the help of the needle and incubated at 26 ± 2°C for 24 hours [5].

The nutrient broth (Merck-VM775843711) was used as the liquid feed-lot. 8 g of nutrient broth feed-lot was added to one liter of distilled water and pH was adjusted to 7.0. The mixture was sterilized by autoclave for 15 minutes at 121°C and then allowed to cool. A single colony was taken from the bacteria developed in nutrient agar feed-lot and was transferred to nutrient broth feed-lot in aseptic conditions. The bacteria transferred to the liquid feed-lot were incubated at 26 ± 2°C for 24 hours and at 120 rpm in the horizontal shaker. After incubation, the bacteria concentrations were turbidimetrically adjusted to ~ 10^8cfu / ml. The isolates were transferred to hyacinth bulbs which were previously passed through tap water and detergent water and kept for 20 minutes in 5% (v/v) sodium hypochlorite and washed 3 times with pure water. Dried bulbs were planted on the field one day later. The bulbs planted in November 2018 were removed from the place they were planted after the flowering had ended and the vegetative parts had completely dried. The bulbs were weighted with a scale, their lengths and widths were measured by calipers and recorded.

The analysis of the data was done in the SAS 9.1 statistical package program according to randomized plot trial design in laboratory experiments. But field experiments were conducted according to randomized block trial design. LSD multiple comparison test was used for comparing the averages. Tests were performed at $\alpha = 0.05$ importance level. Descriptive statistics in terms of the traits emphasized; given as average and standard error. The difference between the applications was determined according to independent sample t test [6].

Results

According to the results of our study, the highest value of hyacinth bulb weight in laboratory applications was obtained in control application with 37.09 gr, while the difference between full dose NPK and 1/2 NPK applications was statistically insignificant (Table 1). The lowest value was obtained with the application of *Cellulomonas turbata* (TV54A) with 21.34 g, while it was in the same group with other bacterial applications. According to the results of the research, inorganic fertilization and bacterial applications tended to decrease bulb weight. In bacterial applications, *Cellulomonas turbata* (TV54A) + *Bacillus*-GC Group (TV119E) showed higher results (23.45 g) than other bacteria (Fig. 1). In a previous study using hyacinth bulbs bacteria have been reported to have different effects on the weight of hyacinth bulbs [7]. Similar results were also observed in this study. These results are thought to be due to the fact that phytohormone and enzymes produced by bacteria result in a decrease in bulb weight.

Table 1. Effects of npk fertilizer and bacteria applications on bulb weight, length and width on laboratory conditions

Laboratory Applications / Properties	**Bulb weight*** (g)**	**Bulb length*** (mm)**	**Bulb width*** (mm)**
Control	37.09 A	47.67 A	44.67 A
Full dose NPK	32.43 A	47.24 A	41.08 B
½ NPK	33.79 A	48.12 A	41.17 B
Cellulomonas turbata (TV54A)	21.34 B	41.34 B	34.90 C
Bacillus-GC Group (TV119E)	22.60 B	42.67 B	36.06 C
TV54A + TV119E	23.45 B	44.03 B	36.31 C
Kluyvera cryocrescens (TV113C)	21.57 B	42.08 B	35.24 C
Significant degree	P<0.001	P<0.001	P<0.001

***: In the same letter, there is no statistically significant 0.1% difference between the averages

Bulb length, which is another characteristic examined under laboratory conditions, was found to be the highest in control and inorganic fertilizer application, but the difference between them was not statistically significant. The highest value was obtained from 1/2 NPK application with 48.12 mm (Fig. 2). The lowest value was obtained from *Cellulomonas turbata* (TV54A) bacterial application with 41.34 mm, whereas the difference between other bacterial applications was statistically insignificant. Among the bacterial applications, the highest value was obtained from the combination of double bacteria (44.03 mm) of *Cellulomonas turbata* (TV54A) + *Bacillus*-GC Group (TV119E). It is thought that the partially high value obtained from the paired combination may be due to the synergistic effect of the two bacteria. Similar results were also reached in the study conducted in the tulip [8].

For the width of hyacinth bulb grown in laboratory conditions, which is another value examined, the highest value was found in the control application with 44.67 mm. The lowest value was obtained from *Cellulomonas turbata* (TV54A) bacterial application (34.90 mm) (Fig. 3). Among the bacteria, the highest value was found in the combination of double bacteria. A similar result was observed in the study conducted by [8] (2019). In light of this result, it would be useful to try a combination of binary and more bacteria rather than single application of bacteria in the future.

Table 2. Effects of NPK fertilizer and bacteria applications on bulb weight, length and width on field conditions

Field Applications / Properties	**Bulb weight** (g)**	**Bulb length** (mm)**	**Bulb width* (mm)**
Control	34.77 A	47.58 A	41.54 A
Full dose NPK	31.99 A	46.47 A	40.68 AB
½ NPK	32.33 A	43.25 B	40.47 AB
Cellulomonas turbata (TV54A)	26.95 B	42.62 BC	39.40 AB
Bacillus-GC Group (TV119E)	28.47 B	42.78 BC	38.35 AB
TV54A + TV119E	26.41 B	40.68 C	37.28 B
Kluyvera cryocrescens (TV113C)	28.32 B	43.69 B	40.12 AB
Significant degree	P<0.01	P<0.01	P<0.05

*: In the same letter, there is no statistically significant 5% difference between the averages; **: In the same letter, there is no statistically significant 1% difference between the averages

In the field study, the highest hyacinth bulb weight, length and width values were obtained from the control application, respectively as 34.77 g, 47.58 mm and 41.54 mm (Table 2). The lowest values were obtained from the double bacteria combination of *Cellulomonas turbata* (TV54A) + *Bacillus*-GC Group (TV119E) with 26.41 g, 40.68 mm and 37.28 mm respectively. In terms of bacterial applications, the highest hyacinth bulb weight was obtained in *Bacillus*-GC Group (TV119E) application with 28.47 g (Fig. 1). The highest bulb length and width values were 43.69 mm and 40.12 mm respectively in *Kluyvera cryocrescens* (TV113C) bacteria application (Fig. 2-3). Considering these data, unlike laboratory conditions, the synergistic effect of the double combination under field conditions was not observed and the lowest results were obtained. In addition, higher results were found in single applications. With these results, it is concluded that single bacterial applications are more successful in interaction with other microorganisms in the soil. However, it would be more beneficial to carry out such studies under different ambient conditions and with different bacteria combinations.

Cellulomonas turbata (TV54A), *Bacillus*-GC Group (TV119E), TV54A+TV119E and *Kluyvera cryocrescens* (TV113C) were found to have more positive effects on bulb weight according to t test. When the bulb length is considered ½ NPK and TV54A + TV119E bacterial applications in the laboratory while *Cellulomonas turbata* (TV54A) *and Kluyvera cryocrescens* (TV113C) bacteria were found to have significant effects on the field conditions. The width of the control group bulbs, where nothing was applied, was found important in laboratory conditions (Table 3).

Table 3. Effects of applications on bulb weight, length and width in field and laboratory conditions according to t-test

Applications	Areas		Bulb weight(g)	Bulb length(mm)	Bulb width(mm)
Control group	Field	Average	34.77	47.58	41.54 b
		Std. Deviation	1.279	0.345	1.341
	Laboratory	Average	37.09	47.67	44.67 a
		Std. Deviation	1.976	1.665	0.462
		t value	-1.700 ns	-0.89 ns	0.262*
		n	6	6	6
Full Dose NPK	Field	Average	31.99	46.47	40.68
		Std. Deviation	1.345	0.510	0.552
	Laboratory	Average	32.43	47.24	41.08
		Std. Deviation	3.061	1.548	1.256
		t value	-0.231 ns	-0.812 ns	-0.499 ns
		n	6	6	6
1/2 NPK	Field	Average	32.33	43.25 b	40.47
		Std. Deviation	1.709	1.618	2.747
	Laboratory	Average	33.79	48.12 a	41.17
		Std. Deviation	1.668	0.897	0.947
		t value	-1.055 ns	-4.557*	-0.615 ns
		n	6	6	6
Cellulomonas turbata (TV54A)	Field	Average	26.95 a	42.62 a	39.40
		Std. Deviation	1.336	0.429	4.204
	Laboratory	Average	21.34 b	41.34 b	34.90
		Std. Deviation	2.484	0.177	1.008
		t value	3.445*	4.812*	1.807 ns
		n	6	6	6
Bacillus-GC Group (TV119E)	Field	Average	28.47 a	42.78	38.35
		Std. Deviation	0.205	0.745	1.380
	Laboratory	Average	22.60 b	42.67	36.06
		Std. Deviation	2.043	1.075	0.919

		t value	4.960*	0.153 ns	2.400 ns
		n	6	6	6
TV54A + TV119E	Field	Average	26.41 a	40.68 b	37.28
		Std. Deviation	0.357	0.585	0.590
	Laboratory	Average	23.45 b	44.03 a	36.31
		Std. Deviation	1.205	0.336	1.145
		t value	4.092*	-4.356*	1.315 ns
		n	6	6	6
Kluyvera cryocrescens (TV113C)	Field	Average	28.32 a	43.69 a	40.12
		Std. Deviation	0.828	0.358	3.034
	Laboratory	Average	21.57 b	42.08 b	35.24
		Std. Deviation	2.124	0.635	0.524
		t value	5.133*	3.820*	2.749 ns
		n	6	6	6

*: In the same letter, there is no statistically significant 5% difference between the averages;
ns: no significant

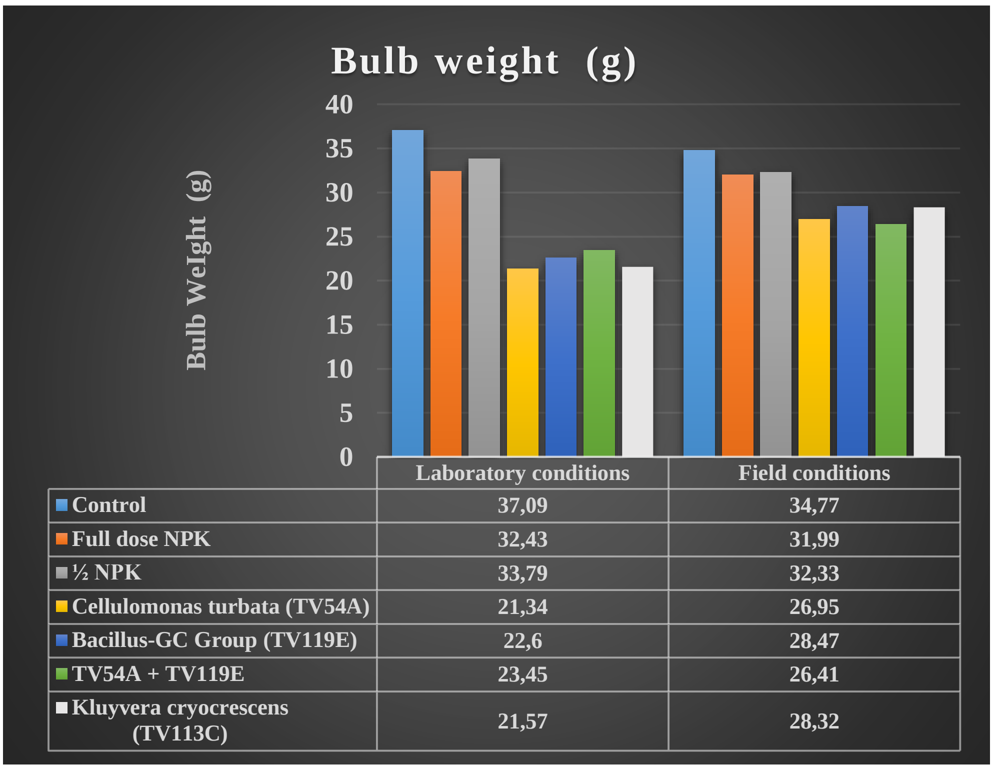
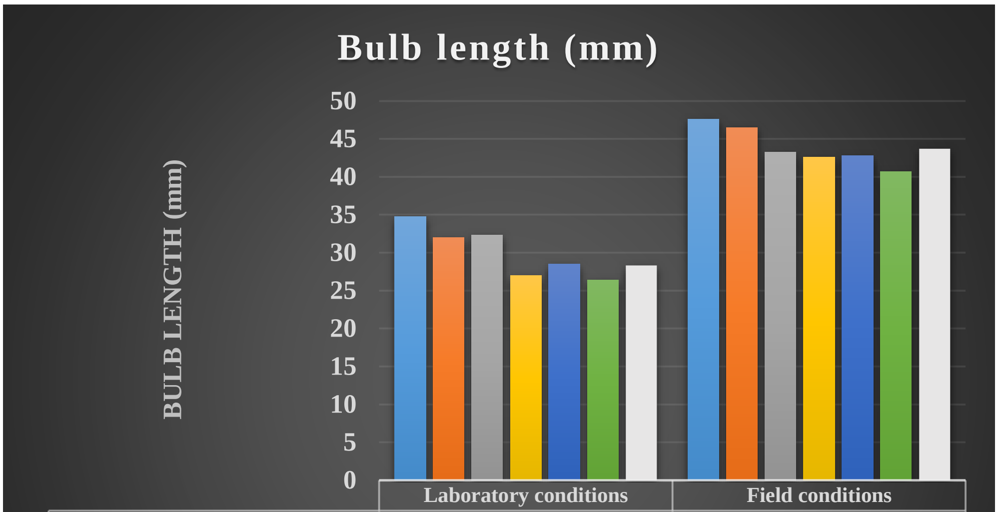
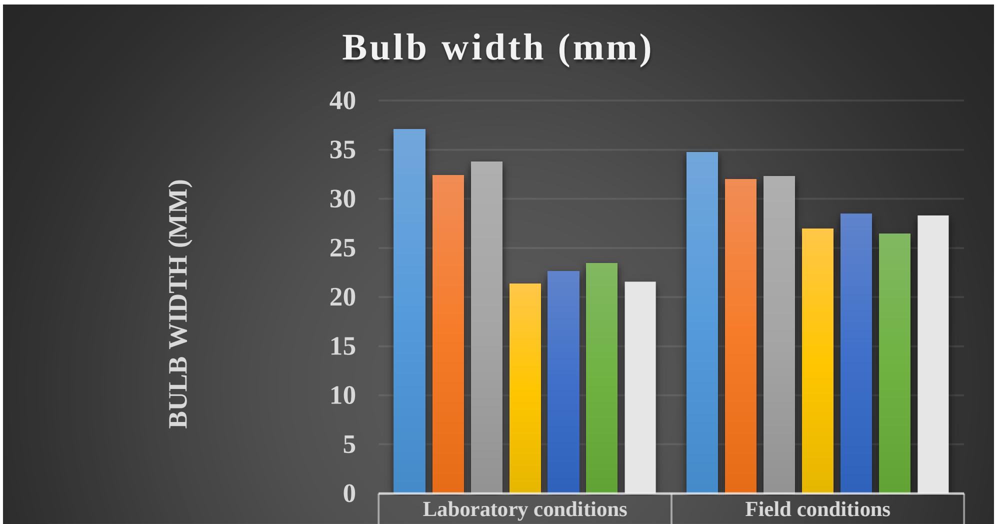


Figure 1. Effects of NPK fertilizer and bacteria applications on bulb weight



	Laboratory conditions	Field conditions
Control	34,77	47,58
Full dose NPK	31,99	46,47
½ NPK	32,33	43,25
Cellulomonas turbata (TV54A)	26,95	42,62
Bacillus-GC Group (TV119E)	28,47	42,78
TV54A + TV119E	26,41	40,68
Kluyvera cryocrescens (TV113C)	28,32	43,69

Figure 2. Effects of NPK fertilizer and bacteria applications on bulb length



	Laboratory conditions	Field conditions
Control	37,09	34,77
Full dose NPK	32,43	31,99
½ NPK	33,79	32,33
Cellulomonas turbata (TV54A)	21,34	26,95
Bacillus-GC Group (TV119E)	22,6	28,47
TV54A + TV119E	23,45	26,41
Kluyvera cryocrescens (TV113C)	21,57	28,32

Figure 3. Effects of NPK fertilizer and bacteria applications on bulb width

In the study carried out with natural flower bulbs (*Lilium candidum*, *Galanthus elwesii* and *Leucojum aestivum*) in Yalova ecological conditions; 0, 5, 10 and 20 kg N applications were performed for each decare in order to determine the effects of different amounts of nitrogen application on bulb size. In the application, it was observed that 10 kg da^{-1} N fertilizer had statistically significant effect on bulb weight of lily (*L. candidum*). However, in snowdrops (*G. elwesii*) and loddon lily (*L. aestivum*), nitrogen applications on bulb size were found to be ineffective [9].

Three different types of *Tulipa gesneriana* L. tulip bulbs were planted by being coded (inoculated) with different bacterial formulations. These formulations are: Formulation A (*Pantoea agglomerans* RK-79 + *Pantoea agglomerans* RK- 92), Formulation B (*Pantoea agglomerans* RK-79 + *Pantoea agglomerans* RK-92 + *Bacillus megaterium* TV-91C + *Bacillus subtilis* TV-17C), Formulation C (*Pantoea agglomerans* RK- 79 + *Pantoea agglomerans* RK-92 + *Bacillus megaterium* TV-3D + *Paenibacillus polymyxa* TV-12E) and Formulation D (*Pantoea agglomerans* RK-79 + *Pantoea agglomerans* RK-92 + *Bacillus megaterium* TV-6D + *Pseudomonas putida* TV-42A). In terms of average number of baby bulbs, formulation C was determined as the most successful application. It has been stated that the number and quality of bulbs can be increased with bacterial formulation applications depending on the variety factor and that bacterial applications have benefits to the amount of macro-micro nutrients in soil, tulip bulb and leaf contents [10].

In a study, *Bacillus subtilis* FZB24 bacteria strain was inoculated into saffron (*Crocus sativus* L.) corms. The effect of bacterial inoculation on plant growth and chemical components of stigma was investigated and compared with the control group. During the comparison, it was found that application of *Bacillus subtilis* FZB24 significantly increased leaf length, number of flowers per corm, stigma weight of first flower and total stigma biomass. In addition, it was observed that bulbs treated with PGPR sprouts faster. According to the results obtained from the research, it was found that *B. subtilis* FZB24 application could contribute to saffron cultivation by accelerating corm development (earlier sprouting) and increasing stigma biomass by 12% [11].

A total of ten applications were performed on saffron grown under greenhouse conditions, and the baby corm diameter (mm), baby corm length (mm) and baby corm weight (g) were determined. These applications are: (1) *Achromobacter xylosoxidans* strain TV-42A, (2) *Brevibacillus choshinensis* strain TV-53D, (3) *Myroides odoratus* strain TV-85C, (4) *Bacillus megaterium* strain TV-87A, (5) *Colwellia psycrerytreae* strain TV-108G, (6) *Kluyvera cryocrescens* strain TV- 113C, (7) *Bacillus* GC group B strain TV119E, (8) Control (without bacteria and hormone application) (9) Control 2 [100 mg L^{-1} IBA (indole-3 butyric acid)] and (10) Control 3 [100 mg L^{-1} GA_3 (gibberellic acid)]. Saffron growth and yield values were higher or equal in some bacterial applications compared to hormone applications. It has been concluded that biofibers used in organic agriculture have a positive effect on the increase of plant growth and development of saffron [12].
In the field study conducted with tulips (*Tulipa gesneriana* L. cv. ‘Clear Water’) in Faisalabad, *Burkholderia phytofirmans* (PsJN), T2*Bacillus* sp. (MN-54), T3*Enterobacter* sp. (MN-17) and *Caulobacter* sp. (FA-13) isolates were used as foliar fertilizer. The results showed that tulip responds well to bacterial strains and a significant improvement is observed in morphological properties, bulb properties and other quality parameters [13].

The amount of substances stored in the bulb and the size of the bulb, determine the size and quality of the flowers. Criteria that increase the commercial value of bulbs: Their appearance, being disease-free and their size. In terms of development, large bulbs are made possible by vegetative growth, irrigation that promotes bulb development and cultural processes such as eliminating weeds, diseases, pests and providing fertilization. However, the bulbs that are not picked up from the flowers and the bulbs growing from the plants left to the seed remain smaller and the quality of the flowers decreases [14-15].

The size and quality of the flower is directly related to the size and weight of the bulb. The size of the bulb is therefore very important. A good fertilization program ensures the efficiency of the growing environment with irrigation and the effective control of weeds and diseases.

Conclusions

As a result, it was determined that bacterial applications had negative effects on the bulb weight, length and width in both laboratuary and field conditions, while the highest values were observed in control (without bacterial application and fertilization) plants.

References

[1] G. İmriz, F. Özdemir, İ. Topal, B. Ercan, M. Taş, E. Yakışır, O. Okur, 2014. Bitkisel üretimde bitki gelişimini teşvik eden rizobakteri (PGPR)'ler ve etki mekanizmaları. Elektronik Mikrobiyoloji Dergisi TR (Eski adı: OrLab On-Line Mikrobiyoloji Dergisi), 12(2) (2014) 1-19.

[2] R.S. Romerio, 2000. Preliminary results on PGPR research at the Universidade Federal De Viçosa, Brazil, Fifth International PGPR Workshop, Cordoba Argentina.

[3] F. Şahin, R. Çakmakçi, F. Kantar, 2004. Sugar beet and barley yields in relation to inoculation with N_2-fixing and phosphate solubilizing bacteria. Plant and Soil, 265 (2004) 123-129.

[4] S. Dobbelaere, A. Croonenborghs, A. Thys, D. Ptacek, J. Vanderleyden, P. Dutto, C. Labandera-Gonzalez, J. Caballero- Mellado, J.F. Aguirre, Y. Kapulnik, S. Brener, S. Burdman, D. Kadouri, S. Sarig, Y. Okon, 2001. Responses of agronomically important crops to inoculation with *Azospirillum*. Australian Journal of Plant Physiol., 28 (2001) 871-879.

[5] M. Sonkurt, F. Çığ, 2019. The effect of plant growth-promoting bacteria on the development, yield and yield components of bread (*Triticum aestivum* L.) and durum (*Triticum durum*) wheats. Applied Ecology and Envıronmental Research, 17(2) (2019) 3877-3896.

[6] O. Düzgünes, T. Kesici, O. Kavuncu, F. Gürbüz, 1987. Araştırma ve Deneme Metotları, Yayın No: 1021, Ders Kitabı: 295, A.Ü. Ziraat Fakültesi Yayınları, Ankara, 381.

[7] F. Parlakova Karagöz, A. Dursun, R. Kotan, 2019. Effects of rhizobacteria on plant development, quality of flowering and bulb mineral contents in *Hyacinthus orientalis* L. Alinteri Journal of Agriculture Sciences, 34(1) (2019) 88-95.

[8] F. Parlakova, A. Dursun, 2019. Effects of nitrogen fixing and phosphate solubilizing bacteria on growth and bulbs production of tulip cultivars, Ege Univ. Ziraat Fak. Derg., 56(2) (2019) 241-248.

[9] E. Uysal, E. Kaya, 2013. Farklı miktarlarda uygulanan azotun, bazı doğal çiçek soğanlarında (*Lilium candidum*, *Galanthus elwesii*, *Leucojum aestivum*) soğan büyüklüğü üzerine etkileri, V. Süs Bitkileri Kongresi, Yalova, 729-732.

[10] F. Parlakova, 2014. Azot Fikseri ve Fosfat Çözücü Bakterilerin Lale Çeşitlerinin Bitkisel Gelişimi, Soğan Sayısı, Kalitesi ve Mineral Madde İçeriğine Etkisi, Atatürk Üniversitesi Fen Bil. Enst., Yüksek Lisans Tezi, Erzurum,113.

[11] M. Sharaf-Eldin, S. Elkholy, J.A. Fernández, H. Junge, R. Cheetham, J. Guardiola, P. Weathers, 2008. *Bacillus subtilis* FZB24® affects flower quantity and quality of saffron (*Crocus sativus*). Planta Medica, 74(10) (2008) 1316.

[12] F. Parlakova Karagöz, A. Dursun, R. Kotan, M. Ekinci, E. Yıldırım, P. Mohammadi, 2016. Assessment of the effects of some bacterial isolates and hormones on corm formation and some plant properties in saffron (*Crocus sativus* L.). Journal of Agricultural Sciences, 22 (2016) 500-511.

[13] M. Bashir, M. Asif, M. Naveed, R.W.K. Qadri, N. Faried, A. Baksh, A. 2019. Pre-harvest exogenous application of bacterial strains to assess the flower and bulb quality of cut Tulip (*Tulipa gesneriana* L.) cv. Clear Water. Discovery, 55(278) (2019) 73-80.

[14] A.R. Rees, 1992. Ornamental Bulbs, Corms and Tubers. C.A.B. International, Wallingford, UK, 220.

[15] M. Le Nard, A.A. De Hertogh, 1993. Tulipa, The Physiology of Flower Bulbs (A Comprehensive Treatise on The Physiology and Utilization Ornamental Flowering Bulbous and Tuberous Plants), (Hertogh, A. De, and Nard, M. Le, Editors), *Elsevier*, Amsterdam, 617-682.