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ORIGINAL ARTICLE

Effect of Drought stress, plant growth promoting Rhizobacteria (PGPR) and Humic acid on some physiological and agronomic traits in Shahriyar Herb Cilantro

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ABSTRACT
To study the effects of water stress, plant growth promoting rhizobacteria (PGPR)and acid on some physiological traits and crops Humic acid herb cilantro, split factorial experiment in a randomized complete block design with three replications was conducted in Shahriar region 2012-2013 crop year. In this experiment, water was considered as the main factor included three levels of irrigation based on 60, 100 and 140 mm evaporation from pan evaporation from class A, four levels of PGPR include not eating, inoculated with the seed, irrigation water and inoculated with seed + irrigation water and Humic acid acid two levels of application and non-application of a factorial Humic acid as sub-agents. Agronomic traits including shoot dry weight, biological yield, grain weight and oil yield were studied physiological traits. Based on the results obtained from the analysis of variance for traits measured, the effect of irrigation simple, easy to use due to plant growth promoting rhizobacteria (PGPR)and also the simple effect of the application of humic acid was significant difference in% probability level. Based on comparison of results with increasing irrigation rate also rose, coriander seed traits.
Keywords: *drought stress, PGPR, Humic acid, fresh weight and essential oil yield*

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INTRODUCTION

Herb plants are economically important raw form or processed used in traditional medicine and modern industries. Some medicinal species have limited habitat and other habitats are large habitat [1].
Herb rich reservoir of secondary metabolites, i.e. tanks active ingredients (essential oils) are the basis of many medications. Despite the biosynthesis of secondary metabolites is genetically controlled, but they are making is strongly influenced by environmental factors [2].
Cilantro is an herb for its active ingredient and the main compound linalool, of great importance in pharmaceuticals, food, cosmetics [3]. Cilantro is cultivated in many parts of Iran, Qazvin, Azerbaijan, Kerman, Kermanshah, Bushehr, Baluchestan and Yazd [4].
Stress is basically a physical sense. The physical stress (Physical Stress) is the force acting on an object, the force of which is caused by changes in the body called the strain (Strain) [5].
Have in recent years in the wake of the crisis, particularly contamination of water and soil pollution that affects human food supplies and the threat to human health have been. Extensive efforts to find appropriate solutions to improve the quality of soil crop and remove contaminants started. The use of bio fertilizers in sustainable agriculture systems today, especially in nutrient-poor soils of great importance in increasing production and maintaining soil quality [6].
Today, one of the principles of sustainable agriculture and the use of bio-fertilizers in agricultural ecosystems with the goal of eliminating or substantially reducing the use of chemical inputs [7].

In bio-fertilizers some cases as an alternative or as a supplement to chemical fertilizers in most cases able to guarantee the sustainability of agricultural production systems [8].
The use of bio fertilizers, plant growth enhancer bacteria play an important role in soil fertility and plant nutrition. These bacteria can enhance plant growth by different mechanisms [9].
Inoculum containing micro-organisms, plant growth enhancer, which refers to a group of different bio-fertilizers, organic fertilizers, manure, green manure, etc. [10].
The micro-organisms by producing plant hormones, nitrogen fixation, and nutrient uptake from the soil and facilitate the production of biological control agents against plant pathogens affect plant growth [16].
Humus can be defined as the stabilized organic matter [11] as part of the acid, humic acid is formed by Folic and Humin acid [11].Most of the compounds in the soil humic acid and humic acid Folic form [17] from various sources (sources of soil and vegetative plants) that are found to vary according to its source in molecular size and chemical structure toge. Humic acid is a naturally occurring compounds in soil, peat, coal and etc [12].
Humic acids are extracted from the earth's resources than those that have been obtained from vegetative plants, greater similarity to each other [13].
Bacteria in bio-fertilizer addition nitrogen fixation and air balancing high consumption and low absorption of essential elements required by plants with the synthesis and secretion of plant growth and release of various amino acids antibiotic growth and development of roots and shoots of plants that produce Similar this causes more and transfer them to increase yield and seed weight [14].
Research has shown that stress decreases due to reduced plant dry matter. A stress condition, plants with lower leaf surface, the surface of organs reduces transpiration and therefore the decrease in leaf area [15].
In their research on herbs and coriander showed that drought severely reduced biomass, root yield and grain weight of this medicinal plant but oil percentage increased [18].
Ayas and Gulser [20] reported that humic acid through increasing the nitrogen content increased growth in height and its biological function is Altb. Application of humic acid foliar application on wheat yield increases of 24 percent in the plant [19].
A researcher due to the reduced stomata closure and reduction of photosynthesis per unit leaf area has been drought [21].

MATERIALS AND METHODS

In order to investigate the effect of different levels of irrigation, the use of different methods and the application of PGPR and Humic acid on physiological and agronomic traits in crop field trial cilantro herb 2012-2013 Shahriar was in the area.
Split factorial experiment in a randomized complete block design with three replications. In this experiment, three irrigation including irrigation based on 60, 100 and 140 mm evaporation from class A pan evaporation as the main factor PGPR on four levels: 1 - Not taking 2 - inoculated seeds, 3 - irrigation 4 - inoculated with the seed + irrigation water and Humic acid at two levels: 1 - Application Humic and 2 - not using a factorial as the lipids were secondary factors.
Soil tillage including plowing, disc and the trowel. In the spring of 2012 to prepare the ground, plow moldboard plowed by site testing and handling of both disk and use a trowel, land clearing operations took place. Then create rivers in the distance was 60 cm. Then proceed to the experimental plots were planting cilantro. Each plot consisted of five lines with a planting distance of 25 cm. Density, distance between lines of culture, variety and planting operations were conducted according to the customs area. Agronomic traits including shoot dry weight, biological yield, grain weight and oil yield were studied physiological traits.

Shoot fresh weight and dry

As mentioned earlier, fresh weight and dry coriander for evaluation by considering the marginal effects on the plant floor and the area of 2 square meters, the fresh weight, and then on the samples in period of 48 hours 75 ° C Avon dry weight was measured with an electronic scale.

Biological yield

For this purpose, the compliance margins, an area of 2 square meters per plot to calculate the yield per hectare on the floor after drying, was converted to kilograms per hectare.

Grain weight

To determine seed weight per plot of five hundred samples of each selected seed as seed weight and mean body weight was selected.

Essential oil yield

After multiplying the amount of coriander essential oil yield of shoot dry weight was calculated and divided by 100.

Statistical Analysis

For statistical analysis was used program Minitab and SAS, Excel.

RESULTS AND DISCUSSION

Wet weight

based on the results obtained from the analysis of variance for fresh weight, simple irrigation effect, simple effect uses a simple application of humic acid plant growth promoting rhizobacteria (PGPR)and the effect of different levels was a significant percentage.

Based on the comparison of means to increase irrigation levels were significantly decreased fresh cilantro. So that treatment with 60 ml irrigation 1742.26 g fresh weight coriander accounted for most of the other irrigation levels showed a statistically significant difference. Minimum weight with fresh cilantro 1217.43 g 140 mm in the treatments with the highest level of irrigation was observed that these treatments also showed significant differences with other levels of irrigation. Based on the comparison of treatment means application irrigate with seed inoculation with bacteria 1620.09 grams more weight accounted coriander And the amount of fresh cilantro in the absence of bacteria, 1308.64 grams. Based on the comparison results Humic use acid coriander plant fresh weight was significantly increased.So, in terms of Humic acid use fresh cilantro 1600.97 g were obtained from the application showed no significant differences between the conditions. In terms of non-acid fresh cilantro Humic Application 1350.96 was hot. In other words, the application of the Humic acid fresh cilantro as much as 18.51% increase (Table1 and 2).

Dry weight

According to the results of analysis of variance (1) was obtained for dry weight, simple irrigation effect, simple effect uses a simple application of humic acid plant growth promoting rhizobacteria (PGPR)and the effect is statistically significant at the one percent level. Comparison results showed that increasing levels of irrigation treatments significantly reduced the dry weight of cilantro.

Based on the comparison among different levels of irrigation, surface irrigation of 140 mm Dry weight significantly different irrigation levels were 100 and 60 mm. Between treatments so that the maximum amount of dry coriander irrigation of 60 mm was observed in the treatment of dry weight in treatment 830.79 g. Dry weight at 100 mm irrigation treatments as well as 738.47 g, respectively.

Comparison of means showed that bacteria use different methods have different effects on dry coriander.

Based on the comparison between the different methods used in the treatment of plant growth promoting rhizobacteria (PGPR), the application of methods in seed inoculation with irrigation 811.43 g dry coriander constituted most of the bacteria were observed in the absence of the irrigation treatments within a group were statistically significant difference with other treatments showed.

Similar results fresh weight, dry weight Humic results showed that the use of coriander is also significantly increased. Based on the comparison results in terms of maximum amount of dry coriander Humic acid was used. So that the Humic acid dry coriander application 777.59 g dry weight of cilantro in the absence of Humic acid application 656.89 g obtained from the use Humic acid treatment showed significant differences (Table1 and 2).

Biological yield

Based on the results obtained from the analysis of variance for biological yield, irrigation works is simple, effective, simple to use, simple application of humic acid plant growth promoting rhizobacteria (PGPR)and also caused a statistically significant at the level of one percent.

Results indicated that the mean increase in irrigation levels were significantly reduced Biological yield cilantro.

Accordingly, surface irrigation was of 140 mm, the yield significantly different irrigation treatments 60 mm. So that the treatment with the 5242.15 kg, the lowest biological yield among the treatments themselves. The results were based on biological yield of coriander 7502.10 kg 60 mm of irrigation.

Based on the comparison of different methods applied to bacteria growth, had a different effect on biological yield of coriander. So that the results using a bacterial inoculum with the seed, watering it with the 7302.90 kg maximum biomass accounted coriander and the lowest yield CS 5686.18 gram bacteria were observed in the absence of a statistically significant difference with other treatments.

Results of mean comparison showed that the use of biomass Humic acid cilantro also increased. Accordingly, it was the highest grain yield in Humic acid application. So, in terms of biomass acid coriander Humic application 6981.68 kg while dry coriander in terms of not using Humic acid 5895.33 kg obtained from the use Humic acid treatment showed significant differences (Table1 and 2).

Thousand grain weight

Based on the results obtained from the analysis of variance for grain weight, Effect of Irrigation simple, easy to use due to the simple application of humic acid plant growth promoting rhizobacteria (PGPR)and the effect is statistically significant at the one percent level.

Based on the comparison of simple majority drought on grain weight Maximum weight coriander seed treatment irrigation was 60 mm. Its value in the treatment of 12.25 mg was statistically significant for the other irrigation levels, the lowest weight of coriander seeds with 9.35 grams per 140 mm of irrigation treatments were.

Based on the comparison between the different methods used in plant growth promoting rhizobacteria (PGPR)was observed, using a form of irrigation+ seed inoculation with the 11.35 grams maximum weight of coriander, In between treatments, the lowest weight of coriander with 10.13 mg was observed in the absence of bacteria.

The results showed that the use of Humic acid, coriander Thousand grain weight also significantly increased. The results were compared with the highest average thousand grain weight coriander Humic acid application. So, in terms of the use of coriander Thousand grain weight Humic acid 11.17 warm while coriander Thousand grain weight in terms of not using Humic acid 10.33 mg, respectively, which showed a statistically significant difference with application Humic acid treatment (Table1 and 2).

Essential oil yield

Based on the results obtained from the analysis of variance for oil yield, irrigation works is simple, effective, simple to use, simple application of humic acid plant growth promoting rhizobacteria (PGPR)and also due to the difference in the likelihood of a significant percentage. Based on the comparison results increased with increasing irrigation rate of Coriander seed oil.

Thus, the irrigation of 140 mm, most of the seed oil with .030 per cent respectively and the experimental treatments, Irrigation treatments, 60 ml of 0.23 seed oil, coriander lowest percentage allocated to that with other treatments showed statistically significant differences .

Based on the comparison results based on the comparison of means, the use of bacteria to inoculate the seed, irrigation with 0.29 seed oil accounted for the highest percentage. Also among the treatments, the treated bacteria did not consume the lowest amount of seed oil 0.24 was observed compared to the other treatments showed no significant difference.

Results showed that mean in terms of the amount of acid in the seed oil of the herb cilantro increase Humic application. Thus, the use of coriander seed essential oil was highest Humic acid.Seed oil used in the treatment of Humic acid 0.28 of the treatment showed no significant difference in consumption of Humic acid. The minimum amount of essential oil of coriander seed 0.26 per cent was achieved in the treatment of non-use Humic Humic acid acid used was different between treatments (Table1 and 2).

Table 1 Analysis of variance of data in different physiological and agronomic traits cilantro

S.O.V	DF	Wet weight	Dry weight	Biological yield	Thousand grain weight	Essential oil yield
Repeat	2	246593.22**	13638.03 ns	1181328.41 ns	3.13 ns	109.83**
Irrigation	2	1653761.05**	378118.71**	30961545.76**	50.59**	112.47**
Error a	4	71710.18	36175.74	2862136.86	1.61	84.38
plant growth promoting rhizobacteria (PGPR)	3	334091.48**	102359.21**	8490868.39**	4.55**	635.40**
Humic acid	1	1125117.50**	262254.55**	21242683.44**	12.73**	947.50**
Irrigation × Bacteria	6	40960.70 ns	4950.76 ns	198925.72 ns	1.48 ns	8.28 ns
Irrigation × Humic acid	2	18460.76 ns	7748.12 ns	627541.99 ns	0.28 ns	36.69 ns
Humic acid × bacteria	3	2880.27 ns	6024.46 ns	488000.92 ns	1.70 ns	11.55ns
Bacteria × Humic × irrigation	6	14923.80 ns	691.48 ns	56008.37 ns	0.58 ns	2.99 ns
Error	42	21111.51	6002.99	498726.70	0.99	13.66
Coefficient of Variation (%)		9.84	10.80	10.96	9.30	11.74

Ns, * and ** represent not significant and significant, respectively, at 5 and 1 percent.

Table 2 compares the average effect of Irrigation intervals, plant growth promoting rhizobacteria (PGPR) and Humic acid

Irrigation intervals	Wet weight (grams per square meter)	Dry weight (g m)	Biological yield (kg per hectare)	Grain weight (g)	Essential oil yield (kg per hectare)
60mm	1742.26a	830.79a	7502.1a	12.25a	31.56a
100mm	1468.20b	738.47a	6571.27ab	10.64b	33.61a
140mm	1217.43c	582.4b	5242.15b	9.35c	29.28b
plant growth promoting rhizobacteria (PGPR)					
No uses	1308.64c	631.8b	5686.18c	10.13b	24.54d
Seed with inoculation	1545.19a	733.47a	6601.21b	10.85a	33.69b
Irrigation water	1429.92b	692.27b	6163.73b	10.66ab	29.28c
Inoculated with seed+ irrigation water	1620.09a	811.43a	7302.9a	11.35a	38.42a
Humic acid					
Not used	1350.96b	656.89b	5895.33b	10.33b	27.85b
Use	1600.97a	777.59a	6981.68a	11.17a	35.11a

Numbers with the same letters in each column according to Duncan test at the 5% level are not significantly different.

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