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Influence of Some Microbial Fertilizers on the Germination of Barley *(Hordeum Vulgare L.)*

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Abstract

Barley *(Hordeum vulgare* L.*)* is an important cereal used as malt and feed. In the world, 65% of the barley planted in the world is used as animal feed, 33% is used in malt production of beer and whiskey and biodiesel production, and 2% is used as human food in the food industry. In the world, barley in cereal production is the fourth after corn, wheat and rice. Barley in Turkey; It is in second place after wheat production. In Turkey, 90% of the consumption is used as animal feed, and the remaining portion is used as malt in beer industry and food industry. The rate used in food industry is very low and the rate used in beer industry is increasing every year. In this study; the effect of microbial fertilizers on germination in barley plant in in vitro conditions was investigated. Two barley varieties were used in the study. The sterilized seeds were germinated at 25 oC in petri dishes containing sterile filter paper. Microbial fertilizers used commercially were liquid seaweed, agritonic, finish seed and T22 Planter box. Germination rates of microbial fertilizers on barley seeds were examined for two weeks. The effect of fertilizers on the germination of barley plants varied.

Keywords: *Hordeum vulgare* L; Microbial fertilizers; Germination.

1. Introduction

In cereals consumed as animal feed; barley has the highest feed value. Barley is also used as raw material of the malt and beer industry. For industrial plants and legumes; it is a good plant of alternation and it is a cultivated plant which can be used for the reclamation of soils that are resistant to saltiness. In our country; with a plantation area of approximately 27.8 million decares and an annual production of 6 million tons, is second only to wheat in cereals [1].

Barley is grown in all regions in Turkey; especially in Central Anatolia and Southeastern Anatolia. The share of the Southeastern Anatolia Region in total barley cultivation area in Turkey is around 20% (566 244 ha). Southeastern Anatolia Region has an important place in terms of barley cultivation in Turkey [1].

Various chemicals are used in agricultural production in order to meet the growing population's nutritional needs and to ensure the need for agricultural products. Chemical fertilization applied to increase fertility, adversely affect soil and water resources, damage natural balance. The use of fertilizers prepared from microorganisms in the soil instead of chemical fertilizers has increased in recent years in order to eliminate this negativity and increase the yield. Fertilizers prepared with microorganisms; to prevent root diseases, to increase seed germination and plant growth, to increase the solubility of nutrients and to provide the plants with their uptake [2]. In recent years, microbial fertilizers prepared using microorganisms have started to be called probiotic fertilizers [3]. Microorganisms widely used soil and seed inoculant and can promote the germination, promote the growth, yield of agronomically important plants [4-6]. Chapman and Chapman [7] reported that the seaweed inoculation increased plant germination and yield. Seaweed is rich in macro and micro nutrients [8]. As was published by Arun, *et al*. [8], seaweed extracts increased seed germination of *Abelmoschus esculentus* and *Solanum lycopersicum*. The effects of microbial inoculants on growth, germination rate, improve seedling of crop plants studied in previous works [5, 6, 9-11].

In Southeastern Anatolia, barley farming is mostly carried out in Şanlıurfa, Turkey. Studies on germination of barley produced in Turkey in relation with the effect of microbial fertilizers are limited. In this study, the effects of some commercial microbial fertilizers on germination of two barley cultivars grown in Şanlıurfa, Turkey were investigated.

2. Materials and Methods

Two barley variety (Sahin-91 and Brenda) seeds were used as material. The seeds were obtained from the GAP Agricultural Research Institute. The microbial fertilizers used; Vitormone Plus Drip (200 ml/da), Liquid seaweed (150 ml / 100 lt), Finish seed (Mycorrhizae and *Azotobacter* sp.) and T22 Planter box (*T.harzianum* KRL-AGZ403) (Table 1). Microbial fertilizers were provided by Bioglobal. Applications were compared with control (untreated). Seeds were first sterilized in 95% ethyl alcohol for 5 min, then in 10 % NaOCl for 10 min and then sterilized 10 times with sterile distilled water [12, 13].

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Table-1. Microbiological fertilizers used in this study

Microbiological Fertilizer	Active ingredient
Vitormone Drip	*Azotobacterc hroococum Azotobacter vinelandii*
Liquid seaweed	*Macrocystıs intergrıfoglıa*
Finish seed	Mycorrhizae, *Azotobacter* sp.
T22 Planter Box	*Trichoderma harzianum* Rifai KRL-AG2

Each petri dish was considered a recurrence and 10 barley seeds were placed on sterile filter papers in petri dishes. The recommended dosages of each of the microbial fertilizers used were applied in the petri dishes. The control plates were moistened with distilled water. All applications were carried out in a plant growth chamber at 25 ^{o}C. The percent germination was recorded after 5 days. The lenghts of roots of germinated seeds were measured. The study was conducted in 5 replications according to randomized trial design. Data were analyzed by using JMP program.

3. Results and Discussion

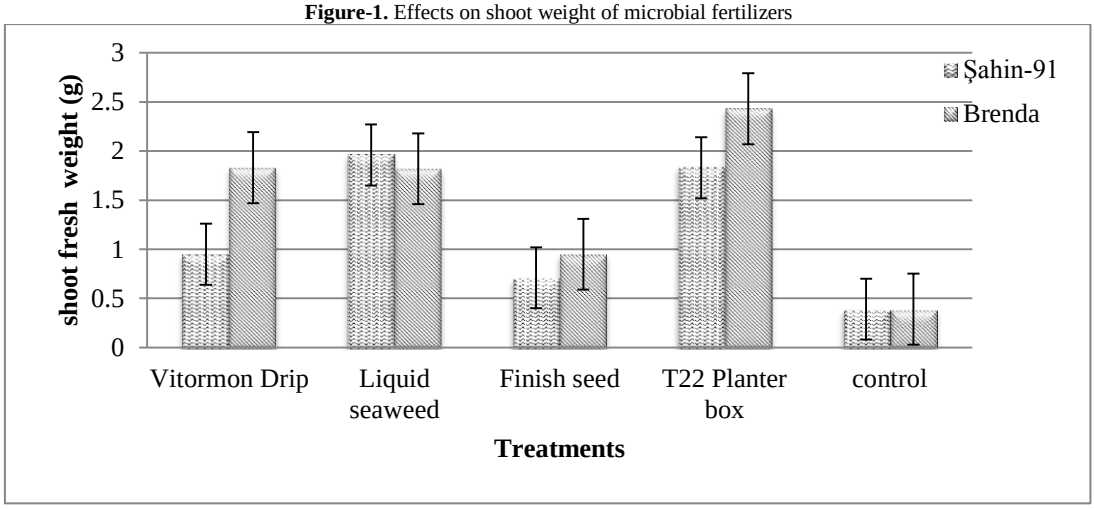
In our study was determined the effects of commercial microbial fertilizers on the germination properties of two different barley cultivars. The comparative of % seed germination, germination time and germination index due to application of the microbial fertilizers in this study are shown in Table 2. The seed germination percentage of tested barley varieties was significantly affected by microbial fertilizers Table 2. The highest seed germination was observed in T22 Planter box treatments in barley varieties. The T22 Planter box application increased the germination rate by 95% in Falcon-91 and 85% in Brenda. The difference between the applications was statistically significant ($p < 0.05$). The lowest germination rate was determined in the control. A study by Mishra and Sinha [4] and Lai, *et al.* [14] reported that inoculated fungi and *Azospirillum rugosum* have been shown to promote growth of root and shoot elongation and germination rates in plants. As was observed by Gholami, *et al.* [15] and Siqueira, *et al.* [16] the microbial fertilizers prepared from microorganisms were affected seed germination, seedling growth, root growth. Based on our results the used microbial fertilizers had seed germination percentage, germination index in barley seeds which agrees with the results of the authors.

Table-2. Effects of applications on germination duration, germination index and number of germinated seeds

Treatment	Variety	Germination time (day)	Germination index (GI)	Seed germination %
Vitormone Drip	Şahin-91	3.22 ef	0.9 cd	45 e
	Brenda	3.55 c	1.2 bcd	62 d
Liquid seaweed	Şahin-91	3.33 d	1.5 abc	75 bc
	Brenda	3.12 f	1 bcd	60 d
Finish seed	Şahin-91	2.25 h	1.1 bcd	85 ab
	Brenda	3.32 de	1.4 a-d	70 c
T22 Planter box	Şahin-91	2.96 g	1.8 a	90 a
	Brenda	2.25 h	1.7 ab	85 ab
Control	Şahin-91	5.2 b	1.1 b-d	55 de
	Brenda	5.76 a	0.9 d	50 e

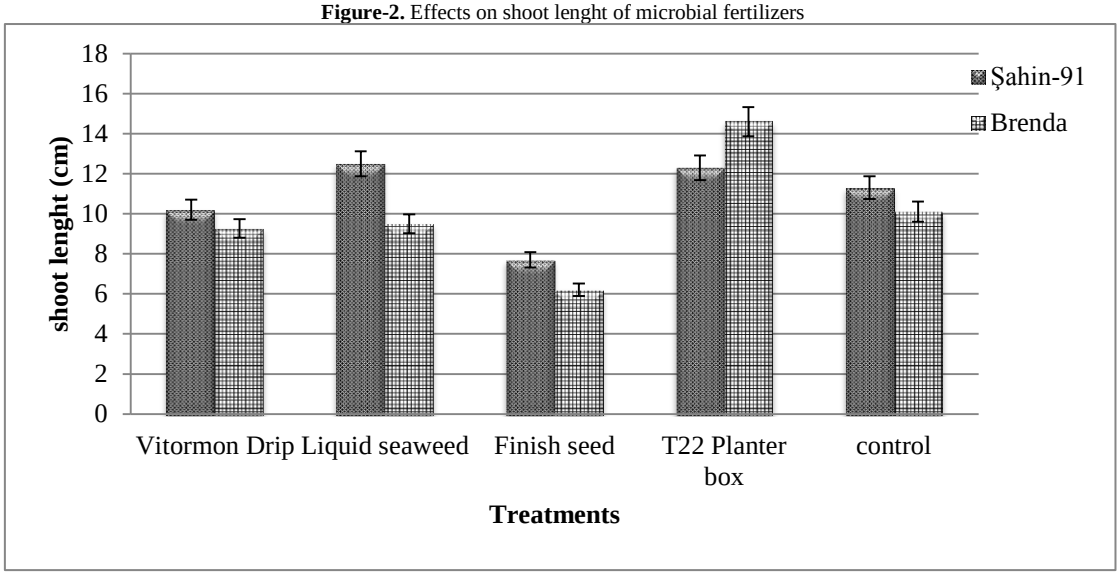
It was determined that muskmelon varieties inoculated with *Trichoderma* isolate increased germination compared to controls [17]. It has been found that germinated seeds, shoot length, and shoot fresh weight were significantly increased in *Trichoderma harzianum* with inoculated muskmelon [17]. Similarly, in this study, among the tested microbial fertilizers in both varieties of barley the higher shoot fresh weight, root weight were obtained in T22 Planter box prepared from *Trichoderma harzianum* application (Fig. 1-3).

Figure-1. Effects on shoot weight of microbial fertilizers



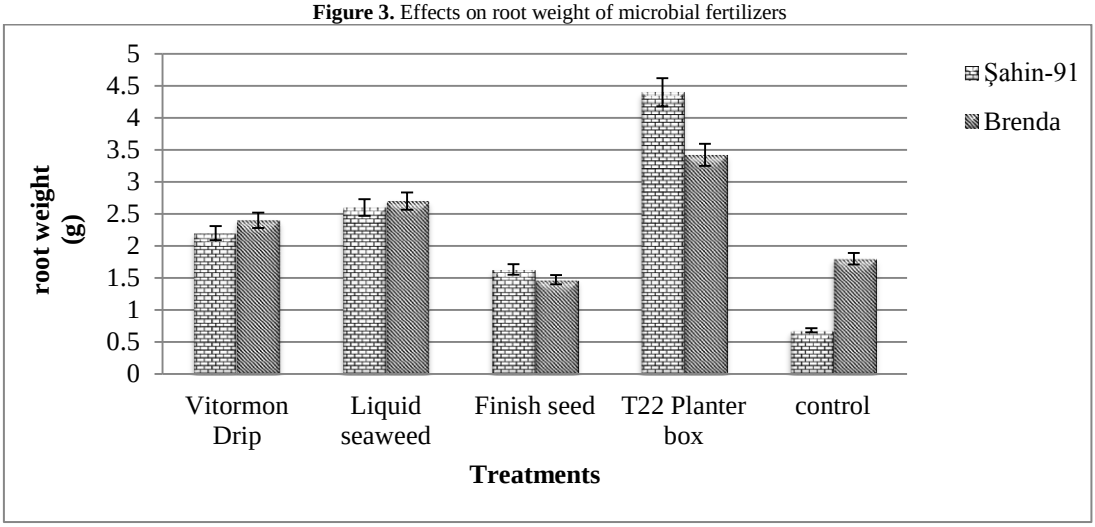
Microbial fertilizers were increased the root weights of the barley varieties compared to the control. In our results; the highest germination was taken from T22 Planter box application among the microbial fertilizers used. This is similar to the results of the researchers [4, 15, 18].

Figure-2. Effects on shoot lenght of microbial fertilizers



Barley, which has a direct consumption in terms of livestock in the Southeastern Anatolia region based on agriculture, is indispensable for farmers. Considering the environmental problems caused by excessive chemical fertilizers and the decrease in agricultural production in relation to the salinity problem, the use of microbiological fertilizers that do not pollute the environment is remarkable. Microorganisms are widely used to improve plant growth [11, 17].

Figure 3. Effects on root weight of microbial fertilizers



Microorganisms play vital roles in plant growth, such as nitrogen fixation, phytohormone production, phosphorus solubilization, providing to nutrient sources, resistance of phytopathogens or environmental stress [6]. As shown in Fig.1-3, the seeds with inoculated different microbial fertilizers and the seed inoculated with T22 Planter box had higher root and shoot weights and shoot fresh lenght in barley varieties than other applications. These results indicate that microbial fertilizers were able to promote the growth of varieties.

4. Conclusion

Applications that are made with various microorganisms that live freely and encourage plant development; increased seed weight, germination rate, chlorophyll ratio, nitrogen content, protein ratio, root and stem weight, and gave plants tolerance to certain diseases. In our work; it was indicated that microbial fertilizers used were increased root length and root weights compared to the control. In addition, microbial fertilizers have led to an increase in germination rates of seeds compared to controls. As a result; commercial microbial fertilizers are effective on germination of barley seeds.

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