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ORIGINAL ARTICLE

Study the effect of Plant Growth promoting Rhizobacteria (PGPR) and Humic acid for some savory (*Satureja hortensis* L.) plant Physiological traits under Drought stress

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ABSTRACT
To evaluate the effect of irrigation, Humic acid PGPR and physiological traits and crops on some savory herbs, split factorial experiment in a randomized complete block design with three replications was conducted in Shahriar region cropping 2012-2013. In this experiment, irrigation as a major factor in three levels(irrigation based on 60, 100 and 140 mm evaporation from evaporation pan classA), PGPR four levels (lack of insemination, seeds, irrigation water and inoculated with seed + irrigation) and two levels of Hugh Mick acid (acid Humic use and non-use) of the factorial design were considered as sub-agents. Analysis of variance for biological yield, oil percentage, oil yield, chlorophyll levels were statistically significant at the one percent. The results of this study showed that drought stress leads to reduced levels of biological yield, essential oil percentage, essence yield, chlorophyll a, chlorophyll b and chlorophyll a + b by the use Humic acid PGPR drivers in stress levels drought increases the desired performance characteristics and the stability in the plant.
Keywords: stress, PGPR, Humic acid, essential oil percentage.

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INTRODUCTION

Throughout history, a human have always had a special affinity medicinal plants and medicinal effects and uses no secret. Side effects of chemical drugs, environmental requirements and the gradual trend towards natural products has led to the use of medicinal plants, especially in recent decades in developed countries increases [1].

Savory is an aromatic herb with effects such as muscle pain, cramps (abdominal cramps), nausea and diarrhea. Also, the plant is used in food as a Flavoring. The plant laboratory antimicrobial effects, antioxidant, has been shown to have hypnotic and antispasmodic [2,3].

As one of the most pleasant savory spices is introduced, this has been used long as a spice. Some of the Pharmacopoeia, Savory is introduced as a medicinal plant. Before I go, people know chili, the savory spices as one of the most enjoyed. They also used this herb drinks.. This plant is a native of the Mediterranean region of southern Europe and North Africa [4].

Drought is the loss of water from the soil so that impair the physiological processes of plant growth and yield will be reduced [5].

Drought has several important effects on the plants, which reduces the effects of cell growth, decreased synthesis of amino acids, decreased cell division, disruption of photosynthesis, the leaves are wilting and abscission.

Humic compounds in soil and water are found in all environments and constitute one of the most abundant forms of organic matter in the surface.

Humus can be defined as the stabilized organic matter as part of the acid is formed humic , Folic and humin acids. Humic acid is a naturally occurring compound in soil, peat, coal [6].

Humic acid is soluble in alkaline solution, but is acidic residues when it is extracted, dark brown color, high molecular weight (30-300 kDa) and changes in carbon is between 50-62%. Folic acid is yellow, gray, low molecular weight (30000-900 Dalton) and a carbon content of 43-52% [7].

The effect of adding humic substances in soil and crop barley, sugar beet and potatoes are studied and the results have shown that humic substances from Kalat to cause facilitate the absorption of nutrients by plants. These substances cause long-term storage of carbon in soil, root and shoot growth in plants, nitrogen uptake and retention, increased photosynthesis, increased resistance to diseases [8].
Also, one of the principles of sustainable agriculture using biological fertilizers in agricultural ecosystems with the goal of eliminating or reducing the use of chemical inputs [9].
Bio-fertilizers and in some cases as an alternative to chemical fertilizers can supplement the majority of cases as to ensure the sustainability of agricultural production systems [10].
Among these PGPR, Azospirillum and Azotobacter due to the wide geographical distribution, host plants and an extensive range of important crop plants can communicate synergistically, such as rice, wheat, maize, sorghum and sugarcane has attracted attention as an known potential biological fertilizers production [11].
Gabler in his research on the herb cilantro showed that drought severely reduced biological yield, grain weight of roots and herbs effortless but greatly increased the essential oil content [12].
Ghorbani examining the use of CRP humic acid significant effect on leaf area index, leaf area duration, grain yield, biological yield, grain number per row and ear length of maize [13].

MATERIALS AND METHODS

To evaluate the effect of irrigation, humic acid on some physiological traits of PGPR and savory herb farm, Split factorial experiment in a randomized complete block design with three replications was conducted in Shahriar region cropping 2012-2013, and geographically is located at 51 degrees east for 3 minutes and 35 degrees 40 minutes North of the width and height of 1165 meters above sea level.
In this experiment, three levels of irrigation as the main factor (irrigation based on 60, 100 and 140 mm evaporation from class pan evaporation A), PGPR four levels (no consumption, inoculated with the seed, irrigation water and inoculated with seed, irrigation water) and two levels of Hugh Mick acid (humic acid application and non-application) of sub-factors were considered as a factorial.
Biological yield, oil percentage, oil yield, chlorophyll a, chlorophyll b, chlorophyll a + b were measured. For statistical analysis were used program Minitab, SAS and Excel.

RESULTS AND DISCUSSION

Biological yield

Analysis of variance showed that only a simple effect on the operation of biological stress, humic acid and PGPR were significant at 1% level (Table 1).
These results indicate that drought stress reduced Biological yield has been also used humic acid PGPR and Biological yield increased (Table 2).

Percent essential

Analysis of variance associated with oil percentage showed that the simple effect of water stress, growth at 1% humic acid PGPR were significantly (Table 1).
The results showed that different levels of drought stress increases the essential oil content and the addition of humic acid and PGPR oil percentage was increased (Table 2).

Essence yield

Analysis of variance showed that the effect on the operation essential simple stress, humic acid PGPR was significant at 1% (Table 1).
Results showed that different levels of applied stress reduces yield was essential but the humic acid PGPR and Essence yield was increased (Table 2).

Chlorophyll a

Analysis of variance showed that only in relation to chlorophyll a simple effect of water stress, humic acid PGPR was significant at the 1% level (Table 1).
Results showed that drought stress reduced the chlorophyll a were cut but exert different levels of stimulus humic acid PGPR increases the character and the balance performance in the plant (Table 2).

Chlorophyll b

Analysis of variance in relation to chlorophyll b showed that the simple effect of water stress, humic acid PGPR was significant at the 1% level (Table 1).
The results of this study showed that drought stress leads to a reduction in the amount of chlorophyll b. But using humic acid and PGPR drivers at different levels of drought stress on yield increase of chlorophyll b and the balance of plant (Table 2).

Chlorophyll a + b

In relation to chlorophyll a + b Analysis of variance showed that the simple effect of water stress, humic acid PGPR was significant at the 1% level (Table 1).

The results of this study showed that drought stress leads to a reduction in the amount of chlorophyll a + b but using humic acid PGPR drivers at different levels of drought stress increased the yield and the desired stability in plant performance (Table 2).

Table 1 . Variance analysis table

Sources of variation	DF	Biological yield	Percent essential	Essence yield	Chlorophyll a	Chlorophyll b	Chlorophyll a + b
Repeat	2	111847.08	0.126	118.13	1.49	0.02	0.15
Irrigation	2	8647125.05**	0.10**	47.27**	1.25**	0.32**	1.56**
error (a)	4	144767.90	0.034	50.40	0.23	0.01	0.072
PGPR	4	4794121.49**	0.027**	280.09**	0.85**	0.14**	0.74**
Humic acid	4	8383113.43**	0.056**	499.81**	0.31**	0.14**	0.51**
Irrigation × PGPR	6	250333.36ns	0.005ns	7.25ns	0.06ns	0.01**	0.041ns
Irrigation × Humic acid	2	175022.87ns	0.0004ns	1.76ns	0.01ns	0.003ns	0.004ns
Humic acid × PGPR	3	430219.02ns	0.001ns	24.81*	0.14*	0.03*	0.14**
PGPR × Humic acid ×irrigation	6	138862.32ns	0.0003ns	2.47ns	0.08ns	0.02ns	0.020ns
Error (b)	42	238033.29	0.004	1.08	1.87	0.17	0.039

Ns, * and **: Not significant, significant at 5% and 1% probability levels, respectively.

Table 2 compares the average simple effect of water stress, growth and humic acid PGPR on biological yield, essential oil percentage, Essence yield and chlorophyll a, b, a + b

		Biological yield (Kg ha)	Essence yield (Kg ha)	essential	Chlorophyll a (Milligrams per liter)	Chlorophyll b (Milligrams per liter)	Chlorophyll a + b (Milligrams per liter)
Simple effects of drought stress	60mm	4191.63a	17.98a	0.35b	1.3296a	0.5809a	1.6764a
	100mm	3388.27b	16.52ab	.43ab	1.0794ab	0.3882ab	1.3582b
	140mm	3017.39c	15.17b	0.47a	0.872b	0.3743b	1.1713b
Simple effect of PGPR	Not using	2866.86c	11.61c	0.36b	0.8349c	0.3562c	1.1521c
	Seed inoculation	3891.52a	19.07a	0.44a	1.2104a	0.5162a	1.5544a
	Irrigation	3385.55b	15.23b	0.41a	1.0049b	0.3861b	1.319b
	Inoculated seed with the irrigation	3985.78a	20.31a	0.45a	1.3244a	0.5327a	1.582a
Simple effect of humic acid	Not using acid humic	3191.21 b	13.92 b	0.39 b	1.0288 b	0.4038 b	1.32 b
	The use of acid humic	3873.65 a	19.19 a	0.44 a	1.1584 a	0.4918 a	1.49 a

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

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